

For 26 years, Karl and Mike Bergey have been harvesting Oklahoma's most abundant crop as they developed the turbines that turn wind into a commercial source of energy.

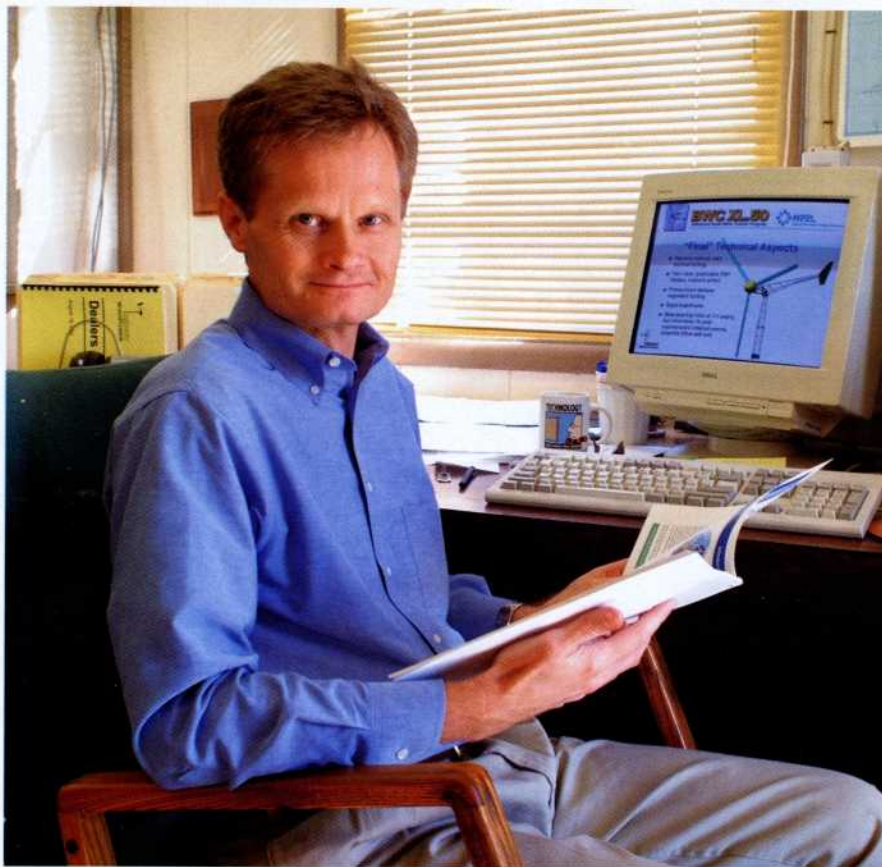
BY RANDALL TURK  
PHOTOS BY ROBERT TAYLOR

Bergey Windpower's  
Karl Bergey

# WIND POWER

**O**n some days in Oklahoma, gusty winds can shake the treetops, rearrange the landscape and send unlikely objects sailing through the sky. Oklahoma, the eighth windiest state in the country, provides an ideal opportunity for harvesting energy from this invisible force of nature.

Bergey Windpower was launched by Karl Bergey, a University of Oklahoma engineering professor, 26 years ago. He continues to serve as chairman and CEO as the company has grown to dominate the field of small wind-turbine technology here and throughout the world. Over the years, Bergey Windpower has developed several models of wind turbines that operate in all 50 states and more than 90 countries. The company has overcome many obstacles that defeated competitors and continues to face daunting challenges posed by fragile energy markets and the risky realm of politics.



While developing the technology to increase the efficiency of his company's wind turbines, Mike Bergey also must fight to gain the governmental support that will make wind power a viable alternative source of energy.

"We've created wind turbines that stand up to the severest weather," says Mike Bergey, the company's president and co-founder with his father, Karl. "We've endured a depressed energy market for the past 20 years and fought the political game with giants. We find it challenging, but it's a business we love."

The idea for the company began on a windy morning in the mid-'70s, with a conversation between the elder Bergey, then an

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aerospace engineering professor, and Tom Love, chair of OU's aerospace and mechanical engineering department.

"Tom suggested that with all the wind we have in Oklahoma, we should do something about it," Karl recalls. "I did some calculations and discovered that our state has enough wind to be attractive in generating energy. That got me started."

Soon, Bergey began a research and development program that produced a small wind-turbine model. He was aided by his son and several other OU aerospace engineering students. Bergey Windpower was launched in 1977, when Mike Bergey graduated from OU, and the company was incorporated in 1979.

Karl Bergey, an aircraft designer, had been responsible for developing several airplanes for the Piper and Aero Commander aircraft companies. One of his designs, the Piper Cherokee, continues to be among the most popular models in general aviation.

"The design of a strong, efficient and cost-effective wind turbine is fully as challenging as designing an airplane," he says. "Both tasks involve aerodynamics, structural analysis, wind tunnel tests and extensive in-flight operation. We've spent a great deal of time on testing our wind turbines. That has been the basis for the reliability of our products."

There were, however, challenges to overcome. The first Bergey wind turbines were equipped with metal blades that stood up under laboratory fatigue tests but had a tendency to crack when put into extended service.

"We started to develop our own airfoil and blades of composite construction using fiberglass and polyvinyl resin," Karl says. "We bit the bullet and replaced all the metal blades on previous models with the composite blades. We've had essentially no fatigue problems since then." The company received two national awards from the Plastics Industry Society for its fiberglass rotor blade designs.

The Bergeys secured a patent on their fixed, variable pitch wind turbine blade. Their research work, financed with their own funds, led to the development of the "BWC 1000" wind turbine, a unit that could produce one kilowatt of electricity.

The company soon captured more market share for residential wind-power products with a larger wind turbine, its 10-kilowatt "Excel" model, this time assisted by a small grant from the U.S. Department of Energy. But in 1986, the U.S. market for wind-power products collapsed when federal energy credits expired for wind power and other alternative energy sources.

The company turned to developing countries, where its



From its facilities on OU's North Campus, Bergey Windpower has manufactured small wind turbines that have improved living conditions in developing countries and supplied power in Europe, where wind power is more economically feasible than in the U.S.

products have been vital to improving living conditions. India, Indonesia, South America and Africa, with huge reaches of remote area foreign to electric power, have provided markets for Bergey products. Other profitable areas have been countries such as England, France, Germany and the Netherlands, where wind power is economically more feasible than in the United States.

Bergey Windpower has produced several wind turbines for small-scale applications abroad. The company is testing a 50-kilowatt XL.50 model designed for powering small villages, small commercial businesses and larger farms. Each new Bergey wind turbine benefits from previous technology, while incorporating advances in efficiency and reliability.

"Our turbine design is the absolute essence of simplicity," Karl says. "They operate automatically and have only three moving parts. They operate in wind speeds of up to 125 miles per hour."

The wind turbines are designed to run 24 hours a day throughout the year in climates that range from the frigid Antarctic to the searing heat of African deserts. "Our machines have to withstand all weather changes and environments, and

endure for a long time," he says. "We design them for at least a 30-year life."

The BWC 1000 was selling "in reasonable quantities" when the Bergeys completed development work on the 10-kW Excel model equipped with a blade 23 feet in diameter. The first Excels were shipped to buyers in 1983.

"We were selling at a high clip and growing rapidly when the Reagan administration did away with tax credits for alternative energy," Karl says. "The world price for oil dropped to \$10 a barrel. Much of the wind power business collapsed. At that time there were 40 or 50 companies in the U.S. that manufactured and sold small wind turbines. We were the only one to survive without going through bankruptcy."

The escalation of energy prices in recent years has revived several of these small wind power competitors, he continues.

The Bergeys endured the tough period by going without salaries and trimming staff. They survived by turning to global sales. The company first concentrated on India, with wind-power projects such as rural electrification and drinking water supply. Later, the company was able to export wind power to South America, Indonesia, Russia and China. Wind-power projects in remote areas of the world have relied on batteries to store electricity and diesel generators to draw on the power when needed. Bergey Windpower has provided complete design, supply and installation services for these hybrid power systems.

"We've done projects for the U.S. Agency for International Development, and we've sold systems for other foreign assistance programs operated by Japan and Great Britain," Karl says.

"The World Bank says that 1.7 billion people in underdeveloped countries are without electricity, but there isn't enough funding to go around," adds Mike Bergey. "This work has been very rewarding from a personal perspective. We've been able to provide safe drinking water and the first electricity for thousands of people, substantially improving their lives."

On the domestic front, Bergey Windpower has experienced a steady comeback over the past 15 years. "We're now seeing a considerable amount of growth," Mike says. "Rebates and tax credits for wind power provided in some states like California have been a lifesaver for us."

A handful of other states offering substantial subsidies for alternative energy, including New York, New Jersey, Montana and Vermont, have provided a new U.S. foothold for Bergey products. "These are important because our progress is limited by the high cost of small wind systems," Mike explains. "But we need production volume to bring prices down. Smart subsidies, we believe, will bridge that gap."

"We are still active in exports, but they are a smaller percentage of our business these days. With a stronger U.S. dollar, current exchange rates make our products more expensive abroad."

Aided by grants from the U.S. Department of Energy and the Oklahoma Center for the Advancement of Science and Technology (OCAST), the Bergeys have continued work on the 50-kilowatt XL.50 model. The objective with the larger wind turbine generator is to provide more power at less cost per kilowatt through economies of scale. A prototype XL.50 has been shipped to the DOE National Renewable Energy Labora-

tory in Boulder for testing.

"Winds in Boulder are erratic, but every once in awhile they have hurricane-scale winds," Karl says. "When our 10-kilowatt model was tested during a severe storm up there, it continued to run after the anemometer had blown away at 120 miles an hour."

There are other examples of the incredible durability of these wind turbines. "One machine based near Norman went through a tornado," Karl remembers. "The second story of a nearby house was blown off, but the wind turbine was still up there, pumping electricity into the power grid."

Generally, there are two categories of wind turbines: smaller models for homes and villages and the huge 1,500-kilowatt machines used on wind farms developed for electric utility companies. Public interest in energy generated from renewable sources, combined with advances in technology that have made it more affordable, have given utility companies the confidence to invest in wind power.

Oklahoma Gas & Electric Company is buying electrical output from a new wind farm near Woodward, developed by Florida-based FPL Energy. OG&E is offering its customers the option of designating wind power for all or part of their electricity, providing up to 50 megawatts of wind power for slightly more than the price charged for electricity generated from traditional fuels including natural gas and coal. Wind power costs more, OG&E officials explain, because traditional generation also must be maintained to meet the demand when the blowing winds are not sufficient to generate the required amount of electricity.

The Oklahoma Municipal Power Authority, which purchases power for member cities such as Edmond, Stillwater and Purcell, also has partnered with FPL Energy to offer 50 megawatts from the Woodward wind farm. And Western Farmers Electric Cooperative, which generates power for Oklahoma's 19 electric distribution co-ops, has committed to purchasing all 75 megawatts produced per year at a new wind farm in the Slick Hills, north of Lawton.

Commercial wind power installations employ wind turbines developed and manufactured primarily in Europe. In the United States, only General Electric has committed to producing these mammoth wind turbines. GE has purchased Enron Windpower and is manufacturing a 1.5-megawatt wind turbine (30 times larger than the 50-kW turbine Bergey is developing) for electric utility companies and other large applications.

By venturing into wind power, electric utilities can ease the impact of fuel price spikes while maintaining control over their



**AT LEFT:** In the Bergey Windpower machine shop, Doug Sellers checks the micrometer measurements on a faceplate he is finishing for the alternator body. **ABOVE:** In the welding shop, Bob Fulford cuts the mainframe for the Excel generator.

generating capacity. But in Oklahoma and other parts of the country, the prime sites for harvesting wind energy often are impractical for electric utilities to develop. Many of the windiest areas are far from the power transmission lines that carry electricity cross-country before it can be distributed to homes and businesses. A major obstacle to large-scale commercial wind farms is the \$1 million per mile it costs to build additional electric transmission lines.

Small wind turbines produced by companies like Bergey Windpower operate at the other end of the spectrum. The smaller units allow consumers to control the source of electric power. The small turbines also are capable of transmitting surplus electricity to the existing power grid without the need for building more transmission lines.

The use of small wind turbines can reduce substantially the cost of consumer electricity bills. A 1978 federal law established that electric utilities must accept surplus power from these small turbine generators and credit customer accounts for the power they produce. But economic reality impedes that prospect. Absent significant tax credits or other government assistance, small wind turbines must be in service for 15 or 20 years before they can generate enough energy to recoup their initial cost. A 10-kW wind turbine, the most common size for homes, can cost \$40,000 or more, including installation. The up-front expense

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is more than most homeowners can bear without some sort of financial assistance from the government.

Mike Bergey maintains that a combination of tax breaks and increased production capacity could lower costs to below \$20,000 for a 10-kW unit, resulting in a “reasonable payback period” for small wind power customers. “Hundreds of homeowners around the country who installed 4- to 12-kW wind turbines during the go-go tax credit days in the early 1980s,” he explains, “now have everything paid for and enjoy monthly electric bills of \$8 to \$30 a month. Their neighbors are paying from \$100 to \$200. The problem, of course, is that these tax credits are long gone. Without them, most homeowners will find a wind generator prohibitively expensive.”

In the early 1980s, the federal tax credit for wind systems was modest, limited to about \$4,000. But many states offered matching tax credits, often more than the federal government provided. Ironically, Bergey Windpower’s home state has been powerless to provide similar economic incentives for wind power customers. Oklahoma’s wind power tax credit, effective in 1985, was

not used because the federal credit expired and wind turbine sales dried up, Mike says. The state credit expired in 1987.

“When Bill Clinton was elected president in 1992, we thought the federal government would offer a new tax credit,” he says. “To keep from repeating the mistakes behind the original tax credit, we wanted a better example to work to.”

In 1992, State Sen. Cal Hobson successfully sponsored a three-year Oklahoma tax credit for wind power. The state tax credit covered 40 percent of the installation cost for wind turbines, with no spending cap for residential systems. But a congressional fight over a proposed “Btu tax” resulted in defeating Clinton’s initiatives for alternative energy, Mike recalls. With no complementary federal assistance, the state tax credit was insufficient. It expired in 1995.

Mike Bergey says he has been to the well many times in search

of support for his industry, to no avail. “It’s fine and dandy for politicians to say we need to use more alternative energy, but in reality we have to stimulate the market to get prices down,” he insists. “They’ve done that in Europe. Wind power is a \$1 billion industry in the U.S., but \$6 billion worldwide. We haven’t seen the same support for small users who would use Bergey products. That’s why political activity is just as important as R&D.”

The company has faced a dilemma since its inception. “We have to push the technology to increase the efficiency of our machines,” he says, “and at the same time increase subsidies to produce more sales. It’s a challenge. It’s a struggle worth



The metal rotor blades on Karl Bergey’s first wind turbines tested well in the laboratory but tended to crack with extended use. Developing a composite of fiberglass and polyvinyl resin solved the problem, and the company replaced all the blades on the old models. Today the blades, here being given a final finish by Ken Parker, are made off-site using the fiberglass “pultrusion” process.

making because of the market’s huge potential and the depth of public interest out there.”

Meanwhile Bergey Windpower continues to manufacture wind turbines in a building on OU’s North Campus. The company has built and sold more than 2,500 wind turbines over the past 26 years. Most are still spinning and delivering electric power.

The very first 10-kW Excel wind turbine produced by the company continues to generate electricity for Karl Bergey’s home in rural Norman. Some of this original wind turbine’s parts actually were rejected for the first Bergey production models.

“Now, with the effect of foreign oil on costs and political obligations, people are taking a better look at alternative energy,” he says. “If natural gas prices continue to escalate as predicted, the effects will be good for Oklahoma and good for wind power.”