



NEWS

Out of Site

Renewables like wind turbines are spreading fast, but can they survive complaints that they mar neighborhoods and threaten wildlife?

WHEN A POWER COMPANY ERECTED three towering white wind turbines on the Maine island of Vinalhaven last year, many residents welcomed the clean electricity the spinning blades would bring. Now, however, the mood has soured for some. “There is this amazing ‘wump’ as the turbine spins; you can feel the sound,” says resident Cheryl Lindgren. “It’s very annoying,” she adds, and disrupts the “sanctity of the island.”

Such complaints are becoming a growing problem for advocates pushing to scale up wind power and other renewable-energy sources. Around the world, an emerging network of groups are marshaling a wide array of arguments—from worries about excessive noise and wrecked views to threats to wildlife, air traffic, and even national security—in bids to block construction of new wind farms. And they are meeting with some success. In the United States, for instance, fierce local opposition has scuttled some major wind projects and delayed others for years.

The siting fights threaten to derail efforts to ultimately use wind turbines to generate up to 20% of U.S. electricity. To reach that goal, U.S. wind-generating capacity would have to increase from about 35 gigawatts today to more than 300 GW. That would require the construction of as many as 100,000 new turbines. Backers argue that they would be cleaner than power plants run on fossil fuels and could reduce per-kilowatt carbon dioxide emissions by 99%. Those benefits, however, haven’t quieted critics. “Siting issues will only get worse and worse,” predicts Robert Thresher of the National Renewable Energy

Laboratory (NREL) in Golden, Colorado. And wind isn’t alone: Similar resistance is facing plans to cover vast swaths of desert with solar collectors or scatter energy-producing buoys along coastlines (see sidebar, p. 789). The lesson, analysts say, is that even when new energy technologies are able to overcome substantial technical or economic hurdles—and offer real environmental benefits—they can still face substantial public opposition that backers ignore at their peril. To defuse the threat, government and industry are now taking a hard look at the problems posed by renewable-energy projects such as wind farms and how best to mitigate them.

The birds and the bats

One of the earliest efforts to understand wind power’s environmental impacts began 2 decades ago, after thousands of dead birds of prey—including golden eagles—began showing up beneath turbines at one of the nation’s first major wind farms on Altamont Pass in California. The kills made headlines and prompted studies aimed at solving the problem. It turned out that the site, a high ridge where many raptors roosted naturally, was unusually prone to bird strikes, says zoologist Dale Strickland of Western Eco-Systems Technology in Cheyenne. Engineers reduced the toll by spacing turbines farther apart and removing machines from the most problematic sites.

These days, those lessons are also being applied at other wind farms, and the bird-strike issue has become less of a concern. A newer issue is understanding how the extensive road

Wilting at windmills. Tensions are rising as wind-turbine developers look for land.

and fence networks associated with wind farms might act as “barriers to local wildlife,” Thresher says. Breezy grasslands could pose particular challenges for turbine planners, he notes, because they host species such as sage grouse, which require extensive open areas.

Scientists are also just beginning to learn about the threat turbines pose to another flying animal: migratory bats. The issue heated up last year, after researchers reported that a single wind farm in West Virginia was killing as many as 4000 bats each year, mostly during fall migrations (*Science*, 24 July 2009, p. 386).

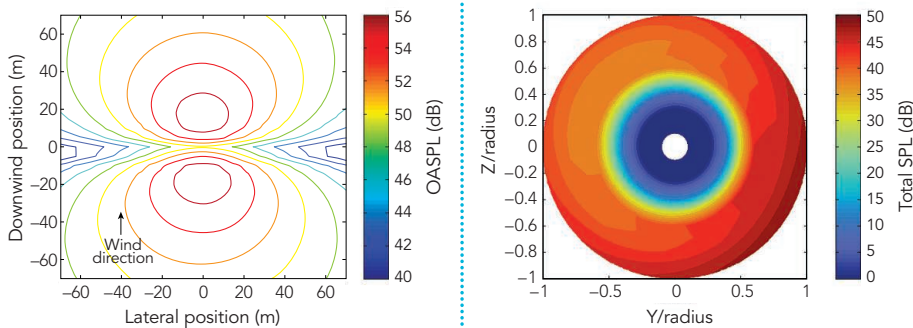
Some scientists hypothesize that the bats are at risk because they navigate along mountain ridges that are also favorable sites for wind farms—but researchers have also documented extensive kills on flat prairies in Alberta, Canada. Infrared video has shown that night-flying bats seem to have a fascination with moving turbine blades, and post-mortems suggest that bats may be dying from air-pressure differences created by the blades, along with blunt trauma from collisions.

Scientists are already beginning to try some fixes. One idea is to turn off turbines before and after storms and on evenings with calm winds, times when studies suggest a lot of fatalities occur. Studies have also shown that raising a turbine’s “cut in”



Surround sound. Microphone arrays provide data to make maps of turbine noise.

SOUND-PRESSURE MAPPING YIELDS CLUES



Sound advice. Turbines are usually equally noisy front and back (*left*) but especially loud on the lower right of the turbine plane.

speed—the minimum wind speed at which the blades spin—can lower kills dramatically. One unpublished study of 23 turbines in southwestern Pennsylvania, led by wildlife biologist Edward Arnett of Bat Conservation International in Austin, found that “curtailed” turbines killed on average 80% fewer bats than uncurtailed turbines did.

Researchers are also experimenting with using sound to protect bats. Arnett and his colleagues have built so-called bat-aways, which blast ultrasonic sound out of 128 speakers per tower. Researchers say bats tend to avoid the ultrasound, perhaps because it jams their sonar. Last summer, in an unpublished study, the team found that turbines fitted with bat-aways caused only one-fifth to one-half as many bat fatalities as turbines without the devices. Still, Arnett says it’s not yet clear the approach “is a viable solution.”

Scanning the horizon

Another problem causing static for wind farmers is radar. Turbines that are too close to radar stations show up on controllers’ screens as individual flickers, and the spinning blades have electronic signatures very similar to those of small planes. Those signals can confuse military or civilian air traffic controllers, who have objected to a number of planned farms. Overall, radar-related concerns have delayed or scuttled U.S. projects pegged to produce 4200 megawatts’ worth of wind power, a 2009 survey by the American Wind Energy Association concluded.

The radar-interference problem will only get worse as the number of wind turbines skyrockets, predicts Gary Seifert of the U.S. Department of Energy’s Idaho National Laboratory in Idaho Falls. But he hopes mitigation efforts will bear fruit. Computer programmers, for instance, are hard at work on new techniques to “tune out” the turbines’

signatures, perhaps by incorporating super-sensitive short-distance radar. Another idea is to make turbine blades “stealthy,” or less visible to radar. Danish turbine maker Vestas and a company called QinetiQ are collaborating on stealthy materials that could be used to build or coat turbine parts.

Wumps and thumps

The toughest challenge facing turbine builders may be mitigating the noise associated with the coming wind storm. People who live near turbines can be subjected to an annoying mix of whooshes, whines, and “thumps,” depending on the model and wind conditions. Wind developers in the United States, the United Kingdom, Canada, and New Zealand have all faced “vehement” local opposition due to noise, says Jim Cummings of the Acoustic Ecology Institute in Santa Fe, New Mexico.

From a simply technical perspective, turbine blades that spin faster make more energy more efficiently—but they also make exponentially more noise. So “there’s always a tradeoff between efficiency and noise,” says NREL engineer Patrick Moriarty. To get more power out of quieter blades, researchers are developing new tools to measure and mitigate the noise. Traditional noise surveys place single microphones upwind and downwind of turbines, but that provides coarse data, Moriarty says. So he and his colleagues have developed 32-microphone arrays that enable computers to create detailed “sound maps” that pinpoint which blades are producing sound and how it propagates through specific environments—an issue that can be as important as turbine design for nearby residents. The maps also help researchers see if new blade designs—such as serrated edges or holes—reduce noise by disrupting the way air eddies across the turbine.

Other Siting Problems

Geothermal energy, which involves tapping warm or cool temperatures underground, has been deployed on a small scale for decades with few problems. But the technique can cause earthquakes. One project near Basel, Switzerland, was shelved after drilling caused a magnitude-3.4 tremor in 2007.

Experts are also developing ways to retrofit historical buildings with solar panels while preserving their character. British preservation groups have created detailed guidelines for such projects. Meanwhile, the California Energy Commission has recommended against building a proposed solar energy installation in the Mojave Desert because of its potential impact on turtles.

Greening coal faces its own challenges, too. Scientists studying the implications of storing billions of tons of CO₂ from power plants underground say that concerns about causing earthquakes or polluting aquifers so far appear overblown. But such worries have already led to scuttled test projects in Germany, the Netherlands, and in Greenville, Ohio. “Not Under My Backyard” was how one paper put it.

—E.K.

The easiest way to make turbines less noisy, however, may be simply to run them less. That can be accomplished by raising the cut-in speed, at a cost of cutting power production by a few percent. But some residents complain about noise produced when the turbines are spinning at speeds at which they produce most of their power; companies aren’t likely to still turbines when the wind is most valuable.

In the end, technical tweaks may never fly with people who simply don’t want to hear—or see—turbines in their backyards. Changing negative attitudes toward wind farms “will mean more than little engineering fixes,” predicts Michael Vickerson of a renewable group called RENEW Wisconsin in Madison. One promising finding for wind advocates, Vickerson notes, is that people tend to become more comfortable with nearby wind farms over time: “The older a project is, we find, the more the turbines are accepted.” That’s a trend many renewable-energy advocates hope proves true.

—ELI KINTISCH