

Developing a renewable future for Oklahoma
by Everett Brazil III, Cashion, Okla.

Oklahoma has long been a major source of energy for the United States. One of the nation's largest oil booms occurred in the state in the early 1900s, and even today, Oklahoma has one of the nation's largest supplies of natural gas.

As petroleum supplies slowly are depleted, the world is searching for energy sources. Research at Oklahoma State University is developing sources for consumer use from Oklahoma's most abundant resources, including wind and grass.

Turning perennial grass into ethanol

The prairie is a sea of waving grass. Endless waves greeted the pioneers as they made their way west through the Plains. With a prime location on the Southern Plains, Oklahoma not only has an abundance of waving grass, but it also contains plenty of fertile farmland to grow it. Researchers at OSU are studying this plentiful resource as a source for ethanol for production.

The idea for the research project was first planted by former Oklahoma Gov. Henry Bellmon.

"[Bellmon] had heard about this type of process and wanted to take advantage of Oklahoma's ability to grow the grasses to support the process," said Ray Huhnke, professor in the OSU Department of Biosystems and Agricultural Engineering and a leader of the project.

The research, which began about five years ago, is a team effort among different individuals, including researchers at the University of Oklahoma and Mississippi State University. Scientists study everything from the grass to the creation of ethanol. Huhnke's role is focused on the harvesting and storage of the biomass and the gasification of the material, a process of burning that converts the biomass to several gases.

The research team has successfully produced ethanol – but only on a laboratory scale. Production has reached about 30 gallons of ethanol per ton of dry material, which is too little for commercial production, said Huhnke. Output should reach at least 60 gallons per ton of dry material before an ethanol plant can be built, he said.

The ultimate goal is to make the process commercially viable and have a facility built to process grass into ethanol, said Huhnke. An OSU study predicted 30 jobs can be provided to area residents with a processing plant capable of producing 50 million gallons of ethanol per year, while local farmers, on the whole, can receive up to \$7 million per year, said Huhnke.

Researchers plan to test different grasses grown in Oklahoma, but for now, they are only studying switchgrass and bermudagrass.

"There has been a lot of interest from farmers [to grow the grasses], but we haven't pursued that yet," said Huhnke. "We'll need producers at the commercial point, but right now, we're too small."

Turning canola into biodiesel

When people think of canola, many think of the healthiest cooking oil on the market. However, cooking oil is not the only product that can be obtained from canola, and researchers at OSU are trying to determine if the production of biodiesel would be profitable in Oklahoma.

The interest in canola originally focused on the benefits from crop rotation and diversification.

"Some fields have grown wheat for more than 100 years," said Thomas Peeper, professor in the OSU Department of Plant and Soil Sciences and a leader of the canola project. "Every type of pest in wheat has favorable circumstances."

To break the pest cycle, farmers needed a rotation crop. The first crop of canola was planted about 15 years ago but failed to survive the winter. In fall 2002, an OSU research station in Goodwell, Okla., grew a crop of cold-resistant canola with modest success. With success at a cold winter research station, researchers at the OSU campus in Stillwater, Okla., decided to go ahead with the project.

Following the first successful season of canola, researchers decided to take the crop to the farmers to determine if Oklahoma farmers would be willing to grow the crop in their fields.

Research is still continuing with farmers in Oklahoma.

"We don't want to push too fast," said Peeper. "We want to try to teach farmers to raise canola – it may be more profitable than wheat."

Current research is determining if a canola-crushing processing plant would be profitable in the state. Researchers are studying everything from projected acreage to the crop prices and the costs of building of a processing plant. They are determining if farmers would be willing to invest in a canola cooperative processing plant, said Phil Kenkel, professor in the OSU Department of Agricultural Economics and a researcher with the canola project.

"It guarantees the farmer [a place] in the canola market and helps the plant be successful," he said.

Getting a processing plant built in the state would be a big step forward for canola production in Oklahoma. Currently, there is not a plant in the state, but one is planned for Enid, Okla., with an opening date of June 2006. When the plant is built, researchers still will need to determine what to do with the canola.

"When the seed is crushed, they obtain a high-quality oil," said Peeper. "That oil can be used for either biodiesel or cooking oil."

Rising diesel prices affect most of the U.S. transportation system, and the agricultural sector uses diesel for operation. The higher fuel prices are making it more difficult for companies and producers to do business, said Peeper.

Biodiesel is gaining more acceptance as a fuel source. Researchers are studying different crops that can be used to produce diesel, and more processing plants are being built across the country. There are 32 biodiesel plants in operation in the United States today, producing 300 million gallons of diesel, said Kenkel.

With a canola processing plant, Oklahoma would have a cheaper, renewable fuel source and a product for other states.

The canola processing plants will determine which product will be produced. Oklahoma canola is shipped to biodiesel plants. Additionally, the companies interested in building plants in Oklahoma intend to produce biodiesel, said Kenkel.

"If I were to build one [a plant] right now, it's a little more likely I'd go biodiesel," said Kenkel.

Turning wind into electricity

Windmills are not new to Oklahoma. Since the days of the Land Run of 1889, farmers have built windmills across the state, using the abundant wind to pump water from the ground. While windmills have been used for many years to generate electricity for private use, they have been built to generate electricity for public consumption only in the past few years.

Oklahoma currently has three wind farms. The farms in Lawton, Okla., and Woodward, Okla., were built in 2003, while the Weatherford, Okla., wind farm is still under construction. Additional wind turbines are projected, with plans to double the sizes of the wind farms in Lawton and Weatherford.

"This isn't something whose time will come in 10 years; these [wind farms] are producing electricity now," said Steve Stadler, climatologist and professor in the OSU Department of Geology.

The farms are built on private lands but are owned by out-of-state utility companies. The companies lease the property from the owners and pay them for the use of the land. The electricity generated by the turbines is owned by the power companies and sold to local electric cooperatives for use by Oklahomans.

Utility companies use two methods to pay land owners: royalties and fixed payments. Royalties are paid as a percentage of electricity produced, similar to oil wells. The other option is fixed payments, which are usually \$2,500 to \$3,500 per year per turbine, said Greg Adams, farmer from Buffalo, Okla., and president of the Oklahoma Renewable Energy Council.

Adams is working with a company in Edmond, Okla., to bring more turbines to the northwest corner of the state.

"All companies are competing, so all percentages and royalties are about the same," he said.

Getting a utility company to build on your property can be a difficult task, said Adams. Locations for wind farms are determined both by the wind resource available and by access to large-scale power grids. Development companies send their own team of experts to look at different locations suitable for wind farms.

After a location has been determined and the contracts have been signed, a team of engineers for the development company looks at the block of land to determine the layout of the farm. Once planning for the farm is finished, construction crews build the wind turbines. The length of time to build a farm is determined by the overall size of the farm and the number of turbines to be built.

Having a wind farm on private property does not mean it can no longer be used for agricultural production. The wind turbines are spread out among many acres and pieces of property, and each turbine only occupies about 100 square feet of land, said Adams.

"Utility-scale wind farms don't limit production, but they do change the property," he said. "It's not pristine, native pasture land, but the revenue streams are pretty profitable."

The revenue earned is another advantage to having wind turbines on the property. The energy revenue can exceed that of many agricultural commodities, such as cattle and wheat, said Adams.

"It's a very profitable use of the land," he said.

Most of the potential for wind energy has already been mapped. The Oklahoma Wind Power Initiative, which is a joint project between OSU and OU, has worked to assess the wind power within the state. The group has no ties to any of the wind farms – it was created four years before the first farms were built. The original goal of the organization was to determine where the best locations to harvest wind would be. Stadler has been with the organization from the beginning.

"We knew wind power would be very big in the U. S., and we wanted Oklahoma involved in it," said Stadler.

Tim Hughes, who at the time was at OU, and Stadler worked to measure wind for the Oklahoma Mesonet, which is an important, on-going agricultural tool that measures climatic conditions, including wind speed, wind direction, rainfall and temperature. They created the instruments used to measure wind speed across the state and were behind efforts to place the instruments in all 77 counties.

Although the instruments gather wind data for the on-going Mesonet project, they also have been used to gather data for the OWPI project, modeling where in the state most of the wind is located.

Researchers with the project want to study the wind more but they need upgraded instruments to further the research. Current instruments measure the wind at 10 meters, which is considerably shorter than many modern wind towers. Wind turbines can be built higher than 50 meters above the ground, said Stadler.

"At that height, the wind moves differently – it's a little bit faster," he said. "We know what the patterns are, but we want to know more about the resource."

Because much of the wind data already has been mapped, the OWPI has shifted its focus from research to education. Many people don't understand wind farms or the electricity produced by the wind, so the OWPI is educating the public about the resource, said Stadler.

While experts agree wind power will never provide all of Oklahoma's electricity needs, most agree generating electricity from the wind is great for Oklahoma, especially in the western counties.

"It's a good idea to be in this game for rural development," said Stadler.

Oklahoma's renewable future

Oklahoma is a rural state. With wide-open spaces and fertile farm land, the state has the resources to produce renewable energy. Beyond the resources covered in this story, hydropower, geothermal power and solar power bring energy to Oklahoma, and the state is taking advantage of its renewable energy potential.

While it's doubtful these resources will meet Oklahoma's energy needs, they will go far in lowering the nation's dependence on petroleum and reaffirm Oklahoma's position as an energy leader.

For more about renewable energy, the following contacts can provide information:

- *Ray Huhnke, professor, OSU Department of Biosystems and Agricultural Engineering at (405) 744-6059 or <http://www.biosystems.okstate.edu>;*

- *Thomas Peeper, professor, OSU Department of Plant and Soil Sciences at (405) 744-6425 or <http://www.pss.okstate.edu>;*
- *Phil Kenkel, professor, OSU Department of Agricultural Economics at (405) 744-6161 or <http://www.agecon.okstate.edu>; and*
- *Steve Stadler, professor, Oklahoma Wind Power Initiative at (405) 744-9172 or <http://www.seic.okstate.edu/owpi>.*

Ray Huhnke holds a handful of switchgrass that will be processed into ethanol. (photo by Dustin Mielke)

A wind turbine at the Weatherford wind farm generates electricity for western Oklahoma. (photo by Everett Brazil III.)