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Decades ago, President Jimmy Carter set America's sights on a renewable energy economy, calling for 20 percent reliance on resources like solar and wind by the year 2000. We entered the new millennium without achieving that goal, but the past several years have seen a dramatic rise in America's use of wind power. With more than 40 gigawatts in service across the country, wind farms are generating a timely debate about the environmentally sustainable rollout of this transformative technology.

Living in New England, I have learned first hand just how hard it can be to move wind power from the drawing boards to the grid. In 2001, energy developer Jim Gordon unfurled his plans to build America's first offshore wind farm in Nantucket Sound. It wasn't long before the battle lines were drawn between clean energy advocates, who heralded the project as New England's first big step toward a post-carbon future, and a group of vacation homeowners on Cape Cod and the islands who vehemently opposed it as an unacceptable encroachment on their ocean views. As the years went by, Cape Wind's developers spent millions of dollars preparing studies, filing permit applications, and defending the proposal in and out of court. Yet for every concern raised and addressed, there were more objections placed on the table.

Frustrated by how difficult it was to introduce wind power on a scale that could make a dent in New England's greenhouse gas emissions, I set out in 2009 to explore other parts of the country where I had heard the technology was fast taking hold. My first stop was Cloud County, Kansas, an isolated stretch of prairie just east of the 100th meridian. There, a few months before my visit, the Meridian Way Wind Farm had begun churning out enough electricity for about 55,000 Kansas and Missouri households. Wanting to know how Cloud County residents felt about this new project, I began asking.

Kurt Kocher is a fourth-generation farmer and rancher. He has nine wind turbines on his property and also hosts one of the wind farm's transformer stations. By his reckoning, turbines are just one more addition to a working landscape that has kept his family solvent for generations. Tens of thousands of dollars in yearly income from the wind help the Kochers offset the ups and downs of grain and cattle prices as well as the vicissitudes of prairie weather.



Philip Warburg, former President of the Conservation Law Foundation, is the author of "Harvest the Wind: America's Journey to Jobs, Energy Independence, and Climate Stability," from which this excerpt is adapted. Copyright 2012 by Philip Warburg. Reprinted by permission of Beacon Press, Boston.

Kirk Lowell is executive director of Cloud County's economic development agency, Cloud-Corp. Pointing to the hundreds of jobs that came with Meridian Way's construction, the area's prime business booster also praised the ongoing employment associated with operating the wind farm. He spoke, too, about Cloud County Community College, which has recently emerged as one of the nation's leading centers for training wind technicians.

Wind energy's praises were sung by many of the people I encountered on my travels: farmers, ranchers, crane operators, truckers, factory line workers, and others. That embrace was not universal or unqualified, however. Among the wildlife biologists

I met, concerns about the adverse impacts of wind farms on birds and bats loomed large. The densely packed jumble of low-sweeping turbines at California's older wind farms, built in the 1970s and 1980s, has rightly led to a vigorous legal campaign to introduce a smaller number of taller, more widely spaced machines — particularly important in areas where raptors have fallen victim to fast-spinning blades as they dive for prey. More broadly, the U.S. Fish and Wildlife Service has been working closely with conservationists as well as wind farm developers to come up with a guidance document designed to honor the Bald and Golden Eagle Protection Act's provisions preventing the unauthorized taking of these iconic birds.

Areas that are prime mating and nesting grounds for prairie chickens and sage grouse raise concerns about whether these grassland birds might abandon their habitats because they mistake looming turbines for large trees where predators might perch. A Wyoming executive order, issued in 2008 and updated in 2010, has set aside about a fifth of the state as core habitat areas for the greater sage grouse, in an attempt to forestall the federal listing of this bird under the Endangered Species Act. While wind development is "not recommended" in these areas, existing oil and gas wells can continue their operations, and mining as well as drilling for new oil and gas are even allowed under certain conditions. Erik Molvar at the Biodiversity Conservation Alliance in Laramie questions this imbalance, but he observes that the core area designation still leaves Wyoming with five million acres of "go zones" where wind farms can tap some of the nation's most robust and sustained, high-energy winds.

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Noise is another issue that wind developers are grappling with. Dr. Michael Nissenbaum of the Northern Maine Medical Center calls the melange of sounds produced by wind turbines "an acoustic pizza" including high-frequency aerodynamic noise that attenuates relatively quickly, lower-frequency emissions, sometimes pulsating, that carry over greater distances, and ultra-low frequency "infrasound" that can be experienced as vibration. "We're all built differently," Nissenbaum says, pointing to the wide range of individual responses to noise at different levels. Sensitivities may vary, but there is enough anecdotal evidence of annoyance caused by wind farm noise to warrant rigorous measures that will keep this annoyance within bounds. Today's unhappy neighbors could easily become tomorrow's angry litigants in cases that could hamstring a transformative industry just getting off the ground.

The first task in setting limits is deciding what level of turbine-generated noise is acceptable. Acoustic experts often approach this challenge by comparing wind turbine noise to other, more familiar sounds affecting our daily lives. A dishwasher in the next room produces about 50 decibels. A library interior or a suburban area outdoors at nighttime might register 40 decibels (perceived to be half as loud as 50 decibels given the logarithmic scale of sound measurement). Sound at 30 decibels, half as loud again, would approximate a quiet bedroom at night or a quiet rural area with no wind, insects, or traffic.

Today there are no federal noise limits for wind turbines, but the Environmental Protection Agency generally recommends that outdoor noise levels should be no higher than 55 decibels during the day and 45 decibels at night. In the absence of enforceable federal requirements, some states have adopted their own standards. Maine has set general noise limits that mirror EPA's daytime and nighttime guidelines. Most states, though, have treated noise as a matter to be addressed by counties and municipalities. In some of those jurisdictions, new ordinances specifically regulate noise from wind farms. Others have deferred to individual developers, letting them negotiate ad hoc arrangements with neighbors at their project sites.

Requiring turbines to be set back a minimum distance from nearby homes is another way to protect wind farm neighbors from noise. Setbacks, though, are at best a crude proxy for numerical noise limits. A number of environmental factors influence how far and in what direction turbine noise travels. People living downwind of turbines are more exposed than those living on the upwind side. During tempera-

ture inversions, sounds stay closer to the ground and are audible at greater distances. Hard surfaces such as frozen ground reflect rather than absorb sound, causing it to carry farther. And the presence or absence of foliage can play a big role in how quickly sounds attenuate as they pass across cultivated fields, pastures, and woodlands. Taking all these factors into account, Maine-based developer Rob Gardiner of Independence Wind believes that setbacks in the range of 2,500 to 3,000 feet range may be needed, though developers in less hilly areas maintain that setbacks in the 1,000-foot range are sufficient.

Disputes about wind power's visual aesthetics may be less susceptible to rational debate and concrete resolution. I once told a newspaper reporter that I find wind turbines beautiful. She found them ugly. Little about wind farms creates greater public discord than their visual appearance, as I learned from the battle over Cape Wind. Developer Jim Gordon would describe his proposed turbines as rising no higher than a thumbnail held at full arm's length, when viewed from the nearest landfall. Anti-Cape Wind activists countered by decrying the industrialization of their ocean horizon.

In the 1980s, most Americans associated wind farms with the chaotic turbine arrays that crowded California's Altamont, San Geronio, and Tehachapi passes. In their rush to build, developers purchased a haphazard variety of turbines, some with two-bladed rotors, others with three, some mounted on spindly steel-truss towers, others capping smooth metal tubes. The visual effect was jarring and, to some, alien. "Spielberg and Lucas could not have done better," urban and regional planner Sylvia White wrote to the *Los Angeles Times*. "Once-friendly pastoral scenes now bristle with iron forests," she fumed.

Today's wind farms are much kinder to the eye and more respectful of the landscape. Almost all modern wind farms stick to a uniform, three-bladed turbine profile, and turbines are generously spaced — commonly 1,000 feet or more apart. State and local regulations often mandate measures to ensure a degree of visual harmony at wind farms. Yet, even with these changes, the large size of today's turbines — many of them topping 400 feet — makes them visually dominant in many settings. Pointing to the wholesale destruction of landscapes by mountaintop-removal coal mining, or to the flooding of vast coastal areas by sea-level rise caused by global warming, does little to assuage some wind farm neighbors who object to having turbines in their midst.

Bill Browning, a physician who lives on his family's multi-generational ranch in the Flint Hills of Kansas, put it this way as we stood on a broad expanse of tall-grass prairie watching the sun go down. "The beauty of it, for me, is where the hills meet the sky, morning and evening, and the shadows come across the hills and make all the contours stand out. If you're going to put a string of 400-foot steel behemoths across the horizon, it's gone. The loneliness, the emptiness, the absence of people. . . . All that would be lost."

Fellow rancher Pete Ferrell takes a very different view. Back in 2003, he allowed about 50 turbines to be built on his 7,000-acre cattle ranch. He firmly believes he is helping wean America off energy resources that, in the greater scheme of history, are moments away from running out. Citing sustainable agriculture visionary Wes Jackson, Pete likens the last 750 million years of history to a single calendar year, in which we began burning fossil fuels at three seconds to midnight on December 31. By three seconds into the New Year, petroleum will be gone, and coal will be just moments behind it. Ferrell's ranch and the turbines of the Elk River Wind Farm lie inside the boundaries of Governor Sam Brownback's recently designated Tallgrass Heartland. Though Elk River will remain, new wind development is singled out as inappropriate for this 11,000 square mile stretch of prairie.

Wind power supplies just over three percent of our power needs today, but its potential for displacing dirtier fossil fuels is enormous. In terms of raw resource availability, the National Renewable Energy Laboratory has identified enough high-quality land-based wind sites to supply nine times our total nationwide electricity needs. Even if wind only generates a fifth of our power by 2030, the Department of Energy predicts that we would cut carbon dioxide emissions from the power sector by 26 percent. And there are those, like Federal Energy Regulatory Commission Chair Jon Wellinghoff, who believe that wind power can supply us with half our electricity needs by mid-century if we commit ourselves to an expanded transmission network that can deliver power from remote, windy areas to major population centers while using an array of smart-grid tools to accommodate the wind's variability.

Properly implemented, wind energy can transform the way America produces its power. Its success will depend on our success in developing the regulatory tools needed to ensure wind farms' compatibility with their natural and human surroundings. •

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