

Foreword

The wind power industry in America has had four distinct periods of development beginning with the early settlers bringing the European technology to America. The settlers found that the European designs did not provide the flexibility to capture and withstand the fickle weather, especially in the Midwest. The American windmills that were self-regulating and had pivoting blades for high winds were introduced in 1857. The Eclipse windmill was the first to use a solid wheel and a side vane to turn the rotor out of the wind as the rotor speed increased. These water pumping windmills provided year-round water supplies that allowed much of the Great Plains and Midwest to be settled between 1870 and 1920. The third distinct period was the use of wind power to generate electricity. Small units were installed to charge batteries that would supply lights for the kitchen and bathroom, with enough extra power to listen to the radio for an hour or so in the evening. The Jacobs Wind Electric Company reported selling tens of thousands of these units between 1931 and 1957. Most of these machines were removed when the Rural Electrification Administration (REA) installed electric power lines. With the increased cost of fuel in the 1970s, wind enthusiasts and the U.S. government started developing wind systems using modern aerodynamics learned from the aerospace industry. The first major installations occurred in California during the 1984 to 1986 time period when almost 15,000 turbines were installed.

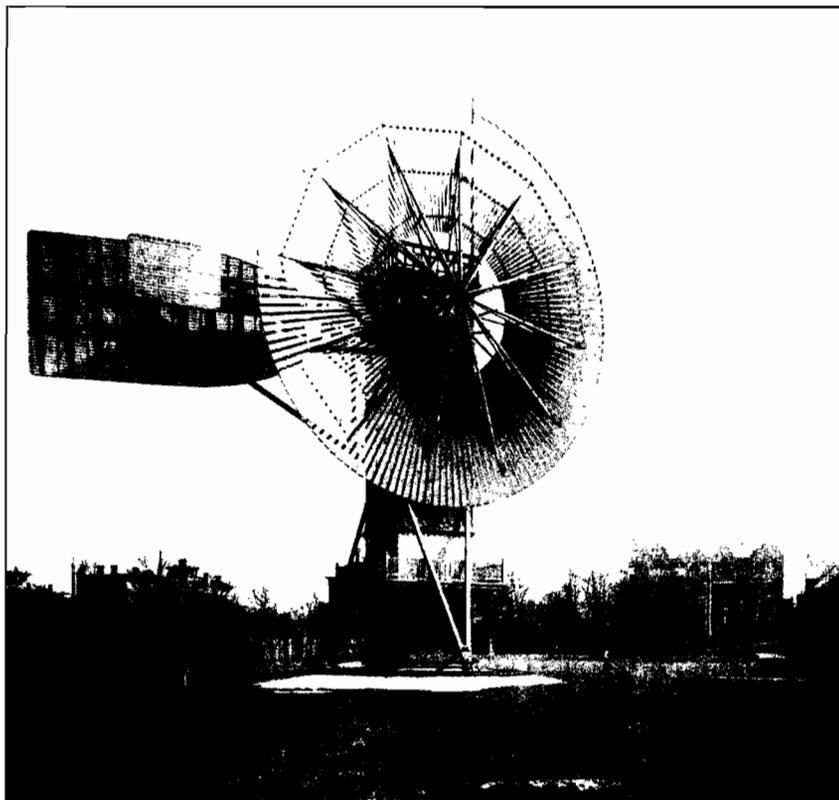
The original wind research and development program of the U. S. Department of Energy contained six program missions. The wind characteristics and wind maps were studied by Battelle Northwest Laboratories. The Solar Energy Research Institute was responsible for innovative and unproven technologies. NASA designed and built four different prototype large machines ranging from 100 kilowatts to 2000 kilowatts. Sandia National Laboratories designed and developed the vertical-axis technology, leading to a commercial company installing almost 1,500 units in California during the 1980s. Rockwell International designed and developed small machines of 8, 15, and 40 kilowatts. Two partnering companies developed their designs into commercial products that were part of the California installations of the 1980s. Finally, the U.S. Department of Agriculture's Agricultural Research Service developed controller interfaces to allow these modern turbines to be used in rural and remote applications such as pumping water, cooling milk and farm products, and ventilating animal buildings. The federal wind research was consolidated when the National Renewable Energy Laboratory was established. Sandia National Laboratories and USDA's Agricultural

Research Service continue as contributors to the federal wind research effort.

At the same time that wind research and development was started in the United States, the Europeans were also hard at work. When the California market opened in 1983, the Europeans were ready with their machines as well. About half of all machines installed in California were manufactured in Europe. Since the mid-1970s, the wind industry has been an international industry with international competition. The U.S. wind industry struggled through almost two decades of on-again and off-again energy policies, resulting in the Europeans taking the lead in wind turbine technology and at one time, leaving the United States with only one manufacturer of utility-sized machines. Several U.S. small machine manufacturers managed to produce enough revenue to remain in business through the 1990s. As world energy prices began to climb at the start of the 21st century, wind turbine manufacturers began to see increased sales as individual states started to establish renewable energy portfolio standards. These state renewable energy standards required electric utilities to add renewable energy to their generation mix. The wind industry was ready to meet this demand. Wind electric power production has increased at about 25 percent per year since 2002, making it the fastest growing power generation technology. Today, the leading manufacturers of utility wind turbines are located in Denmark, Germany, Spain, the United States, Japan, India, and the Netherlands. In 2007, the common size of turbines installed for utilities range from 1.5 to 2.5 megawatts. The machines have rotors over 300 feet in diameter and are on towers 280 feet tall. One megawatt will supply power for 350 to 400 average U.S. homes.

As we see the utilities endorse wind power, and wind farms or wind plants spring up all over the United States, small manufacturers are making machines for individual homes, schools, and small businesses. These units are used to offset high electrical costs and provide the individual owners with an opportunity to reduce emissions from coal-fired generating plants. Wind energy enthusiasts, whether owner, manufacturer, or supporter, have the feeling that they are making our world a better place to live and will help to protect our environment for years to come.

R. Nolan Clark
Agricultural Engineer
Conservation and Production Research Laboratory
U.S. Department of Agriculture
Agricultural Research Service
Bushland, Texas
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