



Wind Energy and Wildlife: Frequently Asked Questions

Q: How does wind energy work? How is electricity generated from the wind?

A: A wind energy system transforms the kinetic energy of the wind into mechanical or electrical energy that can be harnessed for practical use. Wind electric turbines generate electricity for homes and businesses and for sale to utilities.

The most economical application of wind electric turbines is in groups of large machines (660 kilowatts (kW) and up), called "wind power plants" or "wind farms." For example, a 107-megawatt (MW) wind farm near the community of Lake Benton, Minnesota, consists of turbines sited far apart on farmland along windy Buffalo Ridge. The wind farm generates electricity, and extra income for farmers, while agricultural land use continues undisturbed.

A 1-MW wind turbine...

- Powers about 300 average American homes
- Displaces 1,800 tons of carbon dioxide each year* – the equivalent of planting 1 square mile of forest.

*based on the average U.S. utility fuel mix

Wind plants of multiple turbines can range in size from a few megawatts to hundreds of megawatts in capacity. Wind power plants are "modular," which means they consist of small individual modules (the turbines) and can easily be made larger or smaller as needed. Turbines can be added as electricity demand grows. Today, a 50-MW wind farm can be completed in 18 months to two years. Most of that time is needed for measuring the wind and obtaining construction permits—the wind farm itself can be built in less than six months.

Q: How big are wind turbines? What do they look like? What are they made of?

A: Utility-scale wind turbines for land-based wind farms come in various sizes, with rotor diameters ranging from about 50 meters to about 90 meters, and with towers of roughly the same size. A 90-meter machine, definitely at the large end of the scale at this writing (2005), with a 90-meter tower would have a total height, from the tower base to the tip of the rotor, of approximately 135 meters (442 feet). Wind turbines intended for residential or small business use are much smaller. Most have rotor diameters of 8 meters or less and would be mounted on towers of 40 meters in height or less.

There are two basic designs of wind electric turbines: vertical-axis, or "egg-beater" style, and horizontal-axis (propeller-style) machines. Horizontal-axis wind turbines are most common today, constituting nearly all of the "utility-scale" (100 kW capacity and larger) turbines in the

global market. The towers are usually tubular and made of steel. The blades are made of fiberglass-reinforced polyester or wood-epoxy.

Q: How much energy is produced from wind in the U.S. today?

A: Total installed U.S. wind capacity at year's end 2004 was 6,734 megawatts (MW), or enough to serve more than 1.6 million average households (with 4.3 million people). More than 2,000 megawatts of wind generation—enough to serve more than 600,000 average American homes-- were installed in the United States in the past two years alone. In 2004, over 16 billion kilowatt-hours of energy was generated from wind – enough electricity for 1.6 million average American homes.

Q: What states have the most wind development currently installed and operating?

A: The top five states in installed wind energy capacity – California, Texas, Minnesota, Iowa and Wyoming – together account for more than 4,600 MW or over two-thirds of the total installed capacity in the United States.

Q: How much electricity is likely to be produced from wind energy in the future?

A: If the wind industry were to consistently grow at a rate of 18% per year, six percent of the nation's electricity could be generated by wind power by the year 2020, resulting in over \$100 billion of investment in rural America. Over the last five years, U.S. wind capacity has expanded at an annual average rate of 22%, but the lack of consistent federal support for wind energy development threatens to slow that rate of expansion.

Q: What impacts does wind energy development have on land use?

A: Even if wind energy generated 560,000 million kilowatt-hours (kWh) per year – i.e., 15 % of America's electricity, or more than twice what hydropower generates today – only 0.6% of the land of the lower 48 states would have to be developed with wind power plants, according to a study by the Pacific Northwest Laboratory for the U.S. Department of Energy. This amount of land – roughly 18,000 square miles – is about the size of four counties in Montana. Yet within that area, as little as 5% of the land would be taken up by turbines, other equipment and access roads, and most existing land use, such as farming and ranching, would continue as it is now. The 5% of land actually used (900 square miles) would be equivalent to a square, 30 miles by 30 miles. An expanded transmission line system, however, would be needed to transmit the electricity to market in cities where it would be used.

Q: What impacts does wind have on wildlife?

A: Wind is one of the healthiest energy options, and the most compatible with animals and humans. Wind has some minor wildlife impacts (breaking up uninterrupted forest or grassland habitat at some locations, avian and bat collisions, noise disturbance during construction), but they are small compared to other electric generation choices.

The modern wind turbine is far less harmful to birds than are radio towers, tall buildings, airplanes and vehicles and numerous other manmade objects. Bird deaths due to wind development will never be more than a very small fraction of those caused by other commonly-accepted human activities. Summaries of available wind studies can be found at www.currykerlinger.com and at www.nationalwind.org.

All avian studies at wind farm sites show that bird kills per turbine average two to five per year or less, with the exception of a single 3-turbine plant in Tennessee that has recorded eight per turbine per year. These include sites passed by millions of migrating birds each year. At a few sites, no kills have been found at all.

A reasonable, conservative estimate is that of every 10,000 human-related bird deaths in the U.S. today, wind plants cause less than one. Even if wind were used to generate 100% of U.S. electricity needs, at the current rate of bird kills, wind would account for only one of every 250 human-related bird deaths. Leading human-related causes of bird kills, in the U.S. alone, include:

- cats (1 BILLION per year)
- buildings (100 million to 1 BILLION per year)
- hunters (100 million per year);
- vehicles (60 million to 80 million per year)
- communications towers (10 million to 40 million per year)
- pesticides (67 million per year)
- power lines (10,000 to 174 million per year)

In a paper for the National Wind Coordinating Committee, Erickson et al. state that the wide ranges cited for other sources of avian deaths reflect the low level of research work done on those sources—wind energy is the most thoroughly studied by far.

In most areas of the U.S., wind power plants also kill small numbers of bats. However, new wind power plants on ridgelines in Appalachia (Pennsylvania and West Virginia) have been experiencing bat kills in numbers much larger than elsewhere. The reasons for this problem, which first occurred in 2003, are being studied by a research partnership formed by the wind industry, Bat Conservation International, the U.S. Fish and Wildlife Service, and the U.S. Department of Energy's National Renewable Energy Laboratory. Researchers hope to find ways to reduce bat mortality at these sites.

Q: How does wind compare to other energy sources in terms of its impact on wildlife?

A: The list of environmental and wildlife impacts of other energy sources is long and varied, including:

- Habitat impacts from mining (coal, uranium), drilling (natural gas, oil), and compressing fuel (natural gas). Some of these effects are local, while others can extend over fairly broad areas.
- Habitat impacts from air and water pollution: acid rain, smog, mercury, drilling wastewater disposal (fossil fuels).

- Habitat impacts from global warming (fossil fuels). Significant changes in some species' ranges are already occurring, particularly in northern latitudes.
- Habitat impacts from thermal pollution of water (nuclear and fossil power plants).
- Habitat impacts from flooding of land and streamflow changes (hydro).
- Habitat impacts from waste disposal (coal).

While wind plants and their construction definitely have local impacts, the use of wind energy largely avoids these more far-reaching effects.

The picture with human health impacts is similar. Air pollution in particular has been linked to a number of human ailments, including heart and lung problems. Greater use of wind energy will reduce these concerns.

Q: What is the industry’s position on impacts of wind energy development on wildlife?

A: The wind energy industry has worked hard over the past decade to reduce the impact of wind turbines on birds. Those efforts have largely been very successful -- wind turbines and birds can and do coexist successfully. The wind industry is now beginning a similar effort to understand and reduce the regional impact of wind turbines on bats in Appalachia.

New wind projects are carefully planned to minimize environmental impact, even though wind is already one of the cleanest, most environmentally friendly energy sources in the world because it emits no air or water pollutants or global warming pollutants, requires no mining or drilling for fuel, and produces no toxic waste.

Individual bird deaths due to wind development will never be more than a very small fraction of those caused by other commonly accepted human activities and structures--house cats kill an estimated 1 billion birds annually in the U.S. alone, buildings 100 million to 1 billion, automobiles 60-80 million, power lines hundreds of thousands to as many as 175 million, according to the U.S. Fish & Wildlife Service (<http://birds.fws.gov/mortality-fact-sheet.pdf>) and other sources.

The wind industry welcomes scrutiny of, and comparison with, all of the impacts of all sources of power generation. Many extensive studies of bird collisions at wind farms have been carried out, a practice that contrasts greatly with the lack of a systematic effort to monitor direct impacts on avian species from mining and drilling, power plant emissions or pollution, or habitat loss brought on by these activities. Any public or private research effort, regulatory effort, or legislative proposal designed to quantify the impact of power generation on birds, bats, and other wildlife should encompass all power sources, not just wind.

Q: What is the industry’s commitment to wildlife protection?

A: The wind industry has demonstrated continual innovations leading to greater protection of the environment and wildlife.

- The industry has been conducting avian studies at wind sites across the country for more than twenty years. Pre-construction wildlife surveys are common practice throughout the industry. Typically a wildlife consultant is retained, and efforts are made to contact state and federal fish and wildlife agencies and local wildlife groups (e.g., Audubon chapters, Izaak Walton League chapters) to identify any issues of possible concern. The consultant examines the proposed site and prepares a detailed report on impacts for review by the developer. These surveys reduce the threat to birds to minimal levels; cats, hunters, glass windows, and communications towers are far more dangerous to birds.
- Post-construction monitoring of bird kills at several wind sites in a wide variety of geographic locations (Vansycle Ridge, Oregon; Ponnequin, Colorado; Foote Creek Rim, Wyoming; Buffalo Ridge, Minnesota; Searsburg, Vermont; Garrett, Pennsylvania) has validated the industry's ability to assess risk to birds and build safe projects.
- 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. In 1994, shortly after raptor deaths in California's Altamont Pass became a general concern, the wind energy industry joined with other stakeholders (government officials, environmental groups, utilities) to form the National Wind Coordinating Committee (NWCC), a multi-stakeholder collaborative aimed at addressing the wind/avian issue and other issues affecting the industry's future.
- At the same time, the industry began funding research on bird kills and adopting practices (equipment changes to reduce bird electrocutions, use of tubular towers to reduce perching, testing of anti-perching devices and other measures) aimed at minimizing the impact of Altamont and other wind projects on birds. (It should be noted that while raptor deaths in Altamont Pass, one of the first and oldest wind projects, are definitely an issue, the overall number of bird kills there is very low—approximately one bird for every five turbines in the pass per year.)
- The wind industry has supported development by the NWCC of a siting handbook and avian site evaluation guidelines used by wind developers to screen sites and provide research-based analysis that can avoid potential problems. The wind industry has also supported the NWCC's sponsoring of a series of national research summits examining wind energy's impacts on birds and bats. At these meetings, scientists present the latest research findings and talk with other stakeholders about research gaps and future needs. See www.nationalwind.org for more information.
- Even sites with high use by protected species need not necessarily be off limits to wind. At Foote Creek Rim in Wyoming, pre-construction surveys found that golden eagles frequently used the mesa's edge for hunting. The wind farm developer voluntarily redesigned the site to move the planned turbines 50 meters away from the rim, and the subsequent number of eagle deaths at the site has been so small that the technical advisory committee has been discontinued. A baseline and final mortality study for this project can be found at http://www.west-inc.com/wind_reports.php.

- Prior to 2003, bat kills at wind farms studied were generally low. However, the frequency of bat deaths at a newly-constructed wind farm in West Virginia in 2003—far higher than at wind plants elsewhere in the U.S.-- has caused concern. In response, AWEA and several of its member companies have 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. <http://www.awea.org/news/news040303bat.html>
- The wind industry is currently engaged in discussions with the Federal Aviation Agency (FAA) aimed at reducing the aviation safety lighting required on wind projects. One goal of this effort is to ensure that turbine lights do not attract migrating birds on foggy nights—a phenomenon that is believed to have contributed to mass kills at some very tall communications towers and other structures in the past.

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