

## Wind Power in Pennsylvania: It Isn't Easy Being Green<sup>1</sup>

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### ABSTRACT

The generation of electricity by wind is a growing industry in Pennsylvania. While wind energy is certainly an attractive alternative to the pollution produced by fossil fuel power plants, all potential environmental impacts must be measured if electricity produced this way is to truly qualify as "green energy." Surprisingly, only minimal environmental studies need to be done to site a wind farm in Pennsylvania. Improper siting of some wind farms in the U.S. has impacted migratory bird, resident bird, and bat populations. We present bird-impaction data from an industrial facility 30 km south of a proposed wind farm in Luzerne County, Pennsylvania, that suggest caution in the blind embrace of this energy technology. Siting decisions are made at local government levels and are primarily based on economic incentives. We argue (a) that this energy alternative must incorporate robust site-specific impaction studies at each wind farm to demonstrate effects throughout the Commonwealth, and (b) that local government officials be given the guidance necessary to encourage and provide environmental oversight to wind farms located in their areas.

[J PA Acad Sci 79(2/3): 75–80, 2005]

### INTRODUCTION

The production of electricity by wind power is increasing in Pennsylvania. Estimates by organizations advocating this alternative energy project that some 400 megawatts (MW)

will be produced within the Commonwealth by planned wind plants and private owners by 2006 (<http://www.windenergynow.org/windfarms.html>). The American Wind Energy Association maintains that Pennsylvania will produce 10% of its electricity by 2010 (<http://www.awea.org/pennsylvania>). The Mid-Atlantic Renewable Energy Coalition (MAREC) has created an initiative called the Pennsylvania Wind Campaign to enlist individuals and businesses to buy electricity generated by Pennsylvania wind plants. MAREC's coalition includes the U.S. Department of Energy, the Environmental Protection Agency, and nonprofits and businesses in the renewable energy industry. One of their major recruits is the Pennsylvania Consortium of Interdisciplinary Environmental Policy (PCIEP), a group comprised of the Pennsylvania Department of Environmental Protection, Department of Conservation and Natural Resources, and some 50 colleges and universities across Pennsylvania. Over 30 colleges and universities have agreed to purchase electricity through the Wind Campaign even though the cost can be 20–25% higher than electricity produced by fossil and nuclear fuels ([http://www.paconsortium.state.pa.us/wind\\_power\\_purchases.htm](http://www.paconsortium.state.pa.us/wind_power_purchases.htm)). Their motivation is to lead their communities toward this alternative energy by acting as both advocate and role model. For example, Carnegie Mellon University committed to purchasing 5% of its total electricity, or the equivalent of the entire output of a single wind turbine, beginning in 2002. The University of Pennsylvania has purchased the entire output of five wind generators. Students at Eastern College requested and received a tuition hike towards purchasing wind-generated electricity on campus.

The Wind Campaign lauded the Carnegie Mellon purchase by stating that it resulted in "a reduction of carbon dioxide equivalent to planting nearly 19,000 trees, or taking 1,000 cars off the road on an annual basis." A flier printed by the American Wind Energy Association ([http://www.windenergynow.org/env\\_benefits.pdf](http://www.windenergynow.org/env_benefits.pdf)) states that, "Pennsyl-

<sup>1</sup>Submitted for publication 25 February, 2005; accepted 19 July, 2005

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vania's 10.6 megawatts of wind power reduce acid rain emissions (sulfur dioxide) by 220 tons per year, smog emissions (nitrogen oxides) by 70 tons per year, and greenhouse gas emissions (carbon dioxide) by 26,000 tons per year." How are these reductions accomplished when none of the wind turbines have actually replaced any fossil-fuel plant currently in operation, and are unlikely to replace fossil plants in the future? Will energy conservation initiatives in Pennsylvania be affected by the promotion of wind energy? What are the environmental costs of this alternative energy source to Pennsylvania's natural resources? With economics as the primary motivation, are local governments knowledgeable enough, and concerned enough about environmental effects, to make wise development decisions for these facilities? These are the questions we consider in this report.

## POLLUTION REDUCTION

When compared to the pollution emissions from fossil-fuel power plants, wind energy is certainly friendlier to the environment. With zero emissions, wind energy easily outpaces the large amount and many types of pollutants exiting fossil plants. However, the argument that the establishment of wind plants in Pennsylvania will reduce fossil-fuel emissions seems tenuous at best.

The average capacity factor assumed for wind turbines across the country is 30-33% ([http://www.ewe.org/pubs/actsheets/WindEnergyBasics\\_2004-06-18.pdf](http://www.ewe.org/pubs/actsheets/WindEnergyBasics_2004-06-18.pdf)). This means that on average, most turbines are expected to operate less than or equal to a third of the time. Consequently, it seems clear that the traditional energy sources such as coal must continue to be ready to meet the immediate demand for electricity. Until the actual substitution of wind-generated megawatts for fossil-generated megawatts occurs, no net reduction in fossil air pollutants can be realized. When we posed this question to Wind Campaign personnel, they agreed that the traditional sources would be needed until a threshold of wind generation is reached. Apparently they envision a point in the future when additional electricity needs can be offset by wind energy. When asked what the estimated threshold was, none was available.

Some wind-power proponents have argued that wind energy might eliminate the need to build additional fossil plants. However, this does not seem likely given the unreliability of this energy source versus the reliable demand for electricity. The great majority of power plants in the U.S., and around the globe, are base load power plants. Base-load plants, usually fired by coal or nuclear, provide consistent electricity to the transmission grids independent of electricity demand. They are designed to operate at all times except during scheduled repairs or refueling, or when malfunctions occur. During periods when more electricity is needed, as for example hot weather when many air conditioners are used, peak load power plants are added to the grid. Peak plants, most often fired by natural gas, are usually used only

when market demand for electricity can offset the cost of this expensive fuel. The inherent unreliability of wind energy disqualifies this technology as both base and peak-load power, although it can contribute electricity to the grid during both base and peak periods. Perhaps at some time in the future, if large amounts of energy can be stored effectively, wind energy can graduate to peak-load power. Until then, wind energy is a transient addition to the grid.

The number of wind turbines, and subsequent land area, required to replace a single 500-MW fossil plant is astonishing. Even with individual wind-turbine output commonly in the 1.5-MW range, 300-400 constantly-turning turbines would be required to match the output of one fossil plant. Hypothetically, at a 33% capacity factor, three times as many wind turbines would be required to make up the loss in total operating hours. A typical wind plant requires about 0.05 km<sup>2</sup> per wind turbine (<http://www.auswea.com.au/about/faq.htm#space>), which means that the space required for a wind plant to replace the 500-MW fossil plant could be as much as 50 km<sup>2</sup>. The ecological footprint of a facility of that size would be significant and usher in many additional environmental concerns.

## ENERGY CONSERVATION

In the last two decades the United States has reaped seven times as much energy from conservation practices as from all the new oil wells, coal mines, and power plants opened during that time (Lovins and Lovins 1998). The possible effect of wind power on energy conservation initiatives and attitudes in Pennsylvania needs to be monitored. This is especially true because conservation is not a word found at the forefront of PA Department of Environmental Protection (DEP) initiatives. A visit to the DEP's Office of Energy Technology and Development website ([http://www.dep.state.pa.us/dep/deputate/pollprev/pollution\\_prevention.html](http://www.dep.state.pa.us/dep/deputate/pollprev/pollution_prevention.html)) revealed a paucity of energy conservation information relative to energy technology information, including space devoted to promoting wind energy.

Promotions by wind power companies repeatedly stress the renewability of this alternative energy source. Will the promise of "green energy" via wind generation backfire on energy conservation strategies by promoting even more energy use? Will a perceived decrease in reliance on fossil fuels retard our thinking about the inevitable march toward energy limitations based on fossil fuels? When we asked this question of Wind Campaign personnel, they responded by stating that colleges have actually enacted more stringent conservation strategies to offset the cost of wind-power premiums. It is unlikely, however, that colleges are indicative of the general public. And even if they were, the conservation strategy seems to be very much diluted by the economic benefits from wind power that are realized by a few landowners and their respective municipalities. If Pennsylvanians are to escape the dangerous cycle of energy waste and reliance on foreign

energy sources, we must put forward a concise energy strategy that incorporates traditional energy sources, alternative sources like wind power, and energy conservation.

### NATURAL RESOURCE EFFECTS: BIRDS AND BATS

In addition to the unlikely reduction in our present reliance on traditional fuels for electricity production, and dilution of the energy conservation message, wind power also poses a threat to some of Pennsylvania's natural resources, in particular birds and bats. Many are concerned that building tall structures atop ridges will cause mortality among both migratory and resident bird and bat species. For example, wind turbines can extend 90 m or more above the terrain and, when that terrain is a ridge top, could pose a significant target for migratory birds during poor weather when flight patterns are forced closer to the ground.

The wind-power industry has invested a considerable amount of time and money in research and reports to assuage the concerns of avian mortality at wind plants. They have hired ornithological consultants to demonstrate the relatively few numbers of birds killed by wind plants versus those killed by other structures (<http://www.curryklinger.com/birds.htm>; [http://www.nationalwind.org/publications/avian/wildlife\\_factsheet.pdf](http://www.nationalwind.org/publications/avian/wildlife_factsheet.pdf); Erickson et al., 2001). Clearly, bird mortality related to collisions with buildings and other structures greatly exceeds mortality related to wind plants (Klem 1990). However, relatively few of these structures tout the "green" environmental image as the wind industry does.

The senior author witnessed firsthand bird-impact mortality at a steam electric station approximately 30 km from the proposed Bear Creek wind plant in Luzerne County. During spring and fall bird migrations in 1981 alone, 466 dead migratory birds were discovered at the base of the cooling towers (Figure 1). The most commonly killed species include red-eyed vireos (*Vireo olivaceus*), magnolia warblers (*Dendroica magnolia*), black-throated green warblers

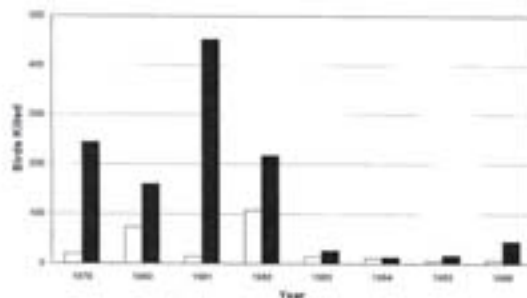


Figure 1. Birds killed by impacts with cooling towers at an electric station in Luzerne Co, PA. White bars indicate spring mortality and black bars indicate fall mortality. Data compiled from Gross et al. (1980, 1982), Gross and Montgomery (1981, 1983, 1984, 1985, 1986), and Gross (1987).

(*Dendroica virens*), and common yellowthroats (*Geothlypis trichas*). These mortalities were correlated with poor weather conditions during nocturnal migrations, when songbirds more typically flying above 150-600 m are forced nearer to the ground ([http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirdsFact\\_Sheets/default.cfm?fsht=9](http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirdsFact_Sheets/default.cfm?fsht=9)). While the cooling towers for the electric station are almost twice the height of the proposed wind turbines to be built in Bear Creek, their location next to a ridge gives them a maximum height of 378 m above mean sea level (msl). The Bear Creek wind turbines are to be located atop a ridge giving them a total height ranging from 640-701 m above msl.

Similar bird mortalities have been observed nationally. Among the more infamous studies are those at the Altamont Wind Resource Area east of San Francisco, CA. Results have shown that this large wind plant (5,400 turbines) has been responsible for the deaths of many birds, especially raptors. In the period of March 1998 through February 1999, 259 bird impactions were recorded near 685 turbines (Thelander and Ruggie 2000). A large number of these birds were red-tailed hawks (*Buteo jamaicensis*), a common bird of prey in Pennsylvania. Other wind plants in the U.S. have not had near the number of impacts that Altamont has experienced, but the effort involved in actually measuring bird mortality at these sites is uncertain (Erickson et al. 2001).

Obviously then, the location of a wind plant is an important variable in the risk associated with bird mortality at these sites. Siting of wind plants is addressed by the for-profit corporation Community Energy, Inc. on their website ([http://www.newwindenergy.com/nwe\\_product\\_faqs.html#question13](http://www.newwindenergy.com/nwe_product_faqs.html#question13)). When asked, "does wind-generated electricity have a negative impact on birds?" they replied, "No, not when wind plants are sited properly. Some of the early wind plants, specifically Altamont Pass in Northern California, have resulted in the death of raptors, such as hawks and eagles. In these areas, these birds of prey occasionally perch atop the wind turbines for a better view while hunting, and get caught in the spinning blades when the wind begins to blow. Fortunately, studies are now conducted to understand bird migration patterns to ensure the safe siting of the wind plants. Our sites have been found to be free of ground prey and bodies of water that attract birds, and are not within hunting range of raptor nests or located on bird migratory routes... The bird deaths at the Altamont Pass site should, however, be considered in context. There were 183 bird deaths there over a two-year period and not all of those were attributable to the wind turbines. In contrast, automobiles are responsible for some 57 million bird deaths a year, more than 97 million birds die by flying into plate glass each year, and about 1.5 million birds die from collisions with structures (towers, stacks, bridges, and buildings) every year—according to the Audubon Society. However, any bird deaths from wind turbines are a problem both from a moral standpoint and from the legal standpoint of injuring or killing a protected bird such as a red-tailed hawk or golden eagle."

A more recent fact sheet issued by the National Wind Coordinating Committee states that "impacts appear to vary from wind plant to wind plant." While wind-power companies point out the need for siting studies, we could not find any evidence of such studies locally, beyond satisfying the minimal environmental requirements for the Bear Creek Project. In letters from Global Winds Harvest, Inc., a company representative stated that the required environmental review for their wind plant included a wetland delineation, a stream crossing permit, a review of threatened/endangered species, a sediment control plan, and a letter from a consulting ornithologist addressing what he believes is a low probability of bird impacts (26 March 2002 and 12 July 2002, Daniel Albano, Global Winds Harvest, Inc.). However, it should be noted that the ornithologist's review did not involve a site visit, but only a review of some documentation about the site. Given the mortality data from the nearby steam electric station, it would be prudent to perform site-specific impact studies before and after wind plant construction, especially during migration periods involving poor weather conditions. These studies would ensure that this alternative energy form was truly as green as it is advertised.

Bird impact studies at wind plants could be done economically, especially when compared to the multi-million dollar investments in these facilities, and the fact that the turbines will likely generate electricity and money for decades. For example, studies could be easily designed and implemented for relatively few thousands of dollars per year involving college students as interns. What if these studies identified significant bird mortality at a wind plant? Technologies now exist, and more are under development, that can be adapted at wind plants to warn birds of impending collisions. Furthermore, the data from the nuclear plant demonstrated these remediation possibilities. A significant decrease in the number of bird impacts after 1982 was associated with the noise created by operation of the towers. Presumably, if bird impacts prove problematic for certain wind plants, noise-creating devices could be installed to help birds bypass the plants in poor weather.

There is also a growing database that suggests significant bat mortality at wind plants. A Minnesota wind plant with 359 wind turbines, operated by Xcel Energy, is reported to have killed 849 bats in 2001 and 364 in 2002 (Motavalli 2005). University of Maryland researchers recently reported significant bat mortality associated with wind plants in Pennsylvania and West Virginia (<http://www.washingtonpost.com/wp-dyn/articles/A39941-2004Dec31.html?sub=new>). They estimated that 1500-5000 bats were killed in 2004 alone. Obviously these findings present another avenue clearly needing further study before wind plants can be labeled environmentally friendly.

It is our opinion that unless wind-power companies embrace this level of environmental stewardship, their green image is tarnished. However, they themselves have raised the environmental bar by comparing themselves to traditional energy sources.

## GOVERNMENT AND ECONOMICS: THE SITING PROCESS

Siting decisions for wind plants are subject to several layers of review as well as several intergovernmental requirements. In general, Federal, state and local decision makers have jurisdiction over any wind-power site. A brief overview follows.

Federal overview of wind-power sites varies with the specific project. Any project, which involves a "major Federal action", would trigger the environmental impact statement (EIS) requirement of the National Environmental Policy Act of 1969. As a matter of course, wind power developers are required to produce an EIS as part of their project proposal. However, officers of the regional PA Department of Environmental Protection (DEP) office indicated that an EIS was not required of sites such as the Bear Creek, Luzerne County site because the project did not involve federal funds (personal communication, Mark Carman, PA DEP Region II). For the most part, the Federal role in wind-power is minimal since there are presently no Federal funds available for wind-power development and there are no wind-power demonstration projects funded by the US Department of Energy. Therefore, the direct Federal role in wind-power development is minimal. The Federal role is currently limited to certain tax policies that are designed to encourage wind-power development.

The development of wind-power is more likely to engage a state level environmental agency. In Pennsylvania, the PA Department of Environmental Protection is an active party in any siting decision in the commonwealth. A wind-power project may trigger DEP action in any of a number of areas including but not limited to the Clean Streams Law, Sewage Facilities Act, and Clean Water Act. At the very least, any construction of the wind plant will require the issuance of a construction/soil permit. Such permits are issued only after strict conditions are met to mitigate the effects of construction on stream infiltration on the construction site. Again, the actual authority to grant permission to build a wind-power project is ultimately not that of any state government. The actual authority to permit a project is left to local governments (PA Municipalities Planning Code 53 P.S. Section 10101, et. seq. [Act 247 of 1968]).

Local governments in Pennsylvania include cities, townships, boroughs, and counties. Statutory authority over zoning and planning decisions has been delegated to local government by the State Legislature through the Municipal Planning Code (PA Municipalities Planning Code 53 P.S. Section 10101, et. seq. [Act 247 of 1968]). The MPC is the enabling act which allows municipalities control over land planning and land use decisions, constrained only by the provisions of the US Constitution and the Constitution of the Commonwealth of Pennsylvania. Although the MCP requires that counties have a comprehensive plan (MPC Section 301.4), there is no requirement that municipalities [e.g. cities, townships, boroughs] have a comprehensive plan. Under the MPC, local municipalities may either have

own planning and zoning responsibilities to a county planning/zoning agency.

The decision to grant permission to build and ultimately approve a wind plant is held by the local government which has authority over planning and zoning decisions. The basic zoning issue in wind-power development is whether or not the development of a wind plant is a permitted use under the relevant zoning ordinance. The zoning ordinance in question would be either the municipal zoning ordinance or the county zoning ordinance, if the municipality has delegated zoning decisions to PA county government. The usual procedure for resolving the issue would be to have the developer apply for a construction permit from the municipal zoning officer. If the site is zoned "light industrial" or "agricultural," and if wind power production is a permitted use under the zoning ordinance, then there is no clear controversy. Zoning ordinances may not list wind power production as a permitted use. In such a case, a hearing must be held by the municipality's zoning hearing board to determine the issue. Notice is given to the applicant along with a notice to adjoining property owners and the municipality. After a hearing, the zoning board makes a decision based on hearing evidence. Appeals may be taken directly to the Court of Common Pleas of the county in which the municipality is located. Further appeals would be to the Commonwealth Court.

Proponents of projects brought before zoning boards attempt to minimize possible negative impacts of the projects by focusing on the positive impacts. In the case of a wind plant, positive impacts include an increase in the real property tax base (assessed value) and the property tax revenue stream to be expected during the lifetime of the project. Some projects have promised payments in addition to taxes as an added financial incentive to local governments. In a recent article in the *Times Leader* newspaper, Bear Creek Township officials reportedly "see wind power as a way to generate revenue and cut taxes while avoiding overdevelopment in the woodlands that make up most of the 70-square-mile township." Arguably, a wind plant will, to some extent, provide tax revenues that will replace taxes otherwise generated by traditional industrial or residential development. For every wind turbine located in Bear Creek, officials expect the township to earn \$3,000 (<http://www.timesleader.com/mld/timesleader/business/10500642.htm>). Employment impacts, both during the construction phase and the operation phase, are also inducements, though the actual permanent employment from a smaller wind plant may be minimal at best. The real incentive is the increased flow of property tax dollars to the municipality, the county, and the school district.

Obviously, given the power of local zoning officers, and the economic incentive for such projects in local municipalities, it is unlikely that most local governments would reject wind-plant projects. Only grass-roots uprisings by residents of the municipalities would likely derail these projects. Furthermore, the likelihood that zoning officials would have the environmental training to predict the possible environmental effects of a wind plant seems remote. Zoning-board mem-

bers are not required to have any specific technical training. Therefore, we would expect that companies planning wind plants in Pennsylvania would meet with little resistance from local governments. This has been the case with recent projects in Bear Creek, Luzerne County, PA and in Waymart, Wayne County, PA. So then who is the environmental watchdog for these projects?

From a governmental perspective, local government is the major actor in wind-power project decisions. One question policymakers may consider is whether or not local government is the proper venue for making decisions which have such an important impact on national energy policy. State governors and legislators struggling with the need to encourage energy development in general and alternative energy in particular may need to preempt local decision making in the development of alternative energy sources such as wind-power. A precedent for such pre-emption is found in the Telecommunications Act of 1996 which overrides local planning and zoning in the case of cellular towers. In the alternative, state government through rulemaking or training programs, may have to provide greater guidance to local officials as they make decisions to allow the construction of wind plants.

## CONCLUSION

Reliable wind power would certainly be welcomed alternative to electricity generated by fossil fuels. However, it is uncertain if this promise can be realized for Pennsylvania. Until this technology allows for the actual replacement of traditional fossil-fuel plants, the promotion of this energy as "green" is dubious. The question still remains as to the effect of wind energy on the perception of Pennsylvanians concerning energy conservation. Given the literal impacts that wind plants can have on birds and bats, it is imperative that siting decisions be fully informed. Without site-specific bird and bat-impaction studies this cannot be realized. Finally, because economics are motivating many of the decisions made by local governments that are not trained on the environmental implications of wind power, it is unlikely that these concerns will ever reach the forefront of most projects like this in the Commonwealth.

As a result, we recommend that site-specific bird and bat-impaction studies be performed for all proposed and constructed wind plants in Pennsylvania, and that studies be done to assess the affect of wind power on the perception of energy conservation needs in the state. Furthermore, we recommend that guidelines be drafted and made available to local governments dealing with wind-power projects for the conductance and monitoring of site-specific environmental studies.

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