Missouri's biopower industry

by Sam Orr
and Orville Travis

With expert predictions of a bright future for the biopower industry, and many ways for biopower to be applied, Missouri's official biopower bandwagon, "the Green Machine," should be racing in the streets with a full passenger load. However, partners who could share in making biopower a success in Missouri are slow to climb aboard.

Bioenergy is organic – it is made of a variety of carbon-based molecules. Biopower comes from raw or processed energy stored in plant material such as fast-growing hybrid poplars and tall grasses. Paper trash, yard clippings, sawdust, wood waste and used vegetable oils also are biopower sources. Agricultural residues like corn stalks, straw and animal waste also qualify as biopower feedstocks.

Even the most conservative estimates for developing a biopower industry in Missouri are positive. "At the bare minimum, its economic potential could be derived from productive use of materials that are now a disposal problem," said Cher Stuewe-Portnoff, director of the Missouri Department of Natural Resources' Division of Energy.

According to U.S. Department of Energy economists, these benefits likely will include more jobs and an increase in electricity produced from bioenergy. Electricity produced from bioenergy has grown from 200 megawatts in the early 1980s to more than 8,000 megawatts today – a 4,000 percent increase. Biopower now supports 66,000 jobs, many in rural areas; by 2010, biopower could support more than 283,000 jobs throughout the country.

"To achieve these results, action must start today to create steady growth in the industry," said Stuewe-Portnoff. "Eventually, this will create more jobs, develop new markets for farm products and improve the environment."

Farmers, manufacturers, government researchers and consumers should take a cue from an American industrial legend who helped build the biopower bandwagon. Henry Ford knew 50 years ago what many now are reluctant to recognize: renewable resources make good sense. "I foresee the time," Ford said, "when industry shall no longer denude the forests which require generations to mature, nor use up the mines which were ages in the making, but shall draw its raw materials largely from the annual produce of the fields."

Advances in ecology, biology, chemistry and physics are paving the way to a new era of energy from plant material. Ordinarily we see plants as shade-providing, natural air conditioners. As these green wonders go quietly about their work, they capture the energy of the sun through photosynthesis. For the last 50 years, Americans have most commonly used this stored heat and light energy to supply food for animals and people. Yet, for most of history, plant matter, or biomass, was the principle source of energy for heating homes, cooking, and powering industry.

Missouri bioenergy sources

Wood wastes include tree tops and trimmings left behind by loggers, sawdust, slabs, bark and short board ends from sawmills and wood product producers. It also includes solid waste such as unusable lumber from building demolition. Paper and cardboard wastes that cannot be recycled can be used for energy production.

Trees and grasses can be grown specifically for fuel. Cottonwood and sycamore are two native Missouri trees being studied for this use, as are native prairie grasses. In

some cases, removal of selected trees from woodlands for energy production can improve the health of a forest while providing income to the landowner. Grains and crop residue can be used to make ethyl alcohol, also known as ethanol, while yielding protein products for use in animal feed. Soybean oil can be processed as a substitute for petroleum-derived diesel oil.

Another form of bioenergy is biogas, or methane. This gas is produced when wet organic materials ferment in an oxygen-depleted, or anaerobic, atmosphere. Biogas can be produced from grass clippings, animal manure or municipal sewage, and is used like natural gas.

Tapping into biopower

Despite the diverse sources of biopower available, little is used in Missouri. As shown on page 4, coal supplied more than 36 percent of all of Missouri's energy in 1990, and most of it was used to generate electricity. When nuclear and hydropower are considered in the mix, 41 percent of the state's energy was used to produce electricity. Petroleum used for transportation accounted for another 32 percent.

Since 1990, coal use has expanded to a historic high, and use of gasoline and diesel for transportation also has increased.

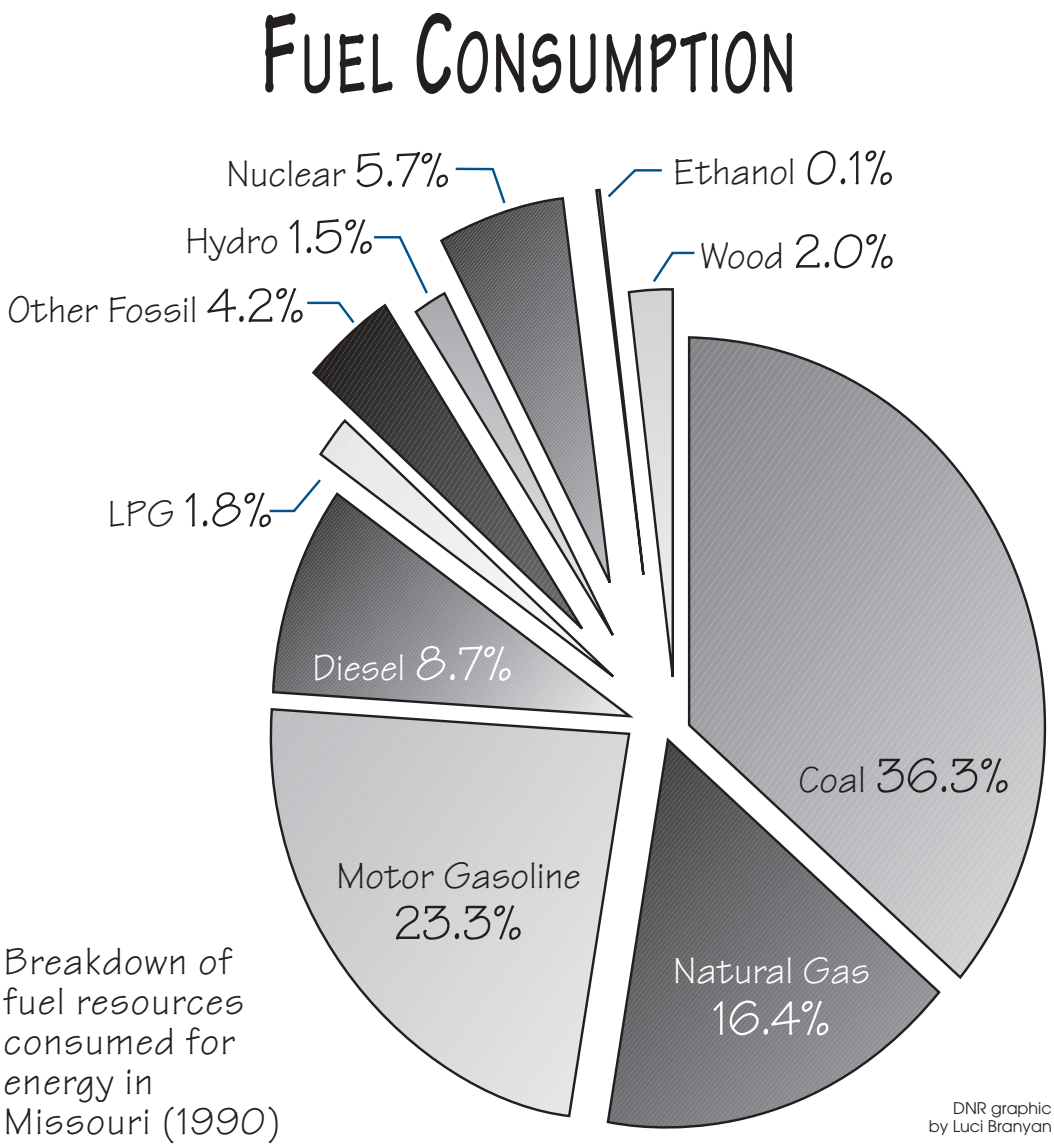
Other energy sources, such as natural gas and liquid propane gas, also are used for heating and industrial uses. Bioenergy contributed less than 1 percent to this total.

One key element in all successful energy systems is the value called total system efficiency. Electric generation using coal has a system efficiency of 24 to 34 percent, with the mining component having an efficiency of 91 to 93 percent. By contrast, biopower systems have a much lower fuel extraction efficiency and need superior power plant and transmission or distribution efficiencies to compete.

Each year Missouri uses about 1,420 trillion British Thermal Units (BTU). If all these BTU were in the form of gasoline, there would be enough gasoline to fill more than 400 large municipal swimming pools in each county in the state. Bioenergy cannot replace all the fossil fuels Missouri uses. However, it can provide energy in many applications. In order to be widely used, bioenergy must compete with other energy sources in cost and convenience.

There are many biopower success stories in Missouri that show evidence of industry growth and progress. No one in Missouri has to wait for biopower. The opportunities exist now.

For example, Anheuser-Busch is using biopower. Anaerobic wastewater pretreatment systems, or "Bioenergy



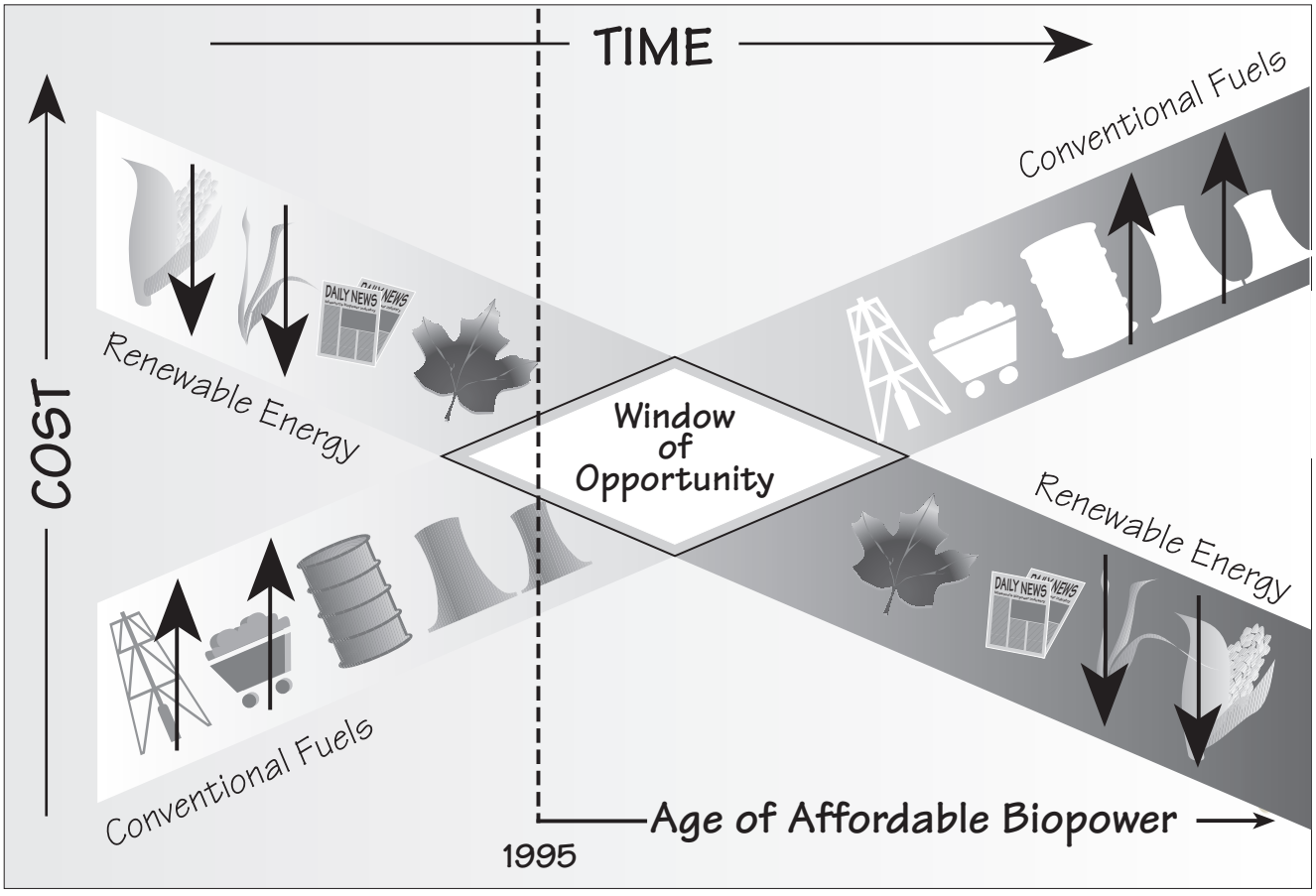
Breakdown of fuel resources consumed for energy in Missouri (1990)

DNR graphic by Luci Branyan

Recovery Systems," are being installed at its breweries. These systems reduce biological oxygen demand and generate methane that is burned to generate power, offsetting about 15 percent of each brewery's fuel purchases. At the Baldwinsville, N.Y., brewery, a savings of 5.7 cents per pound of biological oxygen demand has been realized – which adds up at a rate of 100,000 pounds per day. These systems will save the company more than $50 million per year in wastewater treatment costs and energy savings by the year 2000.

Huebert Fiberboard in Boonville is another example of biopower success in Missouri. The company uses sawdust from local mills to produce high quality fiberboard and to produce steam power needed to run this industrial process. The fiberboard can be used for anything from building construction materials to archery targets. Gerald Huebert, co-owner of the company, said the business started using sawdust for energy in the early 1980s to offset 10 to 15 percent annual price increases for natural gas. Huebert said at that time the business needed to do something to stay competitive. "Even though natural gas costs less now, our system of burning wood byproducts to dry the finished product has kept us in business and made our company very competitive in our market," Huebert said.

"People should care because this helps to keep the environment clean and provides an alternative fuel for a local business. People also should care because the product we burn is not building up in the environment, and not creating a potential problem. It provides the fuel suppliers a



DNR graphic by Luci Branyan

Renewable energy (such as biopower) and conventional fuels have a range of costs. The costs vary with facility location, application, fuel or energy supplier, by-product disposal costs and time. If economic theory holds true, conventional fuel costs will rise over time as supplies diminish. Renewable energy costs have been on a steady downward trend as technological advancements increase their efficiency. The diamond in the center shows the initial window of opportunity that now exists for using renewable energy. We presently are at the left end of the window, finding site-specific economical applications of biopower. As more industries learn about biopower, and more technological improvements are made, Missourians can use biopower to achieve cost savings and energy security.

method to get rid of a byproduct which could otherwise be an environmental problem," he said.

Huebert said companies experimenting with biopower need to make sure there is an available fuel supply and that the technology can be tailored to meet a company's individual needs. "We developed our own equipment and system, and this involved a lot of time and effort to make it work the way we wanted," Huebert said. The company also uses six or seven different suppliers of fuel. "We have developed a relationship with our suppliers, and we don't have to worry about fuel supply or quality," he said. "We know that they will deliver good quality dust to meet our needs. The dust is blown directly into a trailer and then delivered to us. Our suppliers think of their product as a resource rather than a waste material."

Columbia is another leader in bioenergy application. The city's wastewater treatment plant uses gas from a methane digester to produce electricity. The electricity is used to operate eight 60-horsepower surface aerators at the sewage treatment plant, according to Dennie Pendergrass, the city's chief engineer of operations. He said methane also is used to generate 85 percent of the heat needed to warm the building during the winter. To complete the process, the remaining sludge is injected into the soil on area farms to add fertility.

No story about biopower in the Midwest would be complete without Robert Bush and John Redden. Bush, director of the center for research at Northwest Missouri State University (NWMSU), and Redden, plant manager, built a wood-fired boiler system in the early 1980s to heat and cool its campus buildings. Today, NWMSU produces about 90 percent of the energy used to heat and cool the campus from sources such as wood, waste paper and sawdust.

Biofuel choices

If you have a fireplace or woodstove, your home already is one of thousands of Missouri households that meets part of its winter heating needs with biofuels. Highly efficient wood stoves and furnaces capture more heat from each log than is possible with traditional fireplaces.

Some Missourians use wood pellet stoves. These stoves burn pellets made from sawdust that otherwise would build up in large waste piles. Leachate from these piles can discolor streams, and on occasion the piles catch fire, giving off a heavy smoke from the incomplete combustion. Lignetics of Missouri in Doniphan and Pennington Seed Co. in Greenfield, manufacture these pellets for the home stove and commercial marketplace.

Plant materials also can be used to make liquid motor fuels and fuel additives. More than 1.5 billion gallons of ethanol are made from corn annually in the United States. Although Missouri does not have an ethanol production facility, the state is home to two public pumps that dispense an 85 percent ethanol and 15 percent gasoline fuel (E-85).

The Department of Natural Resources' Division of Energy has been working with the Missouri Corn Growers Association and the Governors' Ethanol Coalition to ensure that Missourians have access to E-85. This blend reduces the production of harmful ground-level ozone while reducing dependence on the country's imported petroleum.

The E-85 blend of ethanol is available from two locations that are open to the public: the Convenience Food Mart station at 3714 West Truman Blvd. in Jefferson City, and the Coastal Mart station, at 2110 Choteau Ave. in St. Louis. Pumps that dispense E-85 fuel soon will be available in Columbia and Kansas City, too. This will allow government employees and private

"Even though natural gas costs less now, our system of burning wood byproducts to dry the finished product has kept us in business and made our company very competitive in our market."

– Gerald Huebert
Huebert Fiberboard

owners of E-85 vehicles to travel across Missouri using this alternative fuel.

New developments in fermentation technology are paving the way to produce ethanol from woody and grassy plants. These "ligno-cellulosic" materials offer a feedstock that will complement corn in ethanol production. Because trees and grasses are perennial plants, they can be grown on soils that are not well suited for continuous row-crop production.

The Department of Natural Resources' Division of Energy is working with the Missouri Soybean Association and other organizations to identify opportunities for biodiesel production. Biodiesel can be used directly in modern diesel engines and reduces emissions of air pollutants as well as engine wear. According to Dale Ludwig, executive director of the Missouri Soybean Association, "One hurdle to be crossed in commercialization of new biofuel sources is the high cost of doing research on air emissions. Another is the chicken and egg nature of developing new markets. After new markets reach a certain volume of demand, competition and economies of scale begin to bring the cost of the fuel down to even more attractive levels."

Biopower's next step

Missouri already has the land to produce large amounts of biopower in a sustainable way. Between 1985 and 1992, 1.67 million acres of overused Missouri farmland was protected by the federal government's Conservation Reserve Program. While this land was out of production, wildlife habitat increased and soil quality began to recover. By Sept. 30, 1997, contracts on more than 1.25 million of these acres will expire. Use of this acreage will again be at the farmer's discretion.

If all the lands in the Conservation Reserve Program are returned to crop and livestock production, it could reduce rural economic viability and increase soil erosion and water pollution. Developing biopower offers a brighter picture. These lands can be maintained with soil-protecting perennial ground covers that need fewer chemicals than annual crops to provide a productive return. A truly progressive policy might even consider allowing land to remain in the Conservation Reserve Program while harvesting energy crops.

Energy uses create new markets for traditional crops and new opportunities to realize profitable levels of return for perennial crops. The more markets that exist for producers, the less the potential for disastrous losses in a single year. Energy crops can be sold using multiyear contracts, unlike annual farm crops or livestock, providing a level of farm income stability long sought by the agricultural community. This lays the foundation for a stronger Missouri economy.

Once biopower crops are grown, a market must exist to buy them. Missouri is in good position to create these markets. Technology exists to use these crops, and it is continually being improved. Processes such as pyrolysis, gasification, liquefaction, cogeneration, district heating systems and others are all currently available. Missouri has an opportunity to match technology with available bioenergy feedstocks.

Gov. Mel Carnahan established the Energy Futures Coalition to make recommendations to guide the structure of energy production, delivery and use. One committee, focusing on alternative and renewable fuel supplies, is considering biopower in this mix of future energy sources.

Complexity is the constant in such studies. Coalition members must identify the relative importance Missourians place on environmental quality, the price of energy and the regionwide economic impacts of various energy choices.

The biopower success stories in Missouri all share a common thread. In each case, someone identified an opportunity, and someone championed the effort to embrace that opportunity.

More Missourians are needed to pitch in and jump-start the biopower bandwagon. The industry is waiting for its big break. If more riders and drivers climb aboard, the biopower bandwagon could create its own breakthrough on the road to economic vitality in the 21st century. The department's Division of Energy seeks comments from citizens, researchers, business leaders and farmers willing to share ideas and help develop a statewide plan for increasing biopower production and use. Contact Sam Orr or Orville Travis at DNR's Division of Energy, (573) 751-6654.

Sam Orr is a Renewable Energy Planner, and Orville Travis is a Resource Specialist. Both work for DNR's Division of Energy.

Farms to fuel the future?

The use of bioenergy is at least a partial answer to a problem facing the agricultural industry – how to maximize the use of millions of acres of idle farmland.

The U.S. Department of Agriculture projects that advancement in farm productivity could allow 100 million acres of cropland to become idle if new markets aren't developed. Energy crops grown on this land could supply up to 20 percent of the nation's energy.

Many production factors for energy crops would be the same as agricultural crops. Missouri has more than 1.6 million acres of highly erodible cropland set aside in the Conservation Reserve Program. Some of it could be used to raise energy crops.

The program has reduced soil erosion, improved water quality and wildlife habitat and decreased surpluses of farm products. The state's average erosion rate on enrolled acres dropped from 19 tons per acre to 1.2 tons per acre. The soil saved per year on these lands exceeds 32 million tons – a dramatic example of perennial crops reducing soil erosion.

Energy crops' affect on the environment cannot be determined easily. Air quality should improve if biopower replaces fossil fuels in energy-efficient systems. Bioenergy systems will have low or zero net carbon emissions and no sulfur dioxide emissions. Water quality changes depend on replacing land use management practices.

Much of the Conservation Reserve Program lands are small, irregularly shaped fields that border streams or fence rows. This is desirable wildlife habitat. When producing energy crops, weeds do not have the detrimental effect that they do on cash grain crops. The weeds and the reduced use of chemicals add variety to the habitat and encourage wildlife species to stay.

Nonpoint source water pollution from agriculture is a problem in Missouri. Energy crops could be planted between streams and annual crops to filter runoff from croplands. Energy crops also require less fertilizer than row crops.

A National Audubon Society study documents the relationship between switchgrass and bird populations. It indicates that fields with the most varied plant species also contain the most different varieties and the highest populations of birds.