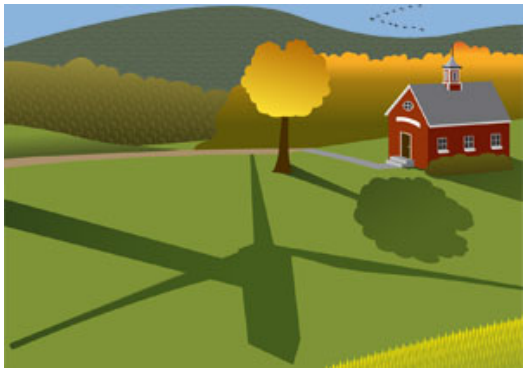
Wind Energy: Claims and Evidence-Working Document

Wind power is a contentious topic when discussing renewable energy. On a national and state level, much debate is occurring. Local newspapers have printed claims about the use of wind power that are sometimes contrary to evidence. These claims are listed and examined using academic research and on-the-ground expertise about the wind energy field.

Health and Safety

Claim: Low frequency vibrations from the turbines cause illness, headaches, and nausea, referred to as wind turbine syndrome.

Evidence:
According to research by the Minnesota Department of Health, most health complaints from wind turbines are headaches and sleeplessness. These types of complaints increase when low frequency noise is higher than 35 decibels (dB (A)) [1] (the sound equivalent of a running refrigerator, or a wind turbine at 304 meters/1,000 feet).[2] Complaints also were more likely when the turbine was within view. The issue of low frequency vibrations is not well understood. Sensitivity to these vibrations differs widely in people.[3] The peer-reviewed status of Dr. Nina Pierpont's published concept of "wind turbine syndrome" is widely contested. More research is needed on the topic.



Claim: Shadow flicker, the strobe-light effect on nearby homes from the turbine blades, is annoying for residents.

Evidence:
The impact of shadow flicker, the shadow cast from movement of turbine blades that creates changes in light intensity, illustrated in the image to the left, will likely be minimal or nonexistent due to required setback of the turbine, typically at distance of 300 meters (0.19 miles)

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[1] Minnesota Department of Health, Environmental Health Division. 2009. "Public health impacts of wind turbines." http://www.windaction.org/documents/21436.

[2] Energy Efficiency & Renewable Energy. July 2008. "20% Wind Energy by 2030." U.S. Department of Energy. Accessed Aug 2009. http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf.

[3] National Research Council. 2007. "Environmental Impacts of Wind-Energy Projects." Committee on Environmental Impacts of Wind Energy Projects, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies. 346 pg.

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or greater.[4] At these distances, shadow flicker will only occur when the sun is low around dawn or dusk. The sunlight is less intense at this time, reducing the impact. The shadow flicker in these instances in the worst-case scenarios will average between 1/2 hour and 1 ½ hours a day.[5] Software does exist to predict and plan for shadow flicker.[6] Some county ordinances require landscaping to minimize any potential shadow flicker resulting from the wind turbine, while one county in Wisconsin requires shutting down the wind turbine until flicker can be remedied if it does occur. However, many county ordinances do not have specific requirements for shadow flicker.[7]

Flicker frequency is not harmful to humans. According to the Epilepsy Foundation, only frequencies above 10 Hertz (Hz) are likely to cause epileptic seizures. Rotor frequency from wind turbines varies from 0.6-1.0 Hz, well below harmful frequency.[8]

Claim: Wind turbines produce loud noises, including disrupting growling sounds.

Evidence:
Wind turbines are designed with noise issues in mind. Newer turbines are much quieter due to larger blades that produce less noise while turning. In fact, 1000 feet (304 meters) from a newer turbine produces only 35 to 45 decibels, similar to the sound of a running kitchen refrigerator. Many county ordinances require at least 300 meter distance from the exterior of an existing home to the turbine.[9] These reading are taken at low wind speeds around 7 - 8 m/s, as higher winds will typically mask the noise of the turbine.[10] According to studies by the British Wind Energy Association, rural nighttime background noises, which have decibel levels from 20-40 dB (A), can aid in drowning out the sound of a wind turbine.[11] Several studies cited in the Minnesota Department of Health assessment do show that some survey respondents reported annoyance, headaches, and sleeplessness that they contribute to wind turbine noise. This study recommends a setback distance of ½ mile or 804 meters.[12] The effects of a wind farm as a whole can have a greater noise impact, due to the accumulation of multiple turbine noises.[13]

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[4] Nielsen, Arne. 2003. "Shadow Flicker Briefing." State of Washington Energy Facility Site Evaluation Council (EFSEC). http://www.efsec.wa.gov/wildhorse/deis/apendices/05%20Wind%20Engineers%2011-20-03%20memo.pdf.
[5] See reference 3.
[6] See reference 1.
[7] Oteri, F. December 2008. "An Overview of Existing Wind Energy Ordinances." National Renewable Energy Laboratory. http://www.windpoweringamerica.gov/pdfs/policy/2008/ordinances_overview.pdf.
[8] See reference 3.
[9] See reference 2.
[10] See reference 3.
[11] British Wind Energy Association. 2007. *Noise from Wind Turbines: The Facts*. London: BWEA. http://www.britishwindenergy.co.uk/pdf/noise.pdf.
[12] See reference 1.
[13] See reference 3.

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Claim: Wind turbines are unsafe to operate: they burn up quickly, can topple, etc.

Evidence:
Properly constructed and maintained wind turbines are very safe to operate. All of the equipment is tested, including the rotor blades, to ensure there will not be any chance of mechanical failure under normal operating conditions. In case of severe weather conditions, which might compromise the safety of the towers, wind turbines are equipped with two sets of brakes. Aerodynamic brakes are built at the tip of rotor blades, using spring mechanics so that they will still work even in the case of power outages. These brakes respond to the hydraulic pressure within the system, and can effectively and safely stop the blades within a couple of rotations. The mechanical brake system is most often used as a backup to the aerodynamic brakes, but it can also be used as a "parking brake," to keep the rotor blades from turning. [14]

Although acts of nature such as tornados, high winds, etc., can occur and are unavoidable, other specific safety risks associated with wind turbines can be addressed. First, in areas with severe winters there is a risk of icing on the blades. The popular conception is that chunks of ice could potentially fly off the blades at an extremely high velocity and injure nearby residents. In actuality, the buildup of ice on the blades will reduce the speed of the blades, causing the turbine to shut down. Even before automatic shutdown, safety issues associated with ice throws are mitigated with the setback distance required for noise by county ordinances.[15] According to Mick Sagrillo, American Wind Energy Association consultant, "realistically, this situation is no more dangerous than being near a tree covered with ice. In fact, because the weight of ice often causes branches to break, ice-laden trees are actually more dangerous than iced wind turbine blades. Unlike trees, towers are specifically designed to withstand heavy ice loads."[16]

Surprisingly, the most common cause of damage to wind turbines is vandalism. Mick Sagrillo has stated,[17] "The most frequently filed vandalism claim involves guns being fired at turbine blades or generators. In either case, damage can be substantial. I also have repaired damage which has been traced to juveniles undoing guy cables which caused a guyed tower to come crashing down."

Contrary to public opinion, there is an incredibly low risk for personal injury or fatality associated with wind farms. Worldwide, only 20 people died due to wind turbines, either directly or indirectly, from the 1970's to 2003. Most of these fatalities were caused by a fall from the wind towers or turbines.[18] Most of these accidents are preventable with common-sense safety measures. In many of the cases where a worker fell from a wind turbine, no fall protection measures were used. With proper safety measures in place, wind turbines are safe for workers and citizens alike.

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[14] Danish Wind Industry Association. 2003. "Wind Turbine Safety." http://www.talentfactory.dk/en/tour/wtrb/safety.htm.
[15] American Wind Energy Association. 2009. "Wind Web Tutorial, Wind Energy and the Environment." http://awea.org/faq/wwt_environment.html.
[16] Sagrillo, Mick. 2009. "Small Wind, Zoning IV, Perceptions/Local Concerns." American Wind Energy Association. http://www.awea.org/smallwind/sagrillo/ms_zoning4.html.
[17] Sagrillo, Mick. 2009. "Small Wind, Insuring Your Wind System, Potential Insurance Needs/Costs." American Wind Energy Association. http://www.awea.org/smallwind/sagrillo/ms_insur2.html.
[18] Gipe, Paul. 2003. "A Summary of Fatal Accidents in Wind Energy." http://www.wind-_works.org/articles/ASummaryofFatalAccidentsinWindEnergy.html.

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Economics

Claim: Wind energy is heavily subsidized per kilowatt hour, second only to solar energy. Two-thirds of the project costs of wind farms are funded by federal tax credits and write-offs.

Evidence:
Wind energy is 1.8% of electricity used in our country as of May 2009.[19]

- On a kilowatt hour basis, wind is more subsidized than other electricity sources, receiving 2 cents per kilowatt hour more than coal in 2007.[20]
- However, on an absolute basis, other energy sources have benefited from decades of subsidies (e.g. coal, oil, natural gas), and of the $7.4 billion spent to subsidize energy sources in 2007, only 10% went to subsidize wind energy. Coal, oil, and natural gas consumed 69% of subsidies to the energy sector.[21]

Tax credits that benefit wind have been in the form of a production tax credit (PTC) based on annual production of electricity. This tax credit is 1.5 cents per kilowatt hour in 1992 dollars. It is adjusted for inflation each year.[22] The American Recovery and Reinvestment Act of 2009 extended the PTC until January 1, 2013 for projects placed in service by January 1, 2010. The act also permits wind companies to choose between the PTC and an investment tax credit (ITC) of 30 percent. An April 2009 report from the Energy Information Administration cites a report from the National Renewable Energy Laboratory finding that, due to the current economic environment, many companies are favoring the ITC option.[23]
*The ITC is a tax credit that can be applied for the purchase of equipment such as renewable energy systems.[24]

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[19] Electric Power Monthly. 2009. "Net Generation by Energy Source: Total (All Sectors)." Energy Information Administration. U.S. Department of Energy. http://www.eia.doe.gov/cneaf/electricity/epm/table1_1.html.
[20] Energy Information Administration. 2007. "Federal Financial Interventions and Subsidies in Energy Markets 2007, Chapter 5 Subsidies per Unit of Production." U.S. Department of Energy. http://www.eia.doe.gov/oiaf/servicerpt/subsidy2/pdf/chap5.pdf. Electric Power Monthly. 2009. "Net Generation by Other Renewables: Total (All Sectors)." Energy Information Administration. U.S. Department of Energy. http://www.eia.doe.gov/cneaf/electricity/epm/table1_1_a.html.
[21] Energy Information Administration. 2007. "Federal Financial Interventions and Subsidies in Energy Markets 2007, Chapter 5 Subsidies per Unit of Production." U.S. Department of Energy. http://www.eia.doe.gov/oiaf/servicerpt/subsidy2/pdf/chap5.pdf.
[22] Energy Information Administration. 2005. "Production Tax Credit for Renewable Electricity Generation." U.S. Department of Energy. http://www.eia.doe.gov/oiaf/aeo/otheranalysis/aeo_2005analysispapers/prcreg.html.
[23] Energy Information Administration. 2009. "An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook." U.S. Department of Energy. http://www.eia.doe.gov/oiaf/servicerpt/stimulus/pdf/sroiaf(2009)03.pdf.
[24] See reference 2.

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Claim: Leases often don't require developers to remove turbines if the company goes bust.

Evidence:
County ordinances are important to this issue. Many counties around the county considering or permitting for wind farms have ordinances requiring decommissioning of turbines. Most of these require removal of the turbine and base at least 4 feet into the ground.[25] Concrete foundations in Indiana are between 7 and 9 feet deep.[26] Decommissioning impacts are similar to those of initial construction, with disruption to surrounding land, possibility for increased soil erosion, and increased water runoff. Removal of the turbine is important due to the hazardous waste substances contained within, such as grease, hydraulic fluid, and lubricating oil.[27] While the Indiana Utility Regulatory Commission has generally declined to exercise jurisdiction over wind farms, IURC has stipulated some requirements of wind farm operators, including ensuring financial ability to decommission the turbines and the presentation of an ordinance outlining removal plans.[28]

Claim: Wind farms are expensive, costing as much as a coal-fired power plant.

Evidence:
A cost comparison is listed below for wind energy and pulverized coal energy. Capital, maintenance, and fuel costs are compared and a levelized cost comparison is also listed. The levelized cost of energy is the annual cost of recovering the total capital costs plus the recurring costs such as operations and maintenance and royalty payments divided by annual expected output.[29]

Costs[30]	Pulverized Coal	Wind
Capital	$2,800 - $5,925/kW	$1,900 - $2,500/kW
Maintenance	$5 - $10/MWh	$13 - $20/MWh
Fuel	$22 - $30/MWh	$0/MWh
Levelized Costs	$78 - $144/MWh	$57 - $113/MWh

[25] Energy Efficiency and Renewable Energy. 2006. "Wind Energy Guide for County Commissioners." U.S. Department of Energy. http://www.windpoweringamerica.gov/pdfs/wpa/county_commissioners.pdf.
[26] Park, Peter. "Wind turbine foundation." E-mail interview with Horizon Wind Energy Project Manager. 14 Oct. 2009.
[27] U.S. Department of the Interior, Bureau of Land Management. 2005. "Wind Energy Final Programmatic Environmental Impact Statement (EIS)." http://www.windeis.anl.gov/documents/fpeis/index.cfm.
[28] Indiana Utility Regulatory Commission. 2009. Original Hearing on Meadow Lake Wind Farm LLC. http://www.in.gov/iurc/files/43678order_081909.pdf.
[29] Reeves, Ari. November 2003. "Wind Energy for Electric Power, A REPP Issue Brief." Renewable Energy Policy Project.http://www.repp.org/articles/static/1/binaries/wind%20issue%20brief_FINAL.pdf
[30] Lazard. Feb 2009. "Levelized Cost of Energy Analysis-Version 3.0." www.lazard.com.

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Claim: Coal-fired power plants run at 80% capacity while wind energy farms will only operate at 20-30 % capacity most of the time.

Evidence:
An understanding of capacity is necessary. The capacity factor is the actual amount of power produced over time divided by the power that would have been produced if power generator operated at maximum output 100% of the time.[31] It is true that wind power is not able to run at the higher capacity factor average of 73.6% (2007 figures)[32] of a coal-fired plant, but that is due solely to fuel issues. The wind does not always blow at high enough speeds to produce electricity with current technology at full capacity. In Indiana in first tier sites, those with the best site for winds, capacity is between 30 and 35%. Future sites that are second or third tier will have capacities of 25-30%.[33] However, wind farms are producing energy –of some amount- 65-90 percent of the time, just at less than full capacity.[34]

Claim: Wind energy generation is hard to integrate into the electric grid and requires conventional fuel backups.

Evidence:
All types of electricity production require backups. Utilities system operators must balance the amount of electricity precisely. This requires the use of reserve power for all energy sources. These reserves are typically equal to 5-7% or more of total generation.[35] In this sense, wind energy would require backups, just as all other sources require during change in electricity demand, plants going on- or offline, etc. The variable nature of wind does not have to be a challenge for the utility operator. Regions with high penetrations of wind energy tend to have hundreds or thousands of turbines spread over hundreds of miles. This results in many minutes or hours for wind generation in a region to change when wind stops blowing at one location.[36] Forecasting equipment being developed by the National Center for Atmospheric Research (NCAR)[37] in conjunction with the National Renewable Energy Laboratory (NREL) will allow advanced knowledge of wind speeds by several hours. This will allow utility operators to balance the energy generation load with wind energy generation and limit the need to rely on reserve power. Advanced knowledge of significant wind events will allow the operators to make critical decisions about powering down fossil fuel-based generation and relying more heavily on alternative energy while still meeting the needs of consumers.

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[31] Renewable Energy Research Laboratory. "Wind Power: Capacity Factor, Intermittency, and what happens when the wind doesn't blow"? http://www.ceere.org/rerl/about_wind/RERL_Fact_Sheet_2a_Capacity_Factor.pdf.
[32] Energy Information Administration. January 2009. "Figure ES 3. Average Capacity Factor by Energy Source." http://www.eia.doe.gov/cneaf/electricity/epa/figes3.html.
[33] Cummings, Paul. "Capacity factor-Indiana wind farms." E-mail interview discussing current capacity factor for Indiana wind farms. 01 Sept 2009.
[34] See reference 31.
[35] American Wind Energy Association. 2005. "20% Wind Energy by 2030: Wind, Backup Power, and Emissions." http://awea.org/pubs/factsheets/Backup_Power.pdf.
[36] See reference 35.
[37] University Corporation for Atmospheric Research. 2009. "NCAR Forecasts Will Help Xcel Energy Harness Wind." http://www.ucar.edu/news/releases/2009/xcel.jsp.

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Experience has indicated that intermittent power from wind energy will have a negligible cost impact when there are low concentrations of wind power present in an area. Wind can be directed into an existing power grid and replaces traditional forms of electricity megawatt-hour for megawatt-hour. According to the Renewable Energy Research Laboratory, in areas where higher concentrations of wind energy are present, the integration of the wind power will have economic impacts—typically 2-5 tenths of a cent per kWh—but studies have shown that the cost is not prohibitive.[38] However, a January 2009 study done by PJM Interconnection—a regional transmission operator with territory in northeast and north central Indiana[39]—forecasts a reduction in locational marginal prices (or wholesale prices) of $5- 5.50/MWh, and a resulting reduction in consumer utility bills of $3.50- 4 monthly with high wind penetration of 15,000 megawatts.[40]

During high-speed winds, a lot of power can be generated. In stand-alone systems that are not connected to the power grid, excess energy can be stored in batteries and capacitors. Occasionally, back-up generators will be needed when this stored power begins to run low. However, for most Indiana residents, wind power will be fed directly into the existing grid system. Thus, no new back-up systems will need to be installed. According to the U.S. Department of Energy, "When wind is added to a utility system, no new backup is required to maintain system reliability."[41]

Claim: Wind farms decrease surrounding property values.

Evidence:
A 2008 study by Lawrence Berkeley National Laboratory[42] was conducted to assess the claim that wind farms devalue property adjacent to or within the view shed up to 1 mile. The preliminary results indicated that no statistical evidence was found between property values and proximity to wind turbines. Over 8,000 homes nation-wide were studied in eleven areas, assessing for "industrialization" from wind farms, scenic vistas disturbance, and nuisance effects, including health.

Similarly, a study was conducted in 2003[43] on ten sites nation-wide with wind farms of 10 megawatt installed capacity or greater from 1998 to 2001. Although a few results were not consistent in each of three studies conducted per site, results gathered in total showed that most property values actually increased when compared with a control group, not supporting the claim that property values will decrease near a wind farm. Also,

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[38] See reference 31.
[39] PJM. 2009. "Map of PJM territory served." http://www.pjm.com/about-pjm/how-we-operate/~/media/about-pjm/pjm-zones.ashx.
[40] PJM. 2009. "Potential Effects of Proposed Climate Change Policies on PJM's Energy Market." http://www.pjm.com/~/media/documents/reports/20090127-carbon-emissions-whitepaper.ashx.
[41] Wind Powering America Fact Sheet Series. 2005. "Wind Energy Myths." http://www.nrel.gov/docs/fy05osti/37657.pdf
[42] Hoen, Ben and Ryan Wiser. 2008. "The Impact of Wind Facilities on Residential Property Values, What We Know And What We Don't Know." Lawrence Berkeley National Laboratory. http://www.regionalwind.org/images/Hoen_Wiser_-_10_Area_Preliminary_Results_-_LBNL_-_RWEI_Nov_08.pdf.
[43] Sterzinger, George, Fredric Beck, and Damian Kostiuk. 2003. "The Effect of Wind Development on Local Property Values." Renewable Energy Policy Project. http://www.repp.org/articles/static/1/binaries/wind_online_final.pdf.

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property values will increase due to the lease payments from the wind project owner to those with turbines on their land. These lease payments average $6,000 to $8,000 per turbine per year in Indiana.[44]

Additional work is needed in this area, although studies to date have found little evidence to support the claim that wind farms negatively impact property values, as cited by Wind Powering America, a program of the Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy.[45]

Land and Wildlife

Claim: Environmental impacts of manufacturing wind turbines make wind an unclean energy source.

Evidence:
Reports by Vestas[46], a large wind turbine manufacturer based in Denmark and operating in the United States—including wind turbines in use in northern Indiana—indicate that the lifecycle impact of wind turbines is quite small. Lifecycle refers to the environmental footprint of the wind turbine from extraction of raw materials used to manufacture the turbine through all processes until dismantling and disposal of the turbine, its foundation and transmission grid. These assessments of wind turbines from 1.65 MW to 3.0 MW[47] in size show that the time that a wind turbine takes to produce as much energy as it has consumed in its lifecycle (referred to as the energy balance) is 7.2 months and 6.6 months, respectively. The footprint of wind turbines, then, is shown to be very small. At the end of the lifecycle of a wind turbine, around 80% of the turbine is recyclable, reducing the need for further extraction of raw materials.[48] The U.S. Department of Energy's report *20% Wind Energy by 2030*[49] states that a scale-up of industries related to materials for manufacturing wind turbines will be needed to achieve the goal of 20% wind energy. This report specifies the expected need for each material, but states that the amount of steel and copper needed, for example, are only a small percentage of current output and would not affect the overall production. The report also states that more manufacturing facilities will be needed for some resources. The environmental impact of building or enlarging these manufacturing facilities is not mentioned, but will nevertheless be a concern for the future.

[44] Park, Peter. Telephone interview with Horizon Wind Energy Project Manager Peter Park. 15 Sept 2009.
[45] See reference 2.
[46] Vestas Wind Systems. 2009. "An environmentally friendly investment, Lifecyle Assessment of a V82 1.65 MW onshore wind turbine."
[47] Vestas Wind Systems. 2009. "An environmentally friendly investment, Lifecycle Assessment of a V90 3.0 MW onshore wind turbine."
[48] See reference 46.
[49] See reference 2.

Claim: Wind farms, often located on ridge tops or in mountain passes, have broad environmental impact as they require quarter-acre clear zones for the turbines and long cuts through forest for permanent service roads.

Evidence:
Wind farms may be located on ridge tops or in mountain passes, but in Indiana, the counties where wind farms have been planned or constructed are primarily agricultural flat land.[50] For example, in 2 counties in Indiana where wind farms are planned or have been constructed, land use ranges from 78-94% agriculture.[51] These areas are able to continue agriculture around the turbines. The turbines and roads consume a small fraction of land. In an Oregon agricultural area, an 83.8 MW wind farm with 127 turbines is being planned over 15 square miles or 9,600 acres of land. The land surface that will actually be occupied by turbines, access roads, and meteorological towers is 60 acres.[52] This is 0.6 percent of the land surface that is dedicated to the wind farm while 99.4 percent still is usable for other purposes. Other estimates state that wind farms can occupy up to 5 percent of land, while 95 percent is still available for agricultural purposes.[53] At Fowler Ridge Wind Farm in Benton County, Indiana, a 50,000 acre farm, only 2,500 acres will be taken out of agricultural production to produce wind energy.

Claim: Increased development of wind energy will disturb more land than other electricity sources such as coal and nuclear, creating a negative environmental consequence.

Evidence: A study funded by The Nature Conservancy and Northwestern University[54] assessed the amount of land in each habitat type in the United States that would be disturbed under different federal energy policies. Conventional forms of energy such as coal and nuclear are forecasted to disturb less land under an energy policy that encourages more growth in these areas. This is due to the large amount of electricity that is produced at each plant and the relatively small amount of land that a coal or nuclear plant would require. Wind energy, conversely, would require large amounts of land to develop multiple wind farms across the country, but mainly in the temperate conifer forests and temperate grasslands. This is due to the need to construct wind turbines across a landscape to harness the energy from wind. Importantly, the study also details the types of land use required for each electricity source. Coal and nuclear require clearing of all natural habitat for plants, as well as the land affected by the mining of coal. Wind energy requires only 3 to 5 percent of the land be cleared of all natural habitat and the remaining 95 percent impacted by fragmenting habitats, species avoidance behavior, and the potential impact to birds and bats if sited improperly. The study recommends minimizing impacts to

[50] State of Indiana. "myLocal.IN.gov." Accessed 2009. http://www.in.gov/mylocal/.
[51] National Agricultural Statistics Service. "Indiana County Estimates." United States Department of Agriculture. http://www.nass.usda.gov/Statistics_by_State/Indiana/Publications/County_Estimates/index.asp.
[52] National Wind Coordinating Committee. 2002. "Permitting of Wind Energy Facilities, A Handbook." http://www.nationalwind.org/publications/siting/permitting2002.pdf.
[53] American Wind Energy Association. 2009. "Wind Energy and the Environment." http://awea.org/faq/wwt_environment.html.
[54] McDonald RI, Fargione J, Kiesecker J, Miller WM, Powell J, 2009 Energy Sprawl or Energy Efficiency: Climate Policy Impacts on Natural Habitat for the United States of America. PLoS ONE 4(8): e6802. doi:10.1371/journal.pone.0006802.

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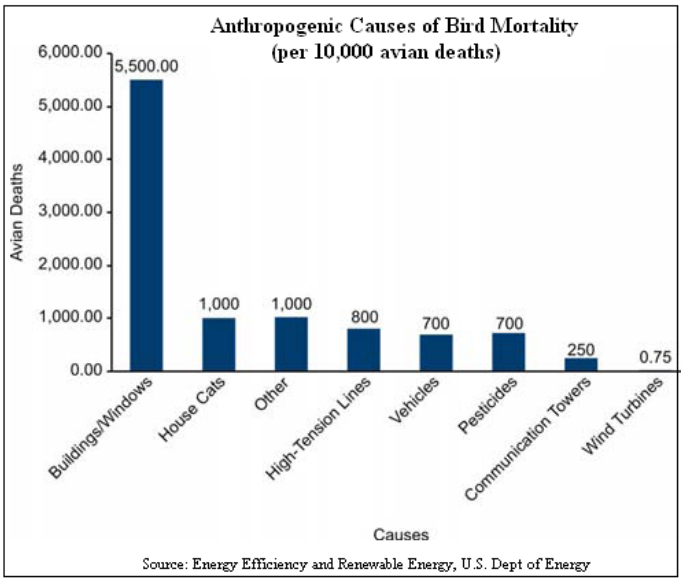
diversity by planning and appropriate site selection, as well as utilizing already disturbed areas in each habitat type.

Claim: Wind turbines are efficient killers of birds and bats.

Evidence:

Improvements in technology such as slower moving turbine blades that are more visible to wildlife and consideration of bird migratory paths have reduced the impact of wind farms on bird and bat populations.[55] Some other preventative technologies being tested are light and sound equipment that will safely and passively drive wildlife away from the turbines. Wind power engineers are also researching the possibility of reducing turbine speeds during times of peak bird activity, to further protect avian populations, according to Laurie Jodziewicz, manager of siting policy at the American Wind Energy Association.[56]



Despite an isolated situation at a wind farm built in the 1980s at Altamont Pass in California where high raptor deaths have been reported due to migration paths, other wind farms have considered these issues and planned turbine placement to avoid these areas. Wind farms are a low anthropogenic killer of birds and bats, as shown in the table to the left[57], while communication towers and building windows provide significant fatalities. According to a USGS biologist,[58] more bat fatalities than expected have been recorded, but this has occurred with non-endangered species high in number. No significant impacts on bird or bat species have been recorded to date nor are expected.[59]

[55] Wind & Hydropower Technology Program, Energy Efficiency & Renewable Energy. Aug 2009. "Frequently Asked Questions." U.S. Department of Energy. Accessed Aug 2009. http://www1.eere.energy.gov/windandhydro/faqs.html.
[56] Reis, Patrick. 2008. "Wildlife: Lawmakers push bill to address bird population decline." http://www.awea.org/newsroom/pdf/WILDLIFE_Corrections_080711.pdf.
[57] See reference 2.
[58] Cryan, P. 2006. "Overview of What We Know About the Bat/Wind Interaction as of November of 2004." Presented at the National Wind Coordinating Collaborative (NWCC) Wildlife Research Meeting VI, November 14, San Antonio, TX. http://www.nationalwind.org/events/wildlife/2006-3/presentations/bats/cryan.pdf.
[59] See reference 2.

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