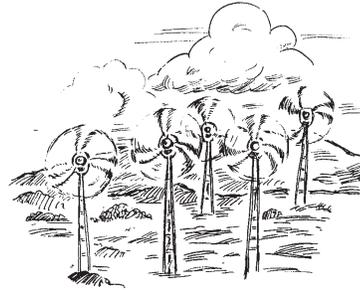




# Wind Energy



**E**PA's State and Local Climate Change Program helps build awareness, expertise, and capacity to address the risk of climate change at the state and local levels. The program provides guidance and technical information to help state and local agencies prepare inventories of greenhouse gas emissions, develop action plans to reduce emissions, and educate their constituents. By emphasizing the many economic and environmental benefits of greenhouse gas reductions, the program encourages state and local decisionmakers to implement voluntary measures to reduce their greenhouse gas emissions.

## Harvesting the Wind

**W**ind turbines use energy from the motion of the wind to make mechanical energy and convert it to electrical energy. Since no combustion occurs in wind power generation, there are no direct emissions of greenhouse gases or other pollutants. Given this advantage plus the steadily declining costs of this kind of energy, wind may be one of the most significant renewable energy sources for the next few decades.

Every megawatt-hour (1,000 kilowatt-hours) of electricity generated by a wind turbine offsets the equivalent of 1,100 to 2,200 pounds of carbon dioxide, depending on the type of fuel used to generate the electricity. Based on the national average fuel mix, wind energy also offsets up to 15 pounds of sulfur and nitrogen oxides and particulates, 3.5 ounces of

trace metals (e.g., mercury), and more than 440 pounds of solid waste from fossil-fueled generation.

Development of wind energy generating capacity can assist utilities and other energy generators in complying with regulations for air pollution and hazardous waste, as well as reducing the greenhouse gas emissions associated with operating fossil fuel power plants.

The U.S. wind industry currently generates about 3.5 billion kilowatt-hours of electricity each year—enough to meet the annual electricity needs of 1 million people. Wind energy installations are being constructed across the country as utilities realize the benefits of adding clean, low-cost, reliable wind energy to their resource portfolios. Although most of the on-line wind energy projects in the United States are located in California, recent installations have broadened the geographical distribution of wind power capacity. With the help of legislation encouraging the use of alternative energy sources, wind power plants were operational or being planned in a total of 18 states by the end of 1998.

Under many circumstances, wind power now can compete economically with conventional generation technologies such as nuclear and modern coal-fired plants. The installed capital costs of wind-driven generating systems decreased from more than \$2,500 per kilowatt (kW) in the early 1980s to \$1,000 per kW or less for large-scale installations in the mid-1990s. These improvements have reduced the cost of wind energy systems from more than 15 cents to less than 5 cents per kWh—not including the federal 1.5-cent/kWh tax credit now available. (Note: the tax credit is scheduled to expire at the end of December 2001.)

New wind power projects have proven that wind energy not only is cost competitive, but also offers additional benefits to the economy and the environment. The development of wind energy carries the economic benefits of creating jobs and new businesses while supporting local economies and reducing reliance on imported energy. Global wind power capacity has grown at an annual average rate of 22.6 percent between 1990 and 1998.

Wind turbines can be installed relatively quickly, once a site is selected and licenses and permits are approved. Clean power's popularity with the public can be a competitive advantage for power companies that invest in this technology. Wind power is available from electricity providers through green power programs where utility restructuring has

occurred and via green pricing programs where restructuring has not occurred.

The National Wind Coordinating Committee was formed in 1994 by the American Wind Energy Association, Electric Power Research Institute, Edison Electric Institute, American Public Power Association, and the U.S. Department of Energy (DOE). The committee intends to plot an orderly path for the development of a self-sustaining commercial market for wind power.

### The Federal Role

The federal government provides technical assistance for the development of wind energy through DOE's Wind Energy Program, the National Renewable Energy Laboratory's (NREL) National Wind Technology Center, and Sandia National Laboratories.

The Energy Policy Act of 1992 (EPACT) established a production tax credit of 1.5 cents per kilowatt-hour (adjusted for inflation) for electricity produced from facilities brought on line between January 1994 and July 1999. The credit can be used for the first 10 years of the facility's existence. Qualification for the tax credit will expire on December 31, 2001.

### State Experiences with Wind Power

#### California

Wind energy in California produced about 1.5 percent of the state's total electricity in 1997, more than enough to light a city the size of San Francisco. More than 13,000 of California's wind turbines, or 95 percent of all of California's wind generating capacity and output, are located in three primary regions: Altamont Pass (east of San Francisco), Tehachapi (southeast of Bakersfield), and San Geronio (near Palm Springs, east of Los Angeles). The roughly 3 billion kilowatt-hours produced each year by California's wind turbines displace 2.1 million tons of CO<sub>2</sub> that would otherwise be emitted by fossil fuel power plants.

In 1995, these areas produced 30 percent of the world's wind-generated electricity. Much of this capacity was installed during the 1980s, and almost all was planned, financed, installed, and operated by independent power producers—companies not affiliated with utilities. Most of the California wind capacity was installed in response to federal and California state legislation that provided a favorable market.

The federal production tax credit is expected to increase California's wind power capacity as older, less-efficient

turbines are replaced with modern, larger, and taller units that generate 35-40 percent more electricity.

#### Minnesota

The U.S. Department of Energy reported in 1991 that wind energy in Minnesota could produce 657 terawatt-hours (625 trillion watt-hours) of electricity annually from about 225 gigawatts of wind energy capacity. Most of that capacity is along Buffalo Ridge, a geological formation that runs through portions of Minnesota, North and South Dakota, and Iowa.

Commissioned in 1994, the Buffalo Ridge Windplant produces 25 megawatts of pollution-free electricity for sale to Northern States Power Company, a major Minnesota utility, under a long-term contract. Northern States Power secured approximately 2,000 acres of privately owned land under easement for construction of the Phase I wind towers. Corn and soybean crops continue to be grown and harvested in the fields surrounding the turbines.

An additional 107 megawatts were commissioned in 1998, and another 175 megawatts in 1999. State mandates for clean power production will result in a total of 425 megawatts of new wind power plants by 2002 and 400 megawatts more by 2012. By that time, the region's wind plants will be capable of producing a total of 825 megawatts of electricity. This would offset approximately 1.7 million tons of CO<sub>2</sub> emissions from fossil fuel power plants annually.

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### For More Information

The *National Renewable Energy Laboratory* operates the *National Wind Technology Center* and other wind-related programs for the U.S. Department of Energy.

Tel: 303-275-3000

Website: <http://www.nrel.gov/wind/>

*Sandia National Laboratories*, located in Albuquerque, New Mexico, has been involved in renewable energy technologies, including wind, for more than 20 years.

Tel: 925-294-3000 and 505-844-3441

Website: [http://www.sandia.gov/Renewable\\_Energy/wind\\_energy/homepage.html](http://www.sandia.gov/Renewable_Energy/wind_energy/homepage.html)

DOE's *Energy Efficiency and Renewable Energy Network* provides information on wind energy.

Website: <http://www.eren.doe.gov/RE/wind.html>

The *National Wind Coordinating Committee* provides a forum for identifying issues that affect the use of wind power.

Tel: 888-764-WIND or 202-965-6398

Website: <http://www.nationalwind.org>

The *American Wind Energy Association* is a national trade association that represents hundreds of wind energy member companies and advocates from the United States and around the world.

Tel: 202-383-2500

Website: <http://www.awea.org>

EPA's State and Local Climate Change Program helps states and communities reduce emissions of greenhouse gases in a cost-effective manner while they address other environmental problems.

Website: <http://www.epa.gov/globalwarming/> and click on "Public Decision Makers" under the "Visitors Center."

### BENEFITS OF WIND ENERGY

- Reduced emissions of greenhouse gases, air pollutants, and hazardous wastes.
- Reduced reliance on imported energy.
- No risk of fuel price hike.
- Increased local job and business opportunities.
- Quick construction with option to build in phases according to need.
- Contribution to local economy through payment of property taxes and land rents.