

The Difference Wind Makes



Wind power is a reality today. More than 5,200 megawatts of wind generation – enough to serve more than 1 million average American homes – was installed in 2007, and 2008 is expected to be at least as strong. With continued government encouragement to accelerate its development, this increasingly competitive source of energy will provide a steadily growing share of U.S. electricity and revitalize farms and rural communities – without consuming any natural resource or emitting any pollution or greenhouse gases. Wind energy works for our economy, environment, and energy security.

Wind energy makes a REAL CONTRIBUTION TO OUR ENERGY NEEDS

- 16,818 megawatts (MW) of wind power plants were in place in the U.S. at the end of 2007, serving the equivalent of 4.5 million average households. By the end of 2008, AWEA expects that number to jump to over 22,000 MW, which can serve the equivalent of over 5.5 million average households.
- Wind energy contributes to our energy security: an inexhaustible, domestic resource, it helps reduce our dependence on imports of natural gas (for electricity generation and residential use), oil and other fuels, often from unstable countries like Nigeria and Russia. The US currently burns about 13 billion cubic feet per day (Bcf/day) of natural gas for electricity generation. During 2007, wind power will be reducing natural gas use for power generation by approximately 5%.
- Although wind energy is variable, PacifiCorp, a major electric utility in the Northwest, assigned its wind projects a 20% capacity credit.¹ That means that the wind energy on PacifiCorp's system has the same value as 20% of an equivalent amount of traditional fossil-fuel generation in contributing to overall utility system reliability (i.e., adding 100 MW of wind is equivalent to adding 20 MW of fossil fuels in improving reliability).
- Modern wind turbines are equipped with high-tech computers and power electronics that process over 200 types of data, from wind speeds and oil temperature to voltage dips on the grid. "Smart" wind turbines can help make the electricity transmission system more reliable.
- Once approved, wind farms can be built relatively quickly to respond to electricity demand.
- Wind is "inflation-proof" – once a wind plant is built, the cost of energy is known, and is not affected by fuel market price volatility.

Worldwide wind power capacity has expanded at a rate of 25% annually from 2002 to 2005.

Globally, over 20,000 MW of new wind capacity was added in 2007. Current installed capacity worldwide at the end of 2006 was over 94,000 MW.

Denmark and some regions of Spain and Germany now have 10% to 25% of electricity generated from wind power.

President Bush has stated that wind energy can provide as much as 20% of the nation's electricity.



¹ *Integrated Resource Plan 2004*, PacifiCorp (Jan 2005)
<http://www.pacificorp.com/File/File47422.pdf>



The Difference Wind Makes, Continued

Wind energy delivers REAL ECONOMIC BENEFITS

- In 2007, new tower, blade, turbine and assembly plants opened in Illinois, Iowa, South Dakota, Texas and Wisconsin. In the same year, seven other facilities were announced in Arkansas, Colorado, Iowa, North Carolina, New York, and Oklahoma. Altogether, the new and announced facilities are expected to create some 6,000 jobs. Investment in manufacturing capability signals confidence in the market and lays the groundwork for expanded growth.
- New York's 322-MW Maple Ridge Wind Farm, which began operating in September 2006, provides \$8 million annually in local property tax revenue, pays landowners \$1.65 million each year in lease payments, and created 163 new local long-term jobs.
- In Washington State, 1,000 MW of installed wind capacity is estimated to create 2,650 new local jobs during construction, an additional 400 new local long-term jobs during the operational years of the wind farms, and a \$1.1 billion total economic benefit over the lifetime of the wind projects.
- One large (108-turbine, 162-MW) project in rural Prowers County, Colorado, increased the county's tax base by 29%, adding annual payments of about \$917,000 to the general school fund, \$203,000 to the school bond fund, \$189,000 to a county medical center, and \$764,000 in new county revenues, as well as 15-20 permanent and well-paying full-time jobs at the wind farm.¹
- In 2007, an analysis from global energy consulting firm Wood Mackenzie found that providing 15% electricity from renewable energy resources by 2020 [through a Federal renewable electric standard] could lower consumer expenditures by nearly \$100 billion, reducing both natural gas prices and electricity prices.²

Wind energy offers REAL ENVIRONMENTAL BENEFITS

Wind energy offsets other, more polluting sources of energy. That is important because electricity generation is the largest industrial source of air pollution in the U.S. When wind projects generate electricity, fuel at other power plants is not consumed.

- To generate the same amount of electricity as today's U.S. wind turbine fleet (16,818 MW) would require burning 23 million tons of coal (a line of 10-ton trucks over 9,000 miles long) or 75 million barrels of oil *each year*
- In 2007, the clean generation provided by wind prevented the emissions of approximately 28 million tons of carbon dioxide. A 2007 report estimates that wind power alone could lower emissions by 150 million tons of carbon dioxide in the year 2020, avoiding nearly 33% of expected emission increases in the electric sector.³
- Wind power requires no mining, drilling, transportation of fuel, or water usage, and does not generate radioactive or other hazardous or polluting waste.
- Emissions from the manufacture and installation of wind turbines are negligible. The "energy payback time" (a measure of how long a power plant must operate to generate the amount of electricity required for its manufacture and construction) of a wind project is 3 to 8 months, depending on the wind speed at the site – one of the shortest of any generation technology.
- A study by the Midwest Independent System Operator (ISO) showed that 16,000 MW of additional wind capacity would avoid 43 million tons of CO₂, or approximately 1,300 pounds of CO₂ for every megawatt-hour of wind generation.⁴

¹ *From Snack Bars to Rebar: How Project Development Boosted Local Businesses Up and Down the Wind Energy 'Supply Chain' in Lamar, Colorado*, (March 2004) Craig Cox, Interwest Energy Alliance.

² *The Impact of a Federal Renewable Portfolio Standard*, Wood Mackenzie (Feb 2007)

³ *Tackling Climate Change in the U.S.*, American Solar Energy Society (Jan 2007) http://www.ases.org/climatechange/climate_change.pdf

⁴ *Transmission Expansion Plan, Vision Exploratory Study*, Midwest ISO (2006) <http://www.midwestiso.org/page/Expansion+Planning>



Wind Power Today

Wind Power

Wind power is much more than the gentle breeze that causes the trees to sway or the waves to move across a lake. The power in the wind can blow a semitrailer truck off the road and flatten buildings. And it can be harnessed to be a non-polluting, never-ending source of energy to meet electric power needs around the world.

Wind power is a form of renewable energy – energy that is replenished daily by the sun. As portions of the earth are heated by the sun, air rushes to fill the low pressure areas, creating wind power. But the wind's characteristics may conceal its true power. The wind is slowed dramatically by friction as it brushes the ground and vegetation, it may not feel very windy at ground level. Yet the power in the wind may be five times greater at the height of a 40-story building (the height of the blade tip on a large, modern wind turbine) than the breeze on your face. Furthermore, the wind is accelerated by major land forms, so that entire areas of the country may be very windy while other areas are relatively calm. Since our country's founders tended to build our cities and towns where the wind doesn't blow strongly, the vast majority of people don't live in high-wind areas. Yet, when wind power is converted to electricity, it can be sent long distances to serve the needs of the cities and towns where we do live.

Creating Electricity

Wind **power** is converted to **electricity** by a **wind turbine**. In a typical, modern, large-scale wind turbine, the kinetic energy in the wind (the energy of moving air molecules) is converted to rotational motion by the **rotor** – typically a three-bladed assembly at the front of the wind turbine. The rotor turns a **shaft** which transfers the motion into the **nacelle** (the large housing at the top of a wind turbine **tower**). Inside the nacelle, the slowly rotating shaft enters a **gearbox** that greatly increases the rotational shaft speed. The output (high-speed) shaft is connected to a **generator** that converts the rotational movement into electricity at **medium voltage** (a few hundred volts). The electricity flows down heavy electric cables inside the tower to a **transformer**, which increases the voltage of the electric power to the **distribution voltage** (a few thousand volts). (Higher voltage electricity flows more easily through electric lines, generating less heat and fewer power losses.) The distribution-voltage power flows through underground lines to a collection point where the power may be combined with other turbines. In many cases, the electricity is sent to nearby farms, residences and towns where it is used. Otherwise, the distribution-voltage power is sent to a **substation** where the voltage is increased dramatically to **transmission-voltage** power (a few hundred thousand volts) and sent through very tall transmission lines many miles to distant cities and factories.

Applications

Wind turbines come in a variety of sizes, depending upon the use of the electricity. The large, **utility-scale** turbine described above may have blades over 40 meters long, meaning the diameter of the rotor is over 80 meters – nearly the length of a football field. The turbines might be mounted on towers 80 meters tall (one blade would extend about half way down the tower), produce 1.8 **megawatts** of power (1.8 **MW** or 1800 **kilowatts**, 1800 **kW**), supply enough electricity for 600 homes, and cost over a million and a half dollars!

Wind turbines designed to supply part of the electricity used by a home or business are much smaller and less costly. A residential- or **farm-sized turbine** may have a rotor up to 15 meters (50 feet) in diameter and be mounted on a metal lattice tower up to 35 meters (120 ft) tall. These turbines may cost from as little as a few thousand dollars for very small units up to perhaps \$40,000-\$80,000.

Very small turbines may be designed to charge **batteries** to supply electricity to homes that are not connected to the utility system. In those systems, the batteries store the electricity until it is needed. Such systems usually include an **inverter** that "conditions" (modifies) the power so that it is suitable to run typical appliances. Of course, the batteries and other necessary equipment increase the cost of the system, and the quantity of electricity available is limited by the battery storage capacity.

Wind Projects

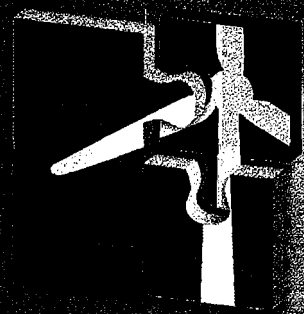
A typical large wind project involves many, many players. The main responsibility for the project lies with the **developer**. The developer negotiates with the **landowner** for the right to "harvest the wind" above the land and to place the turbine on a small plot of land – typically less than 1 acre is removed from normal use (farming, grazing, etc.) for each 50 acres of wind resource captured. (Turbines must be spaced a certain minimum distance apart to avoid "shadowing" each other and reducing power output.) Leasing the right to harvest the wind over a farm can more than double the annual net income from cultivation or grazing. The developer also must find financing, secure a contract with a **utility** to buy the electricity produced, purchase the equipment and contract to have it installed, and arrange for operation of the project. Recently, some landowners have become part owners of the projects on their land. This approach increases the **community** involvement in a project, though the legal arrangements may be quite complicated.

Wind Power Markets

Perhaps there is no "typical" wind power project. Some are built to enable utilities to comply with minimum requirements to purchase renewable energy established by state and local governments ("renewable portfolio standards" or "renewable energy standards"). Others may supply "green pricing" programs in which customers voluntarily purchase wind-generated electricity from their utility. In good wind resource areas, a new, large wind project may produce electricity at less cost (over the 25-year life of a project) than any other new power plant, regardless of the fuel source. While it is true that wind power output varies over time, utilities have learned to integrate wind power with their existing electricity generators. About 20% of Denmark's electricity is generated by wind power, yet Danish utilities report no loss of reliability and no need for expensive new equipment or energy storage.

Making an Impact

The wind resource in the United States is vast. Using today's technology, there is theoretically enough wind power flowing across the country to supply all of our electricity needs. North Dakota alone could supply about one third of the nation's electricity. Adequate winds for commercial power production are found at sites in 46 states. However, less than 1% of the nation's electricity is currently supplied by wind power. Only a small portion of the country's vast potential will likely be tapped in the near term unless there is a shift in our energy policy priorities toward long-term support for renewable energy development. President Bush has stated that wind energy can provide as much as 20% of the nation's electricity. AWEA believes this goal is both feasible and affordable: the barriers to wind energy's expansion on a large scale are regulatory -- not physical -- and can be overcome. The choice is ours.



AWEA Wind Power Value Chain

Building Links to a Cleaner Energy Future

State of Market

For the past five years, new wind power project installations have been expanding at a rate of 29% per year. This year is expected to be the fourth consecutive year of record-setting installations. Given that level of growth, wind industry companies are seeing shortages of parts suppliers, workers, and contributing businesses all along the value chain. Become part of this rapidly growing industry as it ramps up to provide a significant amount of the country's power needs from wind – a clean, domestic, renewable resource.

2007 shattered previous records

The U.S. wind energy industry installed over 5,200 megawatts (MW) in 2007, expanding the nation's total wind power generating capacity by 45% in a single calendar year and injecting an investment of over \$9 billion into the economy. The new wind projects account for about 35% of the entire new power-producing capacity added nationally in 2007. This remarkable and accelerating growth has been driven by strong demand, favorable economics, and a period of stable policy support.

At the end of 2007, U.S. wind power capacity was over 16,800 MW (around 25,000 turbines) located in 34 states. These wind farms will generate an estimated 48 billion kilowatt-hours (kWh) of wind energy in 2008, just over 1% of U.S. electricity supply, powering the equivalent of over 4.5 million homes.

Strong growth continues, strains capacity

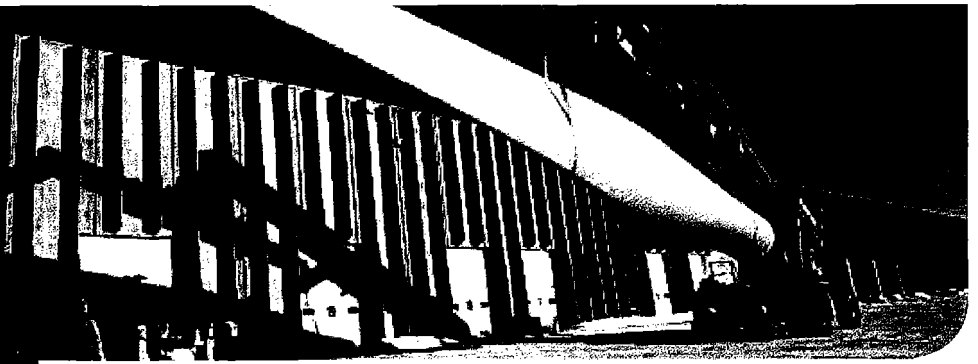
All signs are pointing to 2008 being a better than 2007 in terms of new installations. At the end of 2007, 3,500 MW of new projects (over 2,000 turbines) were already under construction for 2008. Project developers report that strong demand continues for wind power projects across the country and turbine

manufacturers report that they are sold out for the year and are now accepting orders for 2010 and 2011.

Growth in the wind power industry is not only strong in the U.S., but is growing worldwide, driven by the need for new clean, affordable electricity. Over 20,000 MW of wind power was installed worldwide in 2007, led by the U.S., China and Spain, bringing global installed capacity to 94,112 MW, an overall increase of 27% from last year's total.

The strong demand for wind power is causing shortages in many industry segments. Turbine manufacturers report long lead times for components such as gearboxes and generators and machined parts such as large castings, bearings and forgings. Tower manufacturers face shortages of rolled steel towers sections and rings. Construction contractors say that long lead times for transformers and equipment to transport the components and construct the projects are bottlenecks that can delay the construction schedule. The limited number of companies capable of transporting large wind turbine components is a growing concern. Companies all along the value chain report shortages in people and companies experienced in providing solutions to the wind industry.





Market Growth Potential

The U.S. wind energy industry is ramping up toward a level of capacity able to provide 20% of the country's electricity needs. In order to reach that level of production by 2030, the industry would have to more than triple from its current manufacturing and installation base of 5,000 megawatts per year. Over 75,000 new turbines would have to be installed in the coming decades. This aggressive growth trend places a large demand on the current supply chain for parts, equipment and labor. The result is tremendous opportunity for new entrants into the industry. There is also increasing demand for service industries, such as construction, transportation, legal, financial, safety, and operations and maintenance.

Market Forces and Policy Affecting Industry

Market Forces

In many areas of the country, wind power is one of the most cost-effective new sources of electricity generation that a utility can acquire. Although wind turbine prices have increased in the past few years, the same market trends have also driven up the costs of every other form of electricity generation. New wind power plants can be permitted and built much more quickly than can conventional generation plants. In addition, wind power plants are attractive because they eliminate fuel price risk, they produce no carbon dioxide or air pollutant emissions, do not require water, mining, drilling, or transportation of fuel, and do not generate radioactive or other hazardous or polluting waste.

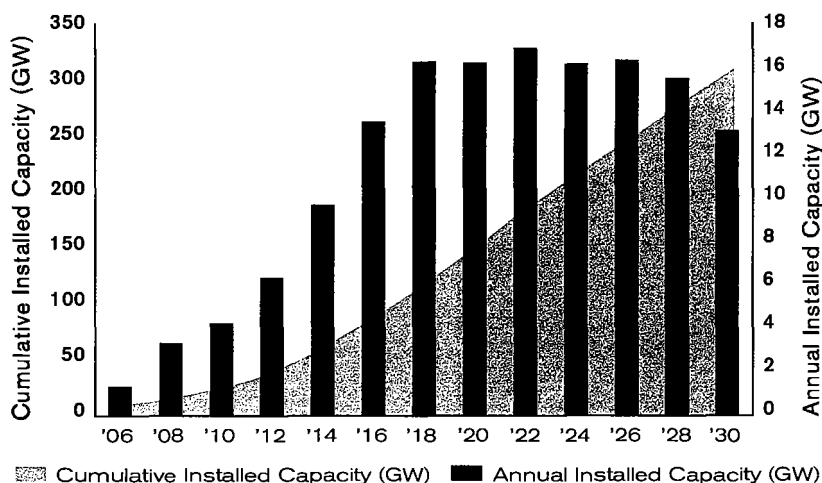
Currently, many components for wind turbines installed in the U.S. are made outside of the U.S., which subjects

wind turbine equipment vendors to added costs due to foreign exchange fluctuations and increased transportation costs. This is driving an interest for U.S. companies to enter the wind market as well as encouraging global wind turbine and components manufacturers to consider locating facilities in the U.S. and seek U.S.-based suppliers. The main barrier to increased manufacturing in the U.S. is the risk associated with the renewable energy Production Tax Credit (PTC).

Policy

The pace of growth beyond 2008 is expected to largely depend on the timing and duration of an extension of the renewable energy PTC, which has been the federal government's main policy mechanism to support renewable energy expansion for the past 15 years. The eligibility period for a project to receive the credit is currently set to expire at the end of 2008. The lack of market certainty caused by the "on / off" nature of the PTC has been an impediment to creating the economic environment needed to ensure a stable supply chain and achieve potential cost savings. Congressional leaders are aware of the situation and are now working on an extension.

In addition to the PTC, a federal Renewable Electricity Standard (RES) requiring that utilities get a certain percentage of their power from renewable resources as well as legislation to limit carbon emissions could provide long-term incentives for expanding wind power. Twenty-five states and the District of Columbia now have state-level renewable electricity standards to promote the use of wind power and other renewable sources.



After ramping up manufacturing capacity, the 20% scenario calls for over 16 GW to be installed annually.

DOE's "20% Wind Energy by 2030" Report



Wind Power Myths vs. Facts

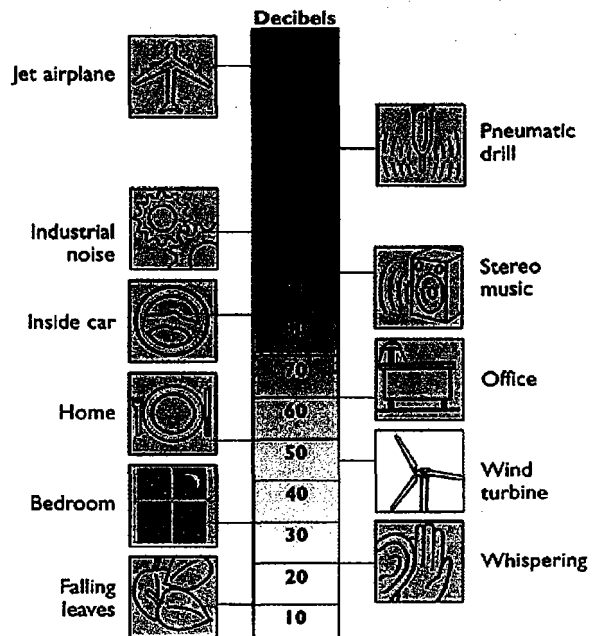
As wind power generates more electricity in the U.S. and moves into new areas of the country, more people are being introduced to wind turbines in their communities. Wind power is still a relatively new technology, and a number of myths - some based on old technologies, some based on misunderstandings - are endlessly repeated by opponents of wind power. This document dispels some of the most common myths about wind power with real facts.

MYTH — Wind Turbines Are a Nuisance

“Turbines Are Noisy”

Fact: Wind turbines are quiet. An operating modern wind farm at a distance of 750 to 1000 feet is no noisier than a kitchen refrigerator or a moderately quiet room. The sound turbines produce is similar to a light whooshing or swishing sound, and much more quiet than other types of modern-day equipment. Even in rural or low-density areas, where there is little additional sound to mask that of the wind turbines, the sound of the blowing wind is often louder.

Exceptions to quiet operating turbines can occur in two instances - with older turbines from the 1980s and with contemporary turbines in some types of hilly terrain. Modern wind turbines have been designed to drastically reduce the noise of mechanical components so the most audible noise is the sound of the wind interacting with the rotor blade. However, in some hilly terrain where residences are located in sheltered dips or hollows downwind from turbines, turbine sounds may carry further and be more audible. This effect can generally be anticipated and avoided in the development process through adequate setbacks from homes.



“Turbine Lighting Is Excessive”

Fact: Lights at wind farms are non-intrusive, and improvements in design will make them even less so as the technology expands. The Federal Aviation Administration (FAA) recommends lighting for most structures more than 200 feet in height to ensure aviation safety.

The wind industry is working with the FAA to test safe and non-intrusive lighting plans for wind farms.

“Nearby Residences Will Be Affected by Shadow Flicker”

Fact: Shadow flicker is the term used to describe what happens when rotating turbine blades come between the viewer and the sun, causing a moving shadow. **Shadow flicker is almost never a problem for residences near new wind farms, and in the few cases where it could be, it is easily avoided.** For some who have homes close to wind turbines, shadow flicker can occur under certain circumstances and can be annoying when trying to read or watch television. However, the effect can be precisely calculated to determine whether a flickering shadow will fall on a given location near a wind farm, and how many hours in a year it will do so. Potential problems can be easily identified using these methods, and solutions range from providing an appropriate setback from the turbines to planting trees to disrupt the effect. Normally, shadow flicker should not be a problem in the U.S. because at U.S. latitudes (except Alaska) the sun’s angle is not very low in the sky. If any effect is experienced, it is generally short-lived, as in a few hours over a year’s time.

“Turbines Interfere with Television and Other Communications Signals”

Fact: Interference is rare and easily avoided. Large wind turbines installed at wind farms can interfere with radio or television signals if a turbine is in the “line of sight.” Improving a receiver’s antenna or installing relays to transmit the signal around the wind farm solves this problem; both solutions are common practice in modern wind energy development.

“Turbines Are Ugly”

Fact: Beauty is in the eye of the beholder. Many people feel wind turbines are majestic. Wind farm developers have computer-modeling tools that accurately depict virtual views from given spots in the surrounding area. Careful design of a wind project can alleviate many visual concerns.

MYTH — Wind Turbines Do Not Benefit Local Communities

“Wind Projects Harm Property Values”

Fact: There is *no evidence* that the presence of a commercial windfarm within sight of a property systematically decreases that property’s value. In fact, a nationwide study conducted in 2003 surveyed property near multiple wind farms and found that not only do wind farms not harm property values, but that in some cases the values increased.

“Wind Projects Depress Tourism”

Fact: There is no evidence to indicate that wind turbines drive tourists away. In some areas, wind turbines even draw tourists. Local governments frequently work with developers to install information stands and signs near wind farms, as well as pull-off areas, similar to “scenic overlooks”, from nearby roads. Surveys of tourists have

“There is so much demand to view the wind turbines that the county is creating a pull-off area and working with the project owner to create an informational kiosk. The wind project has become a destination spot for tourists visiting nearby ski resorts and parks.”

*Robert Burns, Executive Director
Tucker County Development Authority, West Virginia*

found that the presence of wind turbines would not affect the decision of most visitors to return. The thousands of turbines in Palm Springs, California, have had no negative impact on the tourism business; on the contrary, the local tourism center organizes bus tours to the wind farms.

"Wind Projects Don't Contribute to the Local Tax Base"

Fact: Installing millions of dollars of equipment in most areas greatly increases the local taxes assessed, and wind farms are no exception. Wind farms support the local tax base, helping to pay for schools and roads far more than their impact to local facilities. One large (108-turbine) project in rural Prowers County, Colorado, increased the county's tax base by 29%.

What 1,000 Megawatts of Wind Brought to Texas

Taxable value of wind power plants:	<i>\$777 million</i>
Property tax payments to local school districts:	<i>\$11.6 million in 2002</i>
Landowner royalty income:	<i>\$2.5 million in 2002</i>
Wind-related jobs:	<i>2,500</i>

Economic development associated with a new wind farm extends far beyond taxes to increased employment, directly from the wind farm operation and construction, and to money pumped in the local economy through services needed to support a large construction project, including increased hotel stays and restaurant revenues.

MYTH — Wind Turbines Aren't Safe

"Blades Cause Dangerous Ice Throws"

Fact: Ice throw, while it can occur under certain conditions, is of little danger. Setbacks typically used to minimize noise are sufficient to protect against danger to the public. In addition, ice buildup slows a turbine's rotation and will be sensed by a turbine's control system, causing the turbine to shut down.

"Turbines May Throw Blades or Collapse"

Fact: Modern wind turbines are so safe they successfully operate near schools, in urban settings and densely populated areas, and in rural communities. Blade throws were common in the industry's early years, but are unheard-of today because of better turbine design and engineering. Utility-scale wind turbines are certified to international engineering standards, such as those developed by Germanischer Lloyd or Det Norske Veritas, and these include ratings for withstanding different levels of hurricane-strength winds and for other criteria. There are thousands of turbines installed in Europe and thousands in the U.S. - wind turbine standards ensure a high level of operational reliability and safety in the U.S. and worldwide.

MYTH — Wind Turbines Harm Wildlife

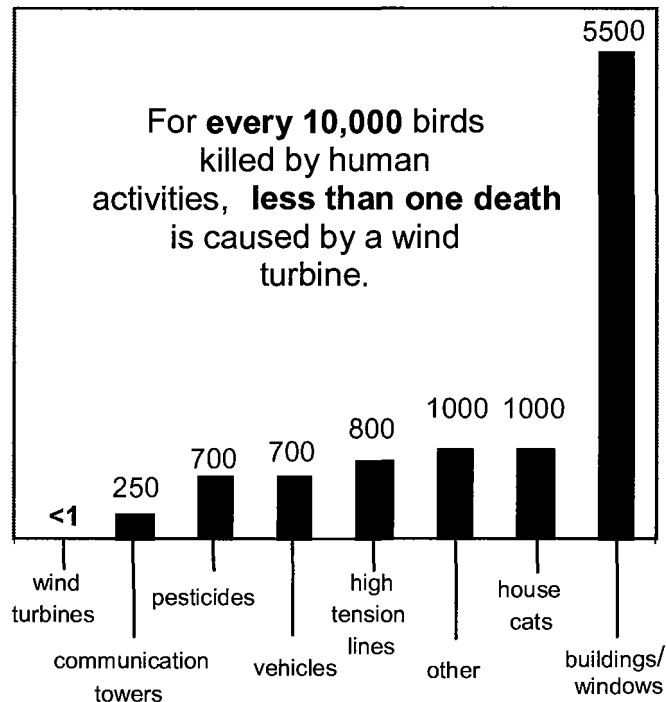
"Turbines Kill Many Birds and Bats"

Fact: Wind energy development's overall impact on birds is extremely low compared with other human-related activities. No matter how extensively wind is developed in the future, bird deaths

from wind energy are unlikely to be ever more than a small fraction of bird deaths caused by other human-related sources, such as cats and buildings.

Raptor kills (of eagles, hawks, and owls) are a problem at one large older wind farm in California, in Altamont Pass, built in the 1980s. Wind farm operators there have worked with wildlife officials and experts to reduce the impacts on raptors, and those efforts continue today.

Prior to 2003, bat kills at wind farms studied were low. However, the frequency of bat deaths at a newly constructed wind farm in West Virginia in 2003 has caused concern. In response, AWEA and several of its member companies entered into a three-year cooperative effort with Bat Conservation International, the National Renewable Energy Laboratory, and the U.S. Fish and Wildlife Service to research wind/bat interaction and test ways to reduce bat mortality. That research is ongoing, and information about the results is being published as they become available.



Data source: Erickson et al., 2002, Summary of Anthropogenic Causes of Bird Mortality.

Despite the minimal impact wind development has on bird and bat populations in most areas, the industry takes potential impacts seriously. In addition to special initiatives such as those described above, avian studies are routinely conducted at wind sites before projects are proposed. Pre-construction wildlife surveys are now common practice throughout the industry.

"Wind Projects Fragment Wildlife Habitat"

Fact: Wind farms are most often built in areas close to transmission lines where habitat has already been modified and fragmented, typically by farming and ranching. And, wind energy has a light footprint, with only the turbine itself, along with some roads and power lines, impacting the land, while pre-existing land use continues around the turbines as before. Windy land can also often be found in undeveloped areas, however, so habitat fragmentation can be a concern, especially in unbroken stretches of prairie grasslands or forests. The industry supports more research to better understand the extent of possible habitat or wildlife impacts in these areas, but those impacts must be balanced against the effects of not developing renewable energy sources and thereby aggravating global warming and pollution pressures on wildlife and their habitats--not just in prairie or forest areas, but around the world.

MYTH — Wind Turbines are Expensive and Unreliable

“Back-up Generation Is Needed for All Wind Turbines”

Fact: Because of the grid’s inherent design, there is no need to back up every megawatt of wind energy with a megawatt of fossil fuel or dispatchable power. The electric grid is designed to have more generation sources than are needed at any one time because no power plant is 100% reliable. It is a complicated system designed to absorb many impacts, from electric generation sources going out of service unexpectedly to industrial customers starting up energy-intensive equipment. The grid operator matches electricity generation to electricity use, and wind energy’s variability is just one more variable in the mix.

Findings of the Utility Wind Interest Group (an organization of some 55 utilities that have wind power on their systems) in November 2003:

"The results to date also lay to rest one of the major concerns often expressed about wind power: that a wind plant would need to be backed up with an equal amount of dispatchable generation. It is now clear that, even at moderate wind penetrations, the need for additional generation to compensate for wind variations is substantially less than one-for-one and is often closer to zero."

One of the most authoritative studies, conducted in 2004 for the Minnesota Department of Commerce found that adding 1,500 megawatts (MW) (enough wind to meet the needs of more than 400,000 homes) to the system of a major utility, Xcel Energy in Minnesota, would require only an additional 8 MW of conventional generation to deal with added variability.

Many sources of electricity considered highly reliable suffer from unexpected outages: for instance nuclear reactors and coal plants that shut down, often at short notice, for safety repairs or maintenance. Yet no one proposes to back up a coal or nuclear power plant with a similar amount of dedicated generation from another plant. The reality is that wind energy is naturally variable, but not unreliable. Wind farms are built in windy areas, and seasonal and daily wind generation patterns can be anticipated. Denmark and utility systems in regional areas elsewhere in Europe operate with 10-15% or more of their power coming from wind, without increased reliability problems or need for additional back-up power plants. And in contrast to conventional power plants, wind farms need not shut down altogether for maintenance and repairs—a turbine fault, when it occurs, can be repaired while the other turbines continue to operate.

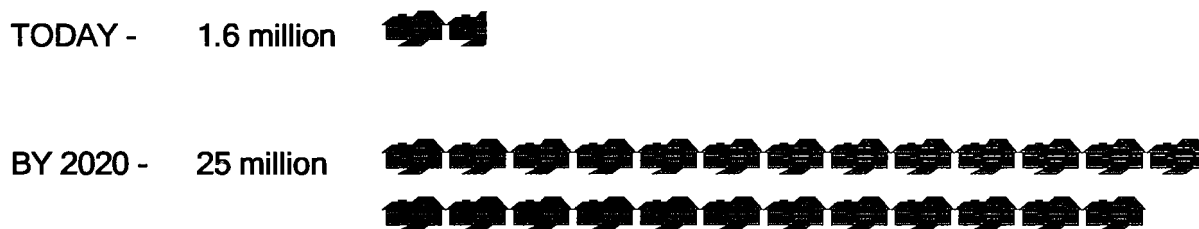
“Wind Turbines Operate Only a Small Fraction of the Time”

Fact: Wind turbines generate electricity most (65-80%) of the time, although the output amount is variable. No power plant generates at 100% “nameplate capacity” 100% of the time. Nameplate capacity refers to the maximum generation potential of a power plant. A conventional power plant is occasionally closed for maintenance or repairs, or runs below full capacity to best match demand. Wind farms are built in areas where the wind blows most of the time, but because of variations in speed, a wind farm will generate power at full rated capacity about 10% of the time, and on average throughout the year the plant will generate 30% to 35% of its rated capacity. A utility in the Northwest, PacifiCorp, added 20% of its wind projects’ nameplate capacity into its baseload calculation in the utility’s 2004 Integrated Resource Plan. This indicates that utilities with experience with wind energy on their system consider it able to provide some consistent power on a regular basis. The full plan can be accessed at <http://www.pacificorp.com/File/File47422.pdf>.

"Wind Energy Will Never Provide More Than a Little Electricity"

Fact: The U.S. Department of Energy estimates America's wind energy potential to be much larger than total U.S. electricity consumption today. Tapping only a fraction of that potential would provide a significant part of America's electricity supply. In the United States, wind energy currently produces approximately 17 billion kilowatt-hours of electricity, equivalent to powering about 1.6 million average American homes year-round. A typical one-megawatt turbine generates enough electricity for 300 homes. With policies to remove barriers to wind energy development, by 2020, 100,000 MW of wind energy could be installed, providing at least 6% of electricity generated in the U.S., or about the same amount as hydropower today. Wind energy is poised to be a significant part of America's diverse energy portfolio.

American Homes Served by Wind Energy
(in millions)



"Wind Turbines Are Inefficient"

Fact: Wind turbines are efficient, and that is part of their beauty. One of the simplest ways to measure overall efficiency is to look at the "energy payback" of an energy technology, i.e., the amount of energy it takes to produce a given amount of energy.

The energy payback time for wind is in fact similar to or better than that of conventional power plants. A recent study by the University of Wisconsin-Madison calculated the average energy payback of Midwestern wind farms to be between 17 and 39 times as much energy as they consume (depending on the average wind speeds at the site), while nuclear power plants generate only about 16 times and coal plants 11 times as much energy as they consume.

Wind turbines are also highly efficient in a larger sense: they generate electricity from a natural, renewable resource, without any hidden social or environmental costs—there is no need to mine for fuel or transport it, no global warming pollutants created, and no need to store, treat, or dispose of wastes.

"Wind Energy Is Expensive"

Fact: Wind energy is now in a range that is competitive with power from new conventional power plants. The up-front, capital cost of wind energy is more expensive than that of some traditional power technologies such as natural gas. However, there are no fuel costs, and in good locations the "levelized" cost (which includes the cost of capital, the

"The new wind farm that Xcel Energy is building near Lamar will save consumers \$4.6 million in their power bills."

- From Xcel Energy testimony to the Federal Energy Regulatory Commission, June 16, 2003

cost of fuel, and the cost of operations and maintenance over the lifetime of the plant) of wind energy can now be very competitive with that of other energy sources.

"Wind Energy Is Heavily Subsidized"

Fact: Every energy technology is subsidized. Wind energy is no exception. Wind receives a tax credit that provides an inflation-adjusted 1.5 cents for each kilowatt-hour generated, over the first ten years of the project. This credit reduces the tax liability of a wind farm, but is not a subsidy of public money flowing to the wind farm owner.

Other energy sources receive subsidies in many forms, including tax deductions, loan guarantees, liability insurance and leasing of public lands at below market prices. Some, like the depletion allowance for oil and gas, are permanent in the tax code. Additional indirect subsidies include federal money for research and development programs and policy provisions in federal legislation. The largest subsidy, however, may be an invisible one—the fact that the environmental impacts from fossil fuel use are not reflected through higher costs of those energy sources. Instead, all of society must pay the price for dirty air, polluted water, health costs, global warming, fuel spills, and cleanup and disposal of fuel byproducts attributed to traditional energy sources. Clean, renewable, domestic wind energy produces no emissions, requires no fuel and the cost is fixed and predictable over time.