

## **Alternative Energies: Wind Energy Basics**

*The following is a shortened and slightly modified version of an article by the Department of Energy – Energy Efficiency and Renewable Energy program. The entire article can be found at <http://www.eren.doe.gov/wind/>.*

Wind is a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover. This wind flow, or motion energy, when "harvested" by modern wind turbines can be used to generate electricity.

Wind turbines, like aircraft propeller blades, turn in the moving air and power an electric generator which supplies an electric current. Wind turbines are often grouped together into a single wind power plant or "wind farm" and generate bulk electrical power. Electricity from these turbines is fed into the local utility grid and distributed to customers just as it is with conventional power plants.

Wind energy is very abundant many parts of the United States. Wind resources are characterized by wind-power density classes, ranging from class 1 (the lowest) to class 7 (the highest). Good wind resources (class 3 and above) which have an average annual wind speed of at least 13 miles per hour, are found along the east coast, the Appalachian Mountain chain, the Great Plains, the Pacific Northwest, and some parts of Alaska such as Kotzebue and Healy. North Dakota, alone, has enough energy from class 4 and higher winds to supply 36% of the electricity of the lower 48 states. Wind speed is a critical feature of wind resources because a stronger wind means a lot more power.

Numerous public opinion surveys have consistently shown that the public prefers wind and other renewable energy forms over conventional sources of generation. Wind energy is a free, renewable resource, so no matter how much is used today, there will still be the same supply in the future. Wind energy is also a source of clean, non-polluting, electricity. Unlike conventional power plants, wind plants emit no air pollutants or greenhouse gases. In 1990, California's wind power plants offset the emission of more than 2.5 billion pounds of carbon dioxide, and 15 million pounds of other pollutants that would have otherwise been produced. It would take a forest of 90 million to 175 million trees to provide the same air quality.

Although wind power plants have relatively little impact on the environment compared to other conventional power plants, there is some concern over the noise produced by the rotor blades, aesthetic (visual) impacts, and sometimes birds have been killed by flying into the rotors. Most of these problems have been resolved or greatly reduced through technological development or by properly siting wind plants. Avian mortality remains an issue to be better understood and resolved.

The major challenge to using wind as a source of power is that it is intermittent and it does not always blow when electricity is needed. Wind cannot be stored (unless batteries are used); and not all winds can be harnessed to meet the timing of electricity demands. Further, good wind sites are often located in remote locations far from areas of electric power demand (such as cities).

Wind energy avoids the external or societal costs associated with conventional resources, namely, the trade deficit from importing foreign oil and other fuels, the health and environmental costs of pollution, and the cost of depleted resources. Wind energy is a domestic, reliable resource that provides more jobs per dollar invested than any other energy technology--more than five times that from coal or nuclear power. In 1994, wind turbine and component manufacturers contributed directly to the economies of 44 states, creating thousands of jobs for Americans.

The wind energy industry has grown steadily over the last 10 years and American companies are now competing aggressively in energy markets across the nation and around the world. Wind energy has been the fastest growing source of electricity generation in the world in the 1990s. However, the majority of this growth has been in Europe, where government policies and high conventional energy costs favor the use of wind energy. The U.S. Department of Energy recently announced the Wind Powering America initiative with goals to power at least 5% of the nation's electricity with wind by 2020, increase the number of states with more than 20 megawatts of wind to 16 by 2005 and 24 by 2010, and increase federal use of wind energy to 5% by 2010.