Wind Generators

Quick Facts about Wind Energy

What is wind energy? The terms "wind energy" or "wind power" describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity to power homes, businesses, schools, and the like.

What causes the wind to blow? 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.

When was wind energy first used? Since earliest recorded history, wind power has been used to move ships, grind grain and pump water. There is evidence that wind energy was used to propel boats along the Nile River as early as 5000 B.C. Within several centuries before Christ, simple windmills were used in China to pump water.

In the United States, millions of windmills were erected as the American West was developed during the late 19th century. Most of them were used to pump water for farms and ranches. By 1900, small electric wind systems were developed to generate direct current, but most of these units fell into disuse as inexpensive grid power was extended to rural areas during the 1930s. By 1910, wind turbine generators were producing electricity in many European countries.

How is the energy in the wind captured? Wind turbines, like aircraft propeller blades, turn in the moving air and power an electric generator which supplies an electric current. Modern wind turbines fall into two basic groups; the horizontal-axis variety, like the traditional farm windmills used for pumping water; and the vertical-axis design, like the eggbeater-style Darrieus model, named after its French inventor. Modern wind technology takes advantage of advances in materials, engineering, electronics, and aerodynamics. Wind turbines are often grouped together into a single wind power plant, also known as a wind farm, and generate bulk electrical power. Electricity from these turbines is fed into the local utility grid and distributes to customers just as it is with conventional power plants.

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How big are wind turbines? Wind turbines are available in a variety of sizes, and therefore power ratings. The largest machine, such as the one built in Hawaii, has propellers that span the more than the length of a football field and stands 20 building stories high, and produces enough electricity to power 1400 homes. A small home-sized wind machine has rotors between 8 and 25 feet in diameter and stands upwards of 30 feet and can supply the power needs of an all-electric home or small business.

What are wind turbines made of? All electric-generating wind turbines, no matter what size, are comprised of a few basic components: the rotor (the part that actually rotates in the wind), the electrical generator, a speed control system, and a tower. Some wind machines have fail-safe shutdown systems so that if part of the machine fails, the shutdown systems turn the blades out of the wind or puts on brakes.

Are there good wind resources in the United States? 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 other locations. North Dakota, alone, has enough energy from class 4 and higher winds to supply 36% of the electricity of the lower 48 states. Of course, it would be impractical to move electricity everywhere from North Dakota. Wind speed is a critical feature of wind resources, because the energy in wind is proportional to the cube of the wind speed. In other words, a stronger wind means a lot more power.

What are the advantages of wind-generated electricity? 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.

What are the economic obstacles to greater wind power usage? Even though the cost of wind power has decreased dramatically in the past 10 years, the technology requires a higher initial investment than fossil-fueled generators. Roughly 80% of the cost is the machinery, with the balance being the site preparation and installation. If wind-generating systems are compared with fossil-fueled systems on a "life-cycle" cost basis (counting fuel and operating

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expenses for the life of the generator), however; wind costs are much more competitive with other generating technologies because there is no fuel to purchase and minimal operating expenses.

Are there environmental problems facing wind power? 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.

Are there other drawbacks to the use of wind energy? 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). Finally, wind resource development may compete with other uses for the land and those alternative uses may be more highly valued than electricity generation. However, wind turbines can be located on land that is also used for grazing or even farming.

Is wind energy good for the economy? 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.

Is the cost of wind power competitive with conventional power plants? New, utility-scale, wind projects are being built all around the United States today with energy costs ranging from 3.9 cents per kilowatt-hour (at very windy sites in Texas) to 5 cents or more (in the Pacific Northwest). These costs are competitive with the direct operating costs of many conventional forms of electricity generation now--and prices are expected to drop even further over the next 10 years. Since wind is an intermittent electricity generator and does not provide power on an "as needed" basis, it has to compare favorably with the costs saved on fuel from fossil generators.

Can homeowners sell excess electricity to the utility? Under the Public Utilities Regulatory Policy Act of 1978 (PURPA), any qualifying individual can install a wind generator and the local electric utility must pay for any excess power produced. PURPA was specifically intended to create a market for clean,

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renewable, electric-generating technologies by guaranteeing a buyer for the excess power. Prior to PURPA, selling power to the utility was an option but was the discretion of the utility. With PURPA, small power producers meeting specific criteria are guaranteed purchase and interconnection. Many states now permit "net metering," in which the utility must buy wind power generated by homeowners at the same retail rate the utility charges. This essentially allows the customer's meter to turn backward while wind energy is supplied to the grid by the customer's turbine.

Wind industry...today. 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. The industry, in partnership with the U.S. Department of Energy, continues to expand and develop a full range of highly reliable, efficient wind turbines. These new-generation turbines, when installed, perform at 98 percent reliability in the field, representing remarkable progress since the technology was first introduced in the early 1980s.

Wind power...tomorrow. Wind power has an expansive future according to experts. 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.

*Information taken from:
http://www.e-marine-inc.com/products/wind_generators/wind.html

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