Section IV

Siting Renewable Energy Facilities

Livia DeMarchis, Yale University

BACKGROUND

“To truly transform our economy, protect our security, and save our planet from the ravages of climate change, we need to ultimately make clean, renewable energy the profitable kind of energy . . . to support that innovation, we will invest fifteen billion dollars a year to develop technologies like wind power and solar power; advanced biofuels, clean coal, and more fuel-efficient cars and trucks built right here in America.” –President Barack Obama, 3/23/2009

General information

The United States is currently heavily reliant on nonrenewable energy sources such as coal, oil, and natural gas. As Figure 1 illustrates, recent data shows that renewables account for approximately 7% of energy consumption in the U.S. While still not a major portion of the nation’s energy supply, use of renewable energy sources has greatly increased in recent years. This session of the conference agenda will focus on the interaction of land conservation and certain types of renewable energy including wind, solar, and geothermal energy, which as of 2006 collectively provided about 10% of the total renewable energy supply in the U.S. (EIA, 2008). A separate session will be dedicated solely to biomass.

Wind

Wind turbines use the wind’s energy to create clean, renewable electricity. Wind turbines are comprised of a tower, on top of which a nacelle and a rotor blade component are attached. The size specification of an industrial-scale wind turbine differs depending on the manufacturer and the production capacity of the wind turbine in question, but industrial-scale turbines are all well over 100 feet aboveground. An industrial turbine with a lower-end production capacity has a maximum height of nearly 400 feet when one rotor blade is fully extended above the tower, and larger turbines may have a total height well above 400 feet. For utility-scale
wind energy production, many wind turbines are built in close proximity to one another to create wind plants or wind farms. These farms can take different shapes, ranging from numerous parallel rows of turbines on a windy plane to a single line of turbines built on a ridge.

Figure 1 The role of renewable energy consumption in the nation’s energy supply, 2006

Source: EIA (2008)

Geothermal
Geothermal energy sources allow the capture of heat from the interior of the Earth to produce electricity and the heating and cooling of buildings. The Earth’s heat energy can be captured from several sources: 1) the ground near the Earth’s surface that retains a temperature of around 50 to 60 F; 2) hot water or steam that can be accessed by drilling deep into the earth; and 3) geothermal reservoirs near the earth’s surface that are mostly located in Alaska, Hawaii, and western states. Utility-scale use of geothermal energy usually involves the capture and use of hot water or steam from reservoirs to power generators. Three types of geothermal power plants exist: dry steam, flash steam, and binary cycle (NREL Geothermal, 2009).

Solar
A variety of techniques exist to convert solar energy—the capture of the sun’s light and heat energy—into usable power. On a broad scale, solar energy capture is either passive or active. Attempts at utility-scale solar energy production involve active solar collection, usually using solar thermal concentrating systems or photovoltaics (PVs). PV cells are composed of two layers of semiconductor material, usually made of silicon crystals, with impurities added to give one layer a positive charge and one a negative charge. Electrons between the two differently charged layers of semiconductor are excited when sunlight enters the PV cell, and these electrons flow through thin wires in the cell, creating energy. Solar thermal concentrating systems
use “mirrors and lenses to concentrate the rays of the sun” to produce very high temperature, which can be used to create energy (Union of Concerned Scientists). The most common form of concentrating system is the parabolic trough, “long, curved mirrors that concentrate sunlight on a liquid inside a tube that runs parallel to the mirror,” and the liquid, in turn, produces steam that drives electric turbines (Union of Concerned Scientists). Currently, solar power is not as viable a utility-scale source of electricity as wind or geothermal energy, though photovoltaic power plants have been built in numerous locations in Europe and a number are in production or under construction in the U.S. The Solar America Initiative (SAI), a U.S. Department of Energy (DOE) initiative to increase the advancement of sophisticated solar energy technology, aims to make solar electricity from photovoltaics price competitive by 2015 (U.S. DOE Solar, 2009).

What are the impacts of renewable energy on land conservation?

Because they produce energy without the production of greenhouse gases that contribute to global warming, renewable energy sources can have many long-term benefits for the future health of conserved land. While beneficial for the environment and for national energy interests because they are naturally replenished and do not produce greenhouse gases or other emissions, renewable energy sources are not, however, without problems. One of the most heated debates about renewable energy recently has centered on the construction of new transmission lines to connect cities to more potential sources of renewable energy. Environmentalists have fallen on both sides of the debate, as in the case of the “Sunrise Powerlink” project proposed between San Diego and the Imperial Valley in California (The Economist, 2009). Transmission is dealt with in detail in a subsequent session paper, and the following section reviews the environmental and land conservation concerns presented specifically by wind, geothermal, and solar energy.

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Pros</th>
<th>Cons</th>
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| Wind          | • Renewable Source  
• Prevents greenhouse gas emission in energy production that contributes to global warming  
• No air pollution | • Negative Aesthetic Impacts  
• Possible industrial scale projects in previously protected areas  
• Bird and Bat Mortality  
• Habitat destruction/Land clearing for construction  
• Noise Impacts  
• Additional transmission lines  
• Erosion from access roads |
| Geothermal    | • Renewable Source  
• Prevents greenhouse gas emission in energy production that contributes to global warming  
• Very limited emissions | • Negative Aesthetic Impacts  
• Requirement of additional transmission lines  
• Potential impairment of geyser and hot-spring activity  
• Noise Impacts  
• Mineral-rich water discharge |
Photo Credit: U.S. DOE (2010)

<table>
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<tr>
<th>Solar</th>
<th>Wind</th>
<th>Geothermal</th>
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<tr>
<td><strong>Renewable Source</strong></td>
<td><strong>Industrial-scale wind, especially, has faced opposition because of its impacts on the landscape and to surrounding wildlife. The National Research Council (NRC) recently wrote a report detailing the environmental impacts of wind energy projects. Many complaints about wind farms involve aesthetic issues because in many cases wind farms involve industrial structures sited in rural and sometimes scenic areas. In the northeast, turbines are often situated on ridges, making them visible from many areas and at significant distances. The NRC study found that regulatory review processes are often inadequate at addressing aesthetic impacts (National Research Council, 2007). Other areas of concern in the permitting and development of wind energy include: impacts on birds and bats (Johnson and Arnett, 2008; Militana, 2009), noise impacts (AEI, 2009), impacts on historic places, habitat disturbance, construction impacts, and decommissioning concerns (State of Vermont Public Service Board, 2007; National Research Council, 2007). Regarding impacts to wildlife, the American Wind Wildlife Institute was created to further the goal of developing wind while protecting wildlife and wildlife habitat and has begun a number of initiatives, including landscape mapping of sensitive wildlife areas at potential wind development locations. In addition to the above concerns presented by wind development, there can be additional financial and tax challenges specific to siting turbines on land that has been preserved either by conservation easement or by sale or gift to a land trust.</strong></td>
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<td><strong>Possible new development of industrial scale projects in previously protected areas</strong></td>
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**Wind**

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**Geothermal**

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concerns in the form of noise, and muffling techniques have had to be developed to limit noise from fans in the plant cooling towers (Geothermal Energy Association). While geothermal power plants do use renewable energy, they are not necessarily completely emissions free; but, even the geothermal plants with highest emissions are “considered environmentally benign compared with fossil fuels” (Geothermal Energy Association).

**Burke, NY: A Cautionary Tale**

A wind farm in Burke, NY gained notoriety and was written up in the NY Times for charges of corruption in 2008. In at least two instances, town Board members signed private leases with the wind developer while they simultaneously negotiated to amend zoning regulations to permit the turbines. The project also caused tension between neighbors and family members, some of whom were eager to sign profitable lease options and others of whom opposed the turbines on aesthetic grounds (Confessore, 2008).

**Fenner, NY: A Success Story?**

In 2001, a 20-turbine wind project began producing energy in Fenner, NY. Since then, a local grass-roots organization, the Fenner Renewable Energy Center (FREE Center), has been founded to educate the public on the benefits of renewable energy. While it is doubtful that all of its neighbors are enthusiastic about the project, it has engendered significant community support. In 2006, a local radio station asked listeners to vote on the top-nine “wonders” of Central NY, and the Fenner wind project was one of only two manmade wonders included in the list (FREE Center).

**Figure 2  30-year land use comparison**

![30 Year Land Use Comparison](image)

*Source: Geothermal energy association. Used with permission.*

**Solar**

Solar energy is generally thought to have very little negative impact on the environment, but as illustrated in Figure 2, it does require significant land use per unit of energy generated because of the large amount of surface area needed to collect the sun's rays. Aesthetic concerns and habitat clearing are the primary issue with siting of solar technology on conserved land. In the opinion of some, “[t]he panels can be as
visible as large buildings, given the way they reflect light.” (Briggs quoted in Soto, 2007). Such aesthetic impacts, which are a problem presented by both solar panels and thermal concentrating systems, can be damaging to land conservation efforts focused especially on the preservation of scenic settings. One recent area in which solar power has created controversy is the Mojave Desert, where plans have been made to generate solar power from seven “immense arrays or mirrors, towers, and turbines” (Revkin, 2009). In addition to the solar panels and thermal concentrating systems, the transmission lines needed to carry commercial-scale solar power to end-users are of land conservation concern (Mieszkowski, 2009). Beyond aesthetic concerns, environmental and health concerns have been raised about the toxicity of manufacturing and disposing of the materials used in PV cells. For example, the heavy metal cadmium is used in cadmium telluride PVs, and there have been worries about it being released into air and water. However, these photovoltaics can be made with a very thin film of cadmium and are generally considered safe (Zweibel, Moskowitz and Fthenakis, 1998). Environmental concerns have recently also been raised about silicon PV manufacture and disposal. A *Washington Post* story about China reported that the toxic byproduct from silicon cell manufacturing had made land unusable for agriculture and a risk to health in at least one village (LaMonica, 2009).
Projections for development

As Figures 3 and 4 illustrate, the energy produced by renewables has increased over the years and it is projected to increase even more significantly in coming decades.

Figure 3  Primary U.S. energy production (quadrillion BTU)

Source: EIA overview (2009)

Figure 4  U.S. energy consumption, 1980-2030 (quadrillion BTU)

Source: EIA (June 2008)

Wind

It has been estimated that onshore wind power in America will grow from a $9 billion industry (in 2007) into a $65 billion market by 2015 (Svenvold, 2008). Already, since the 1980s, almost $28 billion dollars have been invested in wind project installations. In May 2008, the Department of Energy released its Annual Report on U.S. Wind Power Installation, Cost and Performance Trends: 2007. This report provides a detailed
look at recent trends in the growth of wind energy across the country. As of 2007, a total of 16,904 MW of wind energy production capacity had been constructed in the United States (U.S. DOE, May 2008), and in 2007 alone, enough new wind energy was installed in the U.S. to serve approximately 4.5 million households (Krauss, 2008). The average size of wind projects installed in the U.S. in 2007 was almost 120 MW, which is about double the average size of projects constructed between 2004 and 2005. The increased size of projects indicates that wind has become an increasingly “mature” source of energy and has gained more and more capacity to enter the market for domestic energy in a noteworthy way (U.S. DOE, May 2008).

As Figure 5 illustrates, wind energy has grown very significantly since the late 1990s. Wind has been the fastest growing renewable energy sector in recent years, as shown in Figure 6. Both wind and other renewables have increased in annual capacity additions between 2004 and 2007, but wind has increased at a significantly higher rate than other forms of renewable energy.

Figure 7 shows a map of onshore wind resources throughout the U.S. Some such maps have also been produced at the state level and can be useful to the land conservation community in anticipating where future wind development may be a possibility.

In terms of determining where future wind projects might go, some familiarity with relevant siting regulations may be helpful. Federal, state and local governments have myriad policies on the siting of wind facilities. Detailing the specifics of regulation is beyond the scope of this background paper; but it is helpful for the land trust community to have some general familiarity with state regulatory processes in determining whether and how to participate in wind project permitting processes. In a number of states, legislatures have given one agency jurisdiction over wind energy siting decisions. These single agencies often are utilities commissions, environmental agencies, or siting boards. When a wind developer proposes a project, the review
process by a primary agency may include “detailed adjudicatory hearings during which attorneys and expert witnesses provide information about numerous issues,” (AWEA, 2008). Permitting performed by one primary agency can have benefits for developers in that a state-issued permit may constitute a comprehensive permit that exempts a project from further state and/or local review. Instead of giving one state agency responsibility for permitting projects, some states have written model wind ordinances or guidelines that give municipalities a framework within which to review wind projects. For most proposed projects, “one or more local approvals will be required,” (AWEA, 2008). Throughout the permitting process, numerous state regulatory programs related to the environment, agricultural protection, and historic and cultural resources are likely to be triggered (AWEA, 2008).

Figure 6 Relative contribution of generation types to annual capacity additions

Source: U.S. DOE (May 2008)

Geothermal

Figure 8 shows a map of the estimated temperatures found at 6 kilometers below ground. Thermal conductivity, geothermal gradients, heat flow, surface temperature, and the thickness of sedimentary rock are all used to estimate the subterranean temperature, which cannot be measured directly through normal drilling (U.S. DOE). As Figure 8 indicates, the majority of American geothermal resources are found in the western U.S.

In the summer of 2008, the Geothermal Energy Association released a report indicating that 103 new geothermal power projects were underway in Alaska, Arizona, California, Colorado, Florida, Hawaii, Idaho, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming. Together, these new projects could provide almost 4,000 MW of new energy. In addition to these new sources, about 3,000 MW of geothermal
capacity are already online. In January 2006, a task force estimated that 15,000 MW of geothermal energy would be online by 2025, and this estimate could be exceeded given the recent pace of development (U.S. DOE, 2008).

Figure 7 U.S. wind resources map

Figure 8 U.S. geothermal resource map

Source: U.S. DOE, NREL

Solar
Solar power will likely not grow as quickly as wind power due to the more limited opportunity for profit available from this form of renewable energy. However, rapidly advancing technology that may make solar energy more economic could change this trend (Soto, 2007). Figure 9 gives a general idea of the distribution of solar radiation resources across the country, though resources may vary somewhat with weather patterns. In general, deserts, which have little cloud cover and have dry air, offer the best solar resources – in some cases more than six kilowatt-hours per day per square meter (Union of Concerned Scientists). As with similar resource maps for wind and geothermal energy, maps such as Figure 9 can help the land conservation community anticipate locations of future energy development.

In October 2008, Congress passed a solar investment tax credit that extends a 30% federal credit for both commercial and residential solar development for eight years. After the passing of this credit, industry leaders projected dramatic growth of the solar industry, with one industry insider suggesting that solar energy would be the least expensive source of electricity by 2016. As of October 2008, there were about 27 utility-scale solar projects at “various stages of development,” which could provide roughly 5,400 MW of power, but many of these were on hold as tax credits were being worked out (SEIA, 2008).

Figure 9  U.S. PV solar radiation map

How is the land conservation community responding?

When landowners in the past have sold or given away conservation easements on their property, the easements have not generally contained language dealing with energy production. Now, statements in easements that disallow “new structures” stand in the way of using land for environmental purposes that landowners may want, including the construction of wind turbines and solar paneling (Chris Nytch, TNC, in personal communication to Casey R. Pickett). Given the pros and cons of renewable energy development, how should the land conservation community respond? Furthermore, how should the land conservation community respond to the idea of developing renewable resources on land that it owns outright?

Wind

Environmental organizations in general have been very positive about wind because of its potential to provide energy without contributing to global warming. Recently, numerous environmental groups, including Defenders of Wildlife, EarthJustice, the National Audubon Society, and the Natural Resources Defense Council, released a joint statement on the “Key Principles” for balancing renewable energy and land conservation. The statement was very encouraging of large-scale renewable energy development. However, it acknowledged that already-disturbed land should be preferred for energy development and that because of the multiple benefits provided by wildlands, renewable energy development should avoid impacting these sensitive areas. Among other things, the statement stressed that the social and ecological impacts of any renewable energy facility must be studied through a science-based design process that includes opportunities for significant public involvement (Defenders of Wildlife et al., 2008). The land conservation community should stay attuned to opportunities to offer public comment and input on the future of wind development. One opportunity, for example, is becoming involved with the U.S. Fish & Wildlife Service’s (USFWS) Federal Wind Turbine Advisory process. A Wind Turbine Guidelines Advisory Committee has been created by the USFWS to give advice and recommendations to the Secretary of the Interior about developing measures to avoid or minimize impacts to wildlife from onshore wind energy. Though the process is already well underway, there is still opportunity for the land trust community to provide input (U.S. Fish and Wildlife Service).

In managing their own easements and land, land trusts have been asked to deal with the issue of wind power on a case-by-case basis when individual landowners request that their conservation easements allow for the installation of wind energy. Land trusts have had mixed responses to this request. The board of the Orange County Land Trust in Middletown, NY, for example, decided it would be responsible to allow for future wind turbine construction on land subject to a conservation easement along the Shawangunk Ridge. The decision was based on the belief that since easements are in perpetuity, someday it might be important to have the option of using the land for the production of renewable energy. While wind turbines are not disallowed in the easement, the land trust did retain the authority to approve wind
Another land conservation organization with positive experiences around wind development is Save Mount Diablo, which was created over 35 years ago to help conserve land in the area west of the Altamont Pass, home to one of the oldest wind farms in America and still the wind farm with the largest concentration of turbines in the world. As of 2007, Save Mount Diablo had helped to create two parks—one including turbines—in “the heart of the wind farm region.” The organization hopes to work towards replacement and more careful siting of existing wind turbines to lessen the impacts on wildlife. Larger, slower moving turbines are more cost-effective and pose less of a threat to the area’s bird populations. Save Mount Diablo has found that the land used for wind farming can allow for the “protection of large amounts of open space,” (Soto, 2007). Some land trusts, however, respond differently to the idea of future wind project construction and are unwilling to accept easements or land when rights are retained to develop wind energy. The belief behind this decision is that wind development conflicts with the land trust’s mission. For example, a landowner recently wanted to give the Virginia Outdoors Foundation (VOF) 2,000 acres of land but wanted to keep the right to develop turbines on the property’s ridgelines. VOF declined the donation because they have an interest in preserving public viewsheds (Robert Lee, VA Outdoors Foundation, in personal communication with Casey R. Pickett).

If conservation easement holders are willing to allow a limited number of turbines, questions arise about what limits to establish. Many easement clauses now allow the construction of turbines to provide on-site energy use only. For example, the Okanogan Valley Land Council in Tonasket, Washington allowed for the following easement language:

“Utilities. Construction or installation of private, noncommercial utility structures or systems within the Residential Homesite which are necessary for the permitted activities on the Protected Property, or which generate power from solar or wind energy, provided that they do not adversely impact the Conservation Values of the Protected Property,” (Soto, 2007).

In such cases, land trusts often want to restrict a landowner from benefitting financially from energy development. This can create monitoring problems because it can become difficult to regulate whether or not someone is selling power back to the grid (Jessica E. Jay, Conservation Law, P.C., in personal communication with Casey R. Pickett).

If a land trust decides to allow renewable energy development on some portion of conserved land, there is the possibility of conditioning this allowance on mitigation that involves conservation of an equal amount of land in an area less suited for renewable development. Allowing a trade-off of parcels or donating land for conservation to mitigate negative activity in one area has been used before by energy developers. For example, just this year the Virginia Outdoors Foundation
took an easement on 5,000 acres owned by a hydro company to make part of the land accessible to the public. The company wanted to do this as a public relations opportunity because of the bad press that similar companies had gotten (Robert Lee, VA Outdoors Foundation, in personal communication with Casey R. Pickett).

**Geothermal**

Very little appears to have been said by the land conservation community about geothermal energy development. In 1980, the Sierra Club did, however, officially adopt a “position of caution with regard to present geothermal technologies, to recognize that they cannot contribute more than a small percentage to the national energy supply, and to favor the advance of other methods of Earth heat utilization which can, for the most part, be developed independently or naturally occurring hydrothermal reservoirs,” (Sierra Club, 1980). It does not appear that the Sierra Club has updated this position since it was originally written. At the time that it developed its position on geothermal energy, the club also came up with a detailed list of recommendations for geothermal energy development and a list of areas in which it specifically opposes geothermal energy development (Sierra Club, 1980).

**Solar**

Because solar energy is developing less quickly than wind, the land conservation community has had less experience with it (Soto, 2007). However, conservation decisions in some areas have taken into account solar energy. For example, the Arizona Open Land Trust has worked with ranchers to modify easements to allow for solar technology and to allow for “flexibility in easement language” in order to accommodate what solar technology might look like in the coming decades. Other land trusts, however, are less comfortable with allowing solar energy on conserved land. The Land Trust of Napa County in California, for example, feels that solar arrays compromise what they are trying to achieve in preserving scenic settings. Sometimes, conflicts can be resolved and negative visual impacts limited by carefully siting each array of solar collectors for minimum visibility (Soto, 2007).

As mentioned above, one recent high-profile case of solar power development has taken place in the Mojave Desert. There have been well over one hundred solar and wind energy plans for the desert, and Senator Diane Feinstein has asked that plans for 12 proposed solar leases be abandoned due to potential negative impacts on desert habitat. A lot of the land in question was donated by the conservation group the Wildlands Conservancy, and Feinstein claims that, though the Bureau of land management says the only restriction of the donation is that mining not take place on the land, developing the land is contrary to the land’s intended use (Felsinger, 2009).

**QUESTIONS FOR CONSIDERATION**

1) How should climate change impact the priorities of land trusts with regard to renewable energy? What balance should be struck between managing the
short-term impacts of renewable energy facilities and the long-term impacts of climate change?

2) To what degree is renewable energy compatible with land conservation?

3) How should the different “public goods” of renewable energy, open space, habitat conservation, and aesthetics be weighed against one another in siting renewables?

4) What are the opportunities for conservation groups to engage in planning the future of renewable energy? For example, how can the land trust community become more involved in the Federal Wind Turbine Advisory Process?

5) What are the mitigation opportunities? What form should mitigation take and should monetization of conservation values play a role?

6) How can the impacts of wind turbines on conserved land be limited? Burying lines? Strict decommissioning plans?

7) Does limiting wind energy production on conserved land to production for on-site energy use only make sense?

8) How can small-scale community energy production fit into this discussion?

9) Should easements make more allowances for renewable energy? What language might or might not be appropriate?

ORGANIZATIONS AND INDIVIDUALS DOING INTERESTING WORK

- American Wind Energy Association (http://www.awea.org/)
- Federal Wind Siting Information Center (http://www1.eere.energy.gov/windandhydro/federalwindsiting/)
- Land Trust Alliance (http://www.landtrustalliance.org/)
- Maine Coast Heritage Trust (http://www.mcht.org/)
- Mark Z. Jacobson, Stanford University (http://www.stanford.edu/group/efmh/jacobson/)
- National Audubon Society (http://www.audubon.org/campaign/testimony_0507.html)
- New Jersey Conservation Foundation (http://www.njconservation.org/html/03-02-09PreservedFarmEnergy.html)
- New York State Department of Agriculture and Markets (http://www.agmkt.state.ny.us/AP/agservices/constructWind.html)
• U.S. Fish and Wildlife Service Wind Turbine Guidelines Advisory Committee (http://www.fws.gov/habitatconservation/windpower/wind_turbine_advisory_committee.html)
• Vermont Land Trust (http://www.vlt.org/index.html)

USEFUL READINGS/WORKS CITED


Docket No. 7156, Final Order (State of Vermont Public Service Board 2007).


The FREE Center, Inc. Fenner Wind Selected as a “Wonder of Central New York.” Available at: http://www.fennerwind.com/.


Kirk, Karin. Should geothermal energy resources around Yellowstone Park be developed? Exploring the Yellowstone Geocosystem. Available at: http://serc.carleton.edu/research_education/yellowstone/geothermal.html


LaMonica, Martin. E-waste looms behind solar-power boom. Available at: http://news.cnet.com/8301-11128_3-10142451-54.html


ENVIRONMENTAL CONSIDERATIONS FOR WIND ENERGY FACILITIES AND LAND CONSERVATION

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Introduction
The siting, construction and operation of wind-energy facilities affect the natural, cultural and economic values of the land. Although the scientific basis for the analyses is still relatively immature, there are estimates of the impact of large-scale wind farms on biological components, particularly birds and bats. In addition, there are methods for evaluating scenic impacts of wind farms and simple models for economic impacts.

Environmental impacts
The National Research Council recently conducted an evaluation of the environmental impacts of wind energy projects (National Research Council 2007), with an emphasis on the Mid-Atlantic Highland region but inclusive of the United States. Wind turbines cause fatalities of birds and bats, although species are differentially vulnerable depending on their abundance, habitat preferences and behavioral patterns. There is no national standard sampling protocol and studies of fatalities have only been conducted over the last few years. Thus, aggregating data from various sites collected with different methods and schedules, mostly over short durations, requires that the generalizations be viewed with caution. Acknowledging these uncertainties and attempting to reconcile sampling differences, the following are the best estimates for fatalities in North America (north of the Mexican border).

<table>
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<tr>
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<th>Per turbine per year</th>
<th>Per MW per year</th>
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<tbody>
<tr>
<td>All birds</td>
<td>4.27</td>
<td>2.96</td>
</tr>
<tr>
<td>Raptors</td>
<td>0.03</td>
<td>0.02</td>
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Passerine birds constitute about 75% of the total fatalities from wind turbines, with the lowest percentage (68%) in the Northwest. About half of the deaths are nocturnal migrants and half are resident birds. Raptor deaths can be quite high at individual sites, such as the notorious Altamont Pass site in California where there are also high rodent populations, but other sites have low numbers of raptor fatalities.

Bat fatalities are quite variable, ranging from 15.3 – 41.1 per MW per year on ridge tops in the Appalachians to 0.8 to 8.6 in the Midwest. Migratory, tree-roosting bat species appear to be the most susceptible. Eleven of the 45 known North American (north of the Mexico border) species of bats have been found as casualties, 75% of which are from three species, all of which have long migration routes. No threatened or endangered bats have been identified as casualties. There have been a few instances of high mortalities at wind farms where large local bat populations exist, such as that of the Brazilian free-tailed bat in Oklahoma.
There are few guiding generalities for locating turbines to minimize bird and bat fatalities. In the eastern part of the country, turbines placed on ridges appear to have higher probability of causing bat fatalities. Bird species with long migration patterns appear to travel in broad fronts. With these flight patterns there is some indication of higher fatalities with low wind velocities and with thermal inversions or when low clouds force birds to lower elevations as they pass over ridges where they are more likely to collide with turbines. Obviously, migratory species are more vulnerable during migration periods. Fatalities probably have greater detrimental effects on bat and raptor populations than on most bird populations because of the characteristically long life spans and low reproduction rates of bats and the relatively low abundance of raptors. Overall, the impact on bird populations is probably minor, but that estimate is difficult to make because we do not know the denominator (total bird population). Local or even regional impacts could be significant.

Other environmental impacts include such considerations as noise, shadow flicker and visual (aesthetic) effects. For example, a single turbine has sound power level of 50-60 decibels db(A) at a distance of 40 meters, about equal to a normal conversation. There are several methodologies for evaluating visual impacts (e.g., US Forest Service Scenery Management System) of projects such as wind turbine farms. Some guidelines suggest a 10-mile radius, unless the project is viewed from a sensitive area. The most significant impacts are likely to be found within 3 miles of the project, but depending upon the terrain and conditions, turbines can be seen for 20 miles or more.

**Habitat impacts**

Among the largest impacts of siting and operating wind energy facilities is the alteration of habitat. These disturbances occur during construction and operation of the turbines, but also from the service roads and buildings and from the installation of transmission lines. Disturbance around turbines varies with information source and geography, for example in the west the Bureau of Land Management estimates 3 acres per turbine whereas studies in Tennessee estimate one acre per turbine (Arnett 2007). The “depth of the edge influence” from cleared areas varies with the species, but for many forest-dwelling species, it is 100 m; for some invertebrate taxa, the influence is over 200 m and greater than 340 m for cerulean warblers (Dendroica cerulean). Total breeding bird densities were lower on Conservation Reserve Program (CRP) lands with turbines compared to those without turbines in southwestern Minnesota. Densities of birds were remarkably lower to within 80 m of the turbines. Other studies show lower densities within about 100 m of the turbines (Leddy, et al. 1999).

The lesser prairie chicken (Tympanuchus pallidicinctus), an umbrella species, has suffered a large population decline over the last century due to loss and fragmentation of habitat and the increasingly fragmented populations and reductions in habitat connections in the short- and mixed-grass prairie, sand-sagebrush and shinnery-oak ecosystems in the Southwest. Between 25 and 60 square km are needed to support a single lek and habitat continuity is needed for genetic maintenance of populations. Farther east, greater prairie chickens (T. cupido) appear to stay at least 0.5 km from
power transmission lines. The USFWS has recommended that turbines be constructed no closer than 8 km (5 miles) to prairie grouse leks (Pruett, et al. 2009).

Impacts and land conservation

In 2008, 8,358 MW of new generating capacity were installed, shattering all previous records and boosting the nation’s capacity by 50% with $17 billion in investment, 42% of all the new power producing capacity last year, and reducing about 44 million tons of carbon emissions (AWEA). The nation’s total generating capacity is 25,170 MW, producing enough power for 7.0 M households. Because of the economic conditions in the last quarter of 2008 and in 2009, orders for turbines are down drastically. Nevertheless, especially under the current administration, continued growth can be expected in wind farms (and other renewable energy), and the relationship between these facilities and land conservation will continue to escalate.

The Clean Renewable Energy and Economic Development Act, introduced in the Senate on March 5, 2009, would establish a streamlined planning and siting process for transmission lines. The bill directs the President to designate “renewable energy zones” that have at least 1,000 MW in renewable energy potential but lack transmission. Under the planning process, the Federal Energy Regulatory Commission (FERC) would certify one or more organization(s) as the regional planning entity(ies) for a transmission interconnection. The objective would be to enhance transmission access for electricity from renewable energy zones, while recognizing economic, reliability and security goals. The planning process would also be based on established and projected federal and state renewable energy policies and targets.

The Secretary of the U.S. Department of the Interior (DOI) recently issued a Secretarial Order that makes the production, development and delivery of renewable energy one of the highest priorities for DOI, and proposes to establish specific zones on U.S. public lands where DOI can facilitate a rapid responsible move to large-scale production of wind, solar geothermal and biomass energy.

In the State of Washington, developers are required to acquire and then manage replacement wildlife habitats for the life of the project, unless the development occurs on land with little or no wildlife habitat value (under cultivation or otherwise developed or disturbed) (Arnett 2007). The acquisition of replacement habitat is guided by five criteria, namely, this habitat must be:

- comparable to habitat disturbed by development;
- given legal protection;
- protected from degradation during the life of the project;
- in the same geographic region as the project; and
- be jointly agreed to by the developer and the Washington Department of Fish and Wildlife.

The size of the replacement area depends on the value of the land to be disturbed by the project. Alternatively, the developer can pay an annual median fee of $55.00
(which can be adjusted depending on the value of the land) and the Washington Department of Fish and Wildlife will purchase and manage high-value wildlife habitat in the same geographic region as the wind development project.

In recent years our ability to design and select conservation offsets has increased significantly (Kiesecker, et al. 2009, Lovell and Johnson 2009). Quantitative site selection tools such as Marxan provide a transparent and rule based approach to guide site selection (Arponen, et al. 2007). While these methods require considerable data and analyses, today’s GIS systems of federal, state and local agencies frequently can provide much of the required information.

Conclusion

As a renewable energy source, the use of wind energy reduces the country’s reliance on other energy forms which are destructive to wildlife and their habitats. And yet, the installation and operation of wind-energy facilities reduce the quality of or destroy habitats which affect wildlife; birds and bats are killed by wind turbines. The discussion above indicates that research to date allows us some ability to evaluate the environmental impacts of wind energy. There are uncertainties around virtually all of the numerical data and we cannot unequivocally answer such basic questions as (Arnett 2007):

- The extent to which strings of turbines effectively fragment grassland habitat.
- How inferences about avoidance of trees and tall anthropogenic structures by birds transfer to avoidance of wind turbines.

Despite the relative immaturity of the science surrounding wind energy, tentative conclusions can be drawn about its relation to land conservation:

1. Wind-power facilities degrade the environmental quality of habitat, although the degree of degradation depends on the status of the land before development of the wind farm. Thus, all other considerations aside, building and operating wind farms on disturbed sites is preferable. Least preferable is wind power development on large, intact, undisturbed sites.

2. Criteria and standards could be established for high-risk sites for groups of species and any designated “critical habitats” in a state-by-state or regional basis, and developers could be required to avoid impacts to those areas. Examples might include locations important to threatened and endangered species or in large, un-fragmented native habitat (Arnett, et al. 2007). The value of these critical habitats could be monetized and this value could be used in any land conservation action. In addition, the required offset (see #4) would be higher if the land conservation transaction occurred in these critical habitats.

3. Results from attempts to evaluate the economic impacts of wind-energy facilities on land values have been uneven. NextEra, a subsidiary of the FPL
Group, argues that land values do not depreciate with adjacent wind farms, but the company recently guaranteed residents’ property values by paying fair market value for a home that doesn’t sell or paying the property owner the difference if a home sells for an amount below the appraised value without turbines. This depreciated value represents another measure of the impact of wind-power facilities on conservation lands.

4. Using the most recent conservation offset tools, when negotiating conservation easements, land conservation managers could require conservation offsets in return for allowing wind-energy development.

Citations


KEY TAKEAWAYS FROM THE DISCUSSION

Paul Risser, Chair of the National Research Council’s Committee on the Environmental Impacts of Wind Energy Projects, and Kaarsten Turner Dalby, Senior Director of Ecological Services at The Forestland Group LLC (a timber investment firm), started the discussion around the siting of renewable energy facilities. Among the key takeaways from the dialogue were the following:

Scientists have methods to assess the environmental impacts of wind or solar energy projects, but not the long-term data sets needed to be confident in the results. Predictive models are getting better, however.1

1 For an analysis of the potential for wind to provide 20% of US electricity by 2030, see the report by the Department of Energy at http://www.20percentwind.org/.
While many different groups have offered guidelines for site selection, there is a clear need to combine them into national guidelines that can be used across the country. There appears to be an opportunity to build on work already being done in the administration to articulate guidelines for the siting of energy facilities on federal lands.

**Conservation offsets should be required for all new wind/solar facilities** as a way to compensate for their impacts on habitats and other ecosystem services, particularly water and carbon.

**Conservation finance and acquisition programs often apply rules that limit the ability to site renewable energy facilities on conserved lands** – even when they are consistent with the conservation values being protected (such as on farms or working forests). Provisions on floating zones, height restrictions, allowable uses, and similar topics should be re-evaluated in light of the need to use more clean energy, while the working lands purposes of the easement should be used to govern any ambiguities in the language.

**There is a need to move toward pre-approval of areas in which energy development is appropriate and those where it is not.** At the same time, concerns about mapping were expressed, as they can attract as much opposition as support. The potential for using maps to help obtain public input and work through areas of conflict toward siting agreements seemed to outweigh these concerns.

> “We are learning the benefits of saying yes to new, clean energy projects.” — Nathanael Greene, NRDC

A number of environmental organizations are already doing more in the area of mapping energy resources and conserved lands. For example, NRDC has prepared maps of both US renewable energy potential (http://www.nrdc.org/energy/renewables/default.asp/), as well as sensitive areas in the West (http://www.nrdc.org/land/sitingrenewables/).

The renewable energy industry is also learning that the best way to address the environmental impacts of their projects is by partnering with organizations who care – such as Bat Conservation International. In fact, the American Wind and Wildlife Institute (http://www.awwi.org/) was formed to help these two communities understand their differences and identify possible ways forward. Its members include a wide range of environmental organizations and wind energy businesses.

These efforts offer clear opportunities for land trusts to engage at either the project or regional levels. This suggests a potential new, regional role for Land Trust Service Bureaus in helping local land trusts navigate these broader waters on project proposed for their towns.
“The land conservation community does not like to see things change – that is barrier number one.” – Judy Anderson, Community Consultants

“The aesthetics discussion divorced from a broader framework of the many challenges facing society is very frustrating to me as a climate scientist – I do not see how it is possible to keep land unchanged forever.” – Jim Dooley, Joint Global Change Research Institute

Whose aesthetics count and what processes should be used to decide what aesthetics will control any particular project are huge issues for conservation organizations trying to decide what position to take on renewable energy projects. While federal and state processes exist for public input on aesthetics and new methods are being developed for public input on viewsheds, the land trust community needs to better understand the state of knowledge on how the public perceives beauty and makes aesthetic choices.

Whose values count raised a host of questions linked to ownership – of conserved land, of wind and sun. Do both involve the private appropriation of public goods – either wind or scenery? Is there a role for the public trust doctrine in the ownership of either to help ensure that both public and private interests are accommodated? Does such thinking pose threats to the very foundation of private land conservation through private ownership of rights to land? A striking mix of ownership and ethical questions were posed by comparing the opposition to mountaintop removal coal mining (see Section VI below) to the construction of offshore wind turbines.

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“Is it ethical or appropriate to let private transactions permanently bind uses of land?”

– Dan Reicher, Google.org

The traditional response to these questions of change and public interest has regarded the ability of governments to condemn land to put it to a higher public use. Few conservation easements are dynamic and include provisions allowing for change. One potential response is for land trusts to consider including floating zones that allow for changes over time based on best science, new regulations/policies, or other public values.

“Huge areas of the U.S. have wind resources, why should already preserved sites be the first place to look to site new turbines?”

– Rand Wentworth, Land Trust Alliance
One of the concerns over condemnation powers is that conserved sites will be targeted first for new energy developments – as they are often cheaper and may raise less political opposition than taking someone’s home. The general consensus was that, in addition to opposing such takings, the conservation community needs to be part of the solution by helping to site clean energy facilities on less critical habitats/open spaces.

Ultimately, conservation groups will not be able to stay on the sidelines – they will need to decide how they want to engage on renewable energy projects. The response to climate change requires rapid action at large scales. Energy efficiency and decentralized solutions will not be enough – although much more can be done in those areas. At a minimum, the conservation community should agree and push its recommendations for assessment and siting guidelines more widely. The new administration offers a hopeful place to start.