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July 24, 2012

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To:

CONNECTICUT
SITING COUNCIL

Robert Stein, Chairman
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

From:

The Berkshire-Litchfield Environmental Council (BLEC)
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RE: Connecticut Siting Council Draft Wind Regulations

Dear Chairman Stein and Members of the Council,

The Berkshire-Litchfield Environmental Council is a 501 (3)(c) non-profit organization that focuses on environmental issues affecting the Northwest Corner of Connecticut and the Berkshire region of Massachusetts. Founded in 1970, we have a membership of 560 and have addressed our efforts to diverse subjects, including a proposed hydroelectric pumped storage power plant, water and air contamination, land preservation, zoning controls, vernal pools protection, the environmental effects of radio frequency radiation associated with the siting of telecommunications infrastructure, and industrial-scale wind turbines. BLEC was among the first environmental organizations to advocate for renewable energy sources, having published a book on the subject in the early 1980's. Wind was a part of the mix although no one at that time could have envisioned the industrial-scale wind farms of today.

In addition, BLEC President, Starling W. Childs, a lecturer at the Yale School of Forestry and President of EECOS Inc. Environmental Consultants -- a land-use planning/scientific assessment group specializing in innovative farm and forest management and creative development designs -- has been a consultant to wind projects throughout the east coast.

BLEC has sponsored educational forums -- all well attended -- on cell tower siting in 1996 (Falls Village) and 2000 (Litchfield). BLEC co-sponsored cell towers forums in 2007 (Sheffield, MA.) and 2008 (Cornwall). In April of 2011, we sponsored a forum on industrial-scale wind turbines (Falls Village) that was co-sponsored by the Housatonic Valley Association, Cornwall Bridge, CT; Audubon Sharon, Sharon, CT; the Housatonic Environmental Action League, Inc. Cornwall Bridge, CT; the Housatonic Riverkeepers, MA/CT, Lee, MA; the Housatonic River Initiative, Lenoxdale, MA; the Northwest Conservation District, Torrington, CT; and Green Berkshires, Great Barrington, MA. Clearly this is a subject of interest in the region.

Our target audience at the wind forum included municipal agents; planning, zoning, conservation, and inland/wetlands commissions; land-use attorneys, environmentalists, local/state/federal legislators and regulators; potential landowners interested in leasing to wind turbine companies, and concerned citizens.

Our keynote speaker at the forum was Albert M. Manville, II, Ph.D. Senior Wildlife Biologist, Division of Migratory Bird Management, U.S. Fish and Wildlife Service who addressed bird and bat deaths near wind turbines and recent federal recommendations for tower siting and environmental damage/mitigation. Also, Dave McGlinchey, J.D., Senior Program Leader for Energy and Environment at the Manomet Center for Conservation Sciences in Plymouth, MA., focused on the balance between renewable energy development, societal acceptance, and environmental conservation. McGlinchey has a long record in wind development, having organized the "Social Challenge of Wind Energy Conference" in Plymouth, MA in 2010, and having been on the steering committee for the "Tools and Information for Offshore Wind Stakeholders Conference" in Belfast, ME. McGlinchey also directs research on best practices for habitat management near wind turbine sites; the development of effective wind turbine bylaws and is developing a regional network for long-term avian mortality monitoring at wind turbine sites. Prior to joining Manomet, he was executive director of the Vineyard Energy Project on Martha's Vineyard. In addition, Madga Havas, Ph.D., Professor of Biology, University of Trent, Canada, addressed dangerous environmental couplings of electromagnetic fields from wind turbines when renewable energy converts DC to AC current and how to mitigate for "dirty electricity" -- an industry term -- caused by such couplings. And clinical psychologist Helen Parker, Ph.D., discussed Wind Turbine Syndrome caused by environmental infrasound. None of these speakers were anti-wind as part of renewable energy. All were about how to make wind capture safer for humans, wildlife, and the national utility grid via appropriate siting.

CT Attorney General George Jepsen sent an assistant AG to represent that office; state Representative Roberta Willis and State Senator Andrew Roraback both attended, as did numerous local municipal legislators. But surprisingly to all in attendance, the two main regulatory agencies and one legislative committee with a stake in the subject did not attend. The

Connecticut Siting Council was asked to be on the panel or send a representative, as was Daniel Esty, Commissioner of the CT Department of Energy and Environment, and CT Senator John Fonfara, co-chair of the Committee on Energy and Technology – all declined to attend or send representatives.

Some critical questions addressed at the forum included:

- What is the real risk/benefit ratio of wind turbines? Does that ratio change from region to region? What determines those variables?
- Are there potential, permanent adverse effects to other species such as birds and bats that are being ignored?
- Are there adverse effects from low frequency sound, vibration, and light flicker to humans and other species, especially in wetland habitats? What about increased ground current effects near turbines to reptiles and amphibians? Are sensitive habitats such as vernal pools especially vulnerable?
- Are environmental concerns primarily one of scale? And are there some windmill designs that are better than others?
- Are there inherent environmental problems when converting a direct current resource such as wind to an alternating current infrastructure? Are there ways, for instance, to avoid the phenomenon called “dirty electricity,” which creates high frequency harmonics on common utility lines and is considered a new metric for adverse health effects in humans?
- What are reasonable ways to mitigate, legislate, and anticipate such problems before damage is done?
- What is happening at the federal, state, and local levels?

BLEC’s Position:

Industrial wind turbines are more complex than anyone imagines at first glance. This is an issue suddenly facing many communities as wind companies seek to place facilities on pristine ridgelines and in wide valley corridors, ignoring the fact that sometimes our windy areas are also our most cherished.

No one in their right mind could be against renewable energy sources such as wind, solar, geothermal, and tidal resources. In fact, people have embraced small and medium-scale applications with an admirable fervor. Many applaud the federal government for stepping up with stimulus dollars, as well as state governments with tax breaks, to help get promising approaches to clean energy off the ground.

But in our enthusiasm for ‘green’ technologies, have we neglected potential downsides with industrial-scale facilities, especially when proposed for residential neighborhoods, sensitive environmental areas or scenic ridgelines? Have we factored that many interior regions of New England may not lend themselves to anything other than small-scale approaches due to weather, topography, and population density? Or that the financial payback for large-scale facilities may

never be justified in some areas in either the short or the long term? Or the fact that this nascent field is attracting speculators with no intention or ability to build such large systems but are rather developing sites to flip for profit after approvals are garnered? Is our automatic goodwill toward renewables being taken advantage of and how much caution should we bring to the table without being blindly obstructionist?

While BLEC lauds the attention to detail that the CSC has applied to the new Draft Wind Regulations, the regulations should not be adopted as proposed without changes. Below are suggestions:

- **General Impression:** The overall intent of the Draft seems to be to facilitate the wind industry with nothing too onerous and with maximum discretion awarded to the CSC. Unfortunately, this approach may well prove extremely onerous to wildlife and host municipalities, especially residential/scenic areas where 500+ foot turbines are wholly inappropriate. The CSC, in the only state with a centralized siting authority, has a unique opportunity to set the bar higher and better; to actually create a best-practices environmental wind model for the rest of the country. BLEC encourages the CSC to think more outside-the-box. Toward that end, please consider:
- **(Sec. 5, 16-50j-94, gC, p 12) Natural Resource Impact Evaluation Report:**
BLEC request: Incorporate Specific References to US Fish & Wildlife Wind Guidelines and Conservation Documents: Before writing the following point, BLEC queried Dr. Albert Manville (see attached BLEC editorial, Exhibit A.) at the US Fish & Wildlife Service (USFWS) for the Service's best advice to the CSC in drafting wind regulations. His comments include that: **The CSC specifically reference, and strongly recommend, that the USFWS recommendations for wind energy development through the Service's "2012 Wind Energy Guidelines" be strictly followed. (These are posted at www.fws.gov/windenergy/) While these guidelines are still in draft stage and the final version is unavailable for public release, BLEC and USFWS strongly recommend that the CSC closely follow the "Eagle Conservation Plan Guidance (ECPG), Version 1, Wind Module," also available on the USFWS's website. This ECPG guidance provides details of how to assess site development risk to Bald Eagles and Golden Eagles in Connecticut and elsewhere, and to avoid "take resulting in disturbance" and "take resulting in mortality" to both species. The ECPG, Version 1, provides details of how to acquire an individual "take" permit for Bald Eagles (50 CFR 22.26) as well as programmatic "take" for this species, provided the breeding population is stable or increasing. USFWS will not be issuing any permits for "take" of Golden Eagles -- either "disturbance" or "take resulting in mortality"-- individually or programmatically for this species in Connecticut, or anywhere east of Minnesota. While those two documents are voluntary, and the ECPG will provide a protocol for permitting "take" of Bald Eagles in Connecticut through 50 CFR 22.26 and 22.27 (nest take), other established statutes prevail. The "disturbance," killing, and injuring of bald and golden eagles, and the injuring or killing of any of the other 1,007 species of protected migratory birds, are each criminally culpable and each potentially criminal violations of The Bald and Golden Eagle Protection Act, as well as The Migratory Bird Treaty Act. Both are strict**

liability laws. Without specifying this in the CSC Draft, the wind developer, their consultants, and the CSC could be in violation of federal laws protecting the environment. Litchfield County is documented home to many of the species on the federal list, including both species of eagles.

- **Request New Wind Facility Designs:** BLEC requests that the CSC require safer, lower turbine designs such as vertical-axis wind turbines (VAWT's) – see attached Exhibit B – especially for interior land sites. (Quinnipiac University has several on campus.) Such designs can be positioned much closer together than bladed models; can be far shorter; can better capture wind in narrow valleys and thereby spare scenic ridgelines; can completely protect wildlife unlike larger-scale bladed facilities; create no infrasound, ice/blade throw or flicker. In addition, VAWT's do not create “barotraumas” to myriad species, especially bats. Barotraumas are the result of blade wake, turbulence and pressure gradients that can force birds and bats into the blades, sometimes from a great distance away from the facility. In fact, VAWT's bypass most of the problems that the CSC is trying to regulate. Requiring such designs and outlawing the bladed models could apply to both the customer-side distributed resources, as well as the grid-side distributed resources. They have even been shown to capture more wind nearer the ground than taller turbines at significantly higher altitudes. In the least, the CSC could specify that interior hilly areas such as Litchfield County can only site VAWT's. But even off-shore areas along the coast may lend themselves better to VAWT's than bladed models as those are primary seasonal migratory flyways too. Industrial-scale bladed models may eventually be found appropriate only in wide-open windy areas such as the Great Plains. The CSC has an opportunity to truly go “green” by mandating critical design distinctions. VAWT's also reduce community opposition.
- **(Sec.5.2, p.9) State Historic Preservation Office Review:** BLEC requests that adherence to The National Historic Preservation Act, National Natural Landmarks, and properties listed on the National Register of Historic Places be specifically mentioned. The CT State Historic Preservation Office is underfunded and does not always have the staff to conduct specific area reviews, relying instead on inadequate computer databases.
- **(Sec. 6 a, 1, 2, p.13) Setback Distances:** BLEC requests an increase in setbacks to 1.24 miles. The setback of 1.1 times the height of the wind turbine is nowhere near enough. Wind turbine manufacturers will always recommend the smallest setbacks to achieve their purposes. But the CSC, as a regulatory agency, first and foremost has a fiduciary responsibility to protect the citizens and the environment of the state. Although the CSC maintains the right to require greater setbacks, this is too discretionary to gain public confidence. At this small distance, with the wind turbines approved for instance in Colebrook at 492 feet with a blade sweep of close to 2-acres, that would permit a facility to be placed at a mere 500 feet from a property line. Ice throw alone will be greater than that. And according to the waiver section in Sec 6. 2 A, the setback could further be reduced as measured from the property line to a residence. There are numerous reports of people being made ill from such installations at less than 1.24 miles away and more in hilly/mountainous regions (see Exhibit C). Areas with far more experience than Connecticut are all moving toward much larger setbacks, especially in Europe. The Cape

Cod Planning Commission recommends 3000 feet; a lawsuit in Maine was settled when residents living within 3,500 feet of a wind farm were made ill. Falmouth, MA now requires a wind turbine there to be turned off at night because people at 1,320 feet away were being made ill. Please increase this setback to at least 1.24 miles away from property lines, not dwellings.

- **(Sec. 6 b 1, 2A and B p.14) Noise:** BLEC requests a reduction in classification and noise level allowances to below 30dBA at night. The classification of wind turbines as Class C industrial emitters is inappropriate to rural towns where no industry exists and which typically have a quieter ambient sound level under 30 dBA both day and night. This provision alone is a direct giveaway to the wind industry and sets the bar way too low. The Draft allows for 61 dBA during the day and 51 dBA at night – significantly higher than natural background levels in many areas of the state. These allowances are way too high and more realistic region-specific standards need to be set. Other states with far more experience in wind regulation have learned from experience to reduce permitted noise levels. Maine, where the wind constantly howls, especially along the coast, only allows 42 dBA at night. Vermont allows 30dBA at night in a bedroom. Please reduce these allowances. The Council should not grant itself the power to waive these noise levels at its discretion, even where abutting properties grant permission, are non-buildable, contain natural topographical barriers, or abutting parcels are subject to development restrictions. Such areas, while often devoid of potential human dangers, are also typically critical wildlife habitat that can be adversely impacted by increased noise above natural ambient levels. This is particularly true for infrasound which occurs below the human hearing threshold but is audible to other species. Both infrasound and other audible noise levels can result in wildlife site avoidance/abandonment, behavioral changes, reproductive anomalies, and sub-optimal environments that may threaten certain wildlife viability. In addition, such sites often border state forests where people go for peace and quiet. Such a waiver gives the CSC too much authority over sites held for the common good. There are also no provisions for noise monitoring after wind sites are approved.
- **(Sec. 6 c p.14) Shadow Flicker:** BLEC requests that shadow flicker allowances be made more stringent. Shadow flicker affects the whole of a property for humans and wildlife alike, not just inside a home. Seizures have been caused in some sensitive individuals who would then be unable to enjoy their own outdoor environments. The cumulative effects of all wind turbines should be considered and not taken one installation at a time.
- **Additional BLEC Requests:**
 1. BLEC requests that the CSC take the opportunity to include language requiring applicants to mitigate for “dirty electricity” generated when renewable energy is converted from DC to AC. Dirty electricity can create increased ground currents and abnormal energy couplings with powerline distribution networks within several miles of installations. This can cause problems for the utility grid as well as interfere with consumer electrical appliances. Dirty electricity is considered a new metric in human health problems. Technology exists to filter and stop this.

2. BLEC requests that the CSC require additional/better environmental review near protected lands. The waivers granted in the CSC review over all key aspects of wind facility siting are too broad and essentially allow industrial spot zones to be created at will throughout the state. This is contrary to state and local plans of conservation and development. The language of these waivers would allow the CSC to site mammoth wind installations close to lands held by private land trusts, near private recreational areas such as ski resorts, and near state-owned forests and preserves where wildlife abounds. Contained in these waivers is no mention that the CSC should then engage in a more robust environmental analysis near such protected properties, such as requiring the Department of Energy and Environmental Protection (DEEP) to conduct wildlife inventory and site reviews. One presumes that with wind turbines, that DEEP's analysis will be similar to that of its cell tower review, which entails little more than a search of its own inadequate database without site review or inventory. Industrial-scale wind turbines that can top 500 feet, with loud motors and spinning blades operating at the height of the Washington Monument, can carry environmental consequences that simply do not exist with 150 foot cell towers. To state the obvious, wildlife congregates in remote areas. That's the last place where such discretionary waivers should apply without increased levels of environmental review. Please rethink this approach as it appears more for the convenience of the CSC and the nascent wind industry than for the protection of Connecticut citizen's or the best interest of the environment.
3. BLEC requests that the CSC consider placing a time limit on when wind facilities must be built after site approval, after which the approval is automatically rescinded. This will hopefully discourage speculators from taking financial advantage of upfront federal/state stimulus money, then flipping approved sites for profit without facilities ever being built.

Conclusion:

Wind is a clear part of renewable energy but siting such facilities must be done with great care. Connecticut has the opportunity to learn from the mistakes of other states. Unlike passive solar collection or tidal energy capture, wind facilities carry significant environmental risks – many of which simply cannot be mitigated in sensitive environments. Wind energy is not a one-size-fits-all. Siting guidelines should be very region-specific and include considerations that go way beyond available wind modeling. While the CSC Draft Wind Regulations are a good start, more can be done to reduce the downside of wind facilities while augmenting the upside. The public confidence would be better served by clearer, more stringent siting guidelines, based on the best/highest environmental principles.

Thank you for the opportunity to address the CSC on behalf of The Berkshire-Litchfield Environmental Council.

Respectfully Submitted,

Mr. Starling W. Childs, MFS
President, Berkshire Litchfield Environmental Council

Ms. B. Blake Levitt
Communications Director, Berkshire-Litchfield Environmental Council

Mr. Ellery W. Sinclair
Executive Secretary, Berkshire-Litchfield Environmental Council

Attachments:

Exhibit A. “What is the Real Risk/Benefit of Big Wind?” by B. Blake Levitt, The Litchfield County Times, April 6, 2011.

Exhibit B. “Experimental wind-farm produces tenfold power increase,” by Kate Melville, Science agogo.com, July 14, 2011

Exhibit C. “Wind Turbine Syndrome” by Nina Pierpont, from Wind Turbine Syndrome: A Report on a Natural Experiment, 2009.

This appeared in The Litchfield County Times, April 6, 2011

The Bulletin (CTBulletin.com)

<http://countytimes.com/articles/2011/04/06/opinion/op-ed/doc4d9d143487a6b724789036.prt>

What is the Real Risk/Benefit of Big Wind?

Wednesday, April 6, 2011

By B. Blake Levitt

Just when there's an enviro no-brainer to embrace—like green renewable energy—careful scrutiny reveals another yawning maw of unintended consequences.

The Berkshire-Litchfield Environmental Council (BLEC) is sponsoring an educational forum April 16 at the Housatonic Valley Regional High School in Falls Village from 1 to 5 p.m., on commercial-scale wind generation. BLEC comes reluctantly to playing Cassandra this time because we like the idea of capturing something abundant, natural and free, then putting it to good use.

As a broad-based environmental organization founded in 1970, BLEC was an early proponent of renewable energy. We even published one of the first booklets on “renewables” in the early 1980s. That was long before notions of industrial Big Wind hooking into the national utility grid existed, or viable technologies for geothermal, fuel cells, roof-top solar, or current/tidal wave renewable energy were on anyone's radar. It's a whole new renewables world now, increasingly motivated by an imploding Middle East.

But it turns out commercial-scale wind generation is far more complex than anyone imagines at first glance. These are not our grandfather's faithful 30-foot tall windmills gracefully spinning in a farm field, generating enough electricity to pump well water. These are towering 300-to-515-foot tall behemoths—some approaching the height of the Washington Monument, often placed atop scenic ridgelines, creating serious obstacles to anything that flies, including airplanes. Humans can navigate around them; it's the migratory birds and bats—both increasingly imperiled—that get clobbered and suffer bigtime.

According to the BLEC forum's key-note speaker, Dr. Albert Manville, a senior wildlife biologist at the U.S. Fish and Wildlife Service (USFWS) in Washington, D.C., and our nation's authority on avian-structural impact problems, commercial wind turbines kill an estimated 440,000 protected migratory birds each year in the U.S.—an impact increasing with the exponential growth of wind energy. Even more bats may be killed each year from turbine collisions and something called barotraumas—the result of blade wake, turbulence and pressure gradients. The footprint and project area of a wind facility can be enormous—going well beyond just the turbine pads and roads servicing the area, fragmenting habitats, disturbing wildlife, and creating artificial barriers. This can all result in wildlife site avoidance, behavioral modification and the creation of sub-optimal

environments. Inappropriately placed wind facilities can even threaten wildlife population viability.

Dr. Manville says that while USFWS acknowledges the critical need to address our carbon footprint and his agency supports renewable energy as a part of that solution, “We cannot afford to create additional problems for wildlife and their habitats in our efforts to address climate change. Proper siting and selecting the most wildlife- and habitat-friendly locations, is the best way to minimize impacts to species and their habitats,” he noted.

Dr. Manville said that his agency prosecutes for illegal “take”—the term used for death or injury of birds, and disturbance to eagles—especially where proven conservation measures are available to avoid or minimize impacts. Proper responsible facility siting is a tool that can be used, he said.

Two draft documents, released to the public for comment through the Feb. 18 Federal Register, address wind development and eagle issues. These include USFWS’s “Draft Land-Based Wind Energy Guidelines,” based in part on the 2010 recommendations of the Wind Energy Federal Advisory Committee, on how to assess and minimize impacts to birds, bats, other wildlife and habitats.

The “Draft Eagle Conservation Plan Guidance” (also published Feb. 18 and open for comment through May 19), provides additional eagle-specific guidance intended to support issuance of eagle programmatic “take” permits for wind facilities. This draft guidance interprets existing regulations put into force in fall 2009, through which the USFWS finalized a “take” provision for non-purposeful (incidental) “disturbance take” and “take resulting in mortality” for both bald and golden eagles in the U.S. (50 CFR 22.26).

Any “take” of golden eagles in the Western U.S., for instance, must be completely offset by compensatory mitigation. In other words, wind companies can’t keep killing eagles without taking further steps to stabilize or increase populations through verified practices that protect habitats, or produce more surviving fledglings. Currently, no “take” permit of any kind will be issued for golden eagles in the Eastern U.S., including New England. Both eagle species may be present at potential wind development sites in New England during migration, overwintering or breeding.

While both of these new USFWS guidelines are voluntary at the moment, established statutes prevail. The unpermitted “take” of eagles, or any of the other 1,005 species of protected migratory birds, could be a criminal violation of the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, both of which are strict liability statutes. Wind developers, their consultants, planning/zoning commissions, and government officials need to carefully assess these issues and potential impacts before approving, siting and building wind facilities.

Dr. Manville wants Connecticut’s Department of Energy and Environmental Protection (DEEP), and our Siting Council, which has final authority over tower siting and is

currently reviewing the Colebrook and Prospect wind applications, to know it is extremely important that they work with USFWS at the outset to ensure all project sites are the most environmentally responsible and wildlife-sensitive. Improperly sited projects can enhance the likelihood of “take,” which everyone prefers to avoid. This means coordination with his agency before a site is selected, a landowner agreement is reached, a power purchase agreement is negotiated, a bank loan acquired, and the facility is operating. He stresses that the paradigm has shifted significantly, calling for better coordination between USFWS and state agencies.

BLEC has repeatedly invited representatives from both the DEEP and the Siting Council to hear Dr. Manville, but they have refused to send representatives due to perceived “conflicts of interests” while processing wind applications. That’s a specious excuse as they have refused to send even non-voting staff. Both agencies appear to look favorably on wind energy—Gov. Dannel Malloy and DEEP Commissioner Daniel C. Esty came out against a proposed moratorium on wind energy while the state created better regulations. But in the hubris of thinking they already know enough, our siting authorities could easily run afoul of the federal guidelines. Connecticut’s Attorney General George Jepsen would then have to defend those agencies against USFWS, a waste of taxpayers’ money.

Other significant problems for anyone living within several miles of wind turbines include increased ground currents and high-frequency abnormal energy couplings known as “dirty electricity,” which can interfere with other electrical appliances; continual low frequency sound that can reeve as loud as an airplane engine; environmental vibration, and constant light flicker from rotating blades. A combination of these factors can lead to something called Wind Turbine Syndrome in people living as far as a mile away. Symptoms include severe headaches, depression, anxiety, sleeplessness and a host of other adverse effects, including seizures in some susceptible individuals.

Then there is property devaluation; structural failures; fires that burn 500 feet in the air; and ice that can be thrown by moving blades. For an eye-opener of what can go wrong, see the Scottish Web site www.caithnesswindfarms.co.uk/fullaccidents.pdf

Wind may still hold promise in wide-open regions unlike interior New England. But we may have to reconsider the entire scale of commercial wind, see it as suitable only for specific regions, and require new, radically different designs. That’s where effective legislation and regulation come in. The simple fact is that wind energy may not be viable here.

B. Blake Levitt, a Warren author, is the Communications Director for The Berkshire-Litchfield Environmental Council.

URL: <http://www.countytimes.com/articles/2011/04/06/opinion/op-ed/doc4d9d143487a6b724789036.prt>

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14 July 2011

Experimental wind-farm produces tenfold power increase

by Kate Melville

Caltech researchers say the power output of wind-farms can be increased by an order of magnitude - at least tenfold -



simply by optimizing the placement of vertical wind turbines on a given plot of land. Details of the experimental wind-farm, located in northern Los Angeles County, appear in the *Journal of Renewable and Sustainable Energy*.

The experimental wind-farm houses two-dozen 1.2-meter-wide vertical-axis wind turbines (VAWTs). Vertical turbines that have rotors and look like eggbeaters sticking out of the ground. Each turbine is 10 meters tall.

Caltech's John Dabiri, who leads the research, said that despite improvements in the design of conventional propeller-type wind turbines, wind-farms remain inefficient. In such farms, the individual turbines have to be spaced far apart so they don't interfere aerodynamically with neighboring turbines, with the result that "much of the wind energy that enters a wind-farm is never tapped," says Dabiri.

Designers compensate for the energy loss by making bigger blades and taller towers, to suck up more of the available wind and at heights where gusts are more powerful. "But this brings other challenges," Dabiri says, such as higher costs, more complex engineering problems and a larger environmental impact.

The solution, according to Dabiri, is to focus instead on the design of the wind-farm itself, to maximize its energy-collecting efficiency at heights closer to the ground. While winds blow far less energetically at, say,

30 feet off the ground than at 100 feet, "the global wind power available 30 feet off the ground is greater than the world's electricity usage, several times over," he says. "The key is to ensure they're the right turbines, arranged in the right way."

VAWTs provide an important advantage in that they can be positioned very close to one another. This lets them capture nearly all of the energy of the blowing wind and even wind energy above the farm. Having every turbine turn in the opposite direction of its neighbors, the researchers found, also increases their efficiency, perhaps because the opposing spins decrease the drag on each turbine, allowing it to spin faster. Dabiri got the idea for using this type of constructive interference from his studies of schooling fish.

Dabiri measured the rotational speed and power generated by each of the six turbines when placed in a number of different configurations. One turbine was kept in a fixed position for every configuration; the others were on portable footings that allowed them to be shifted around.

The tests showed that an arrangement in which all of the turbines in an array were spaced four turbine diameters apart (roughly 5 meters) completely eliminated the aerodynamic interference between neighboring turbines. By comparison, removing the aerodynamic interference between propeller-style wind turbines would require spacing them about 20 diameters apart, which means a distance of more than one mile between the largest wind turbines now in use.

Impressively, the six VAWTs generated from 21 to 47 watts of power per square meter of land area; a comparably sized conventional wind-farm generates just 2 to 3 watts per square meter. The next steps, says Dabiri, "are to scale up the field demonstration and to improve upon the off-the-shelf wind-turbine designs used for the pilot study. I think these results are a compelling call for further research on alternatives to the wind-energy status quo."

Related:

[Floating Wind Turbines Could Sink NIMBY Protests](#)

[Biofuels' "green" credentials questioned](#)

[Renewables Provide A Ray Of Sunshine In Energy Debate](#)

[More images and video of the site](#)

Alternative Wind Turbine Designs:

http://www.scienceagogo.com/news/20110613232554data_trunc_sys.shtml

“Wind Turbine Syndrome” [700 words of text]

October 10, 2010

Wind turbines majestically threshing the wind—what marvels of human engineering! To stand beneath one is breathtaking. To live near one can be hell on earth. So I have been told by countless people who suddenly find themselves grievously ill from the subtle yet devastating infrasonic jackhammer generated by these “clean, green, renewable energy” giants.

The explanation may be tucked away in the inner ear in a cluster of tiny, interconnected organs with a remarkable evolutionary pedigree. The vestibular organs—the semicircular canals, saccule, and utricle—function as Mother Nature’s gyroscope, controlling our sense of motion, position, and balance, including our spatial thinking. (Remember when you got carsick as a kid? Or seasick?)

Humans share these enigmatic organs with a host of other backboned species, including fish and amphibians. Some scientists indeed see them as a kind of pan-species master key for an extraordinarily broad range of brain function—amounting to a sixth sense.

One of those functions, it now appears, is to register and respond to the sounds and vibrations (infrasound) we don’t consciously hear, but feel—as from wind turbines. For many people, the response is swift and disastrous.

Sometimes it’s advantageous being a country doctor. Six years ago I began hearing health complaints from people living in the shadow of these gigantic turbines. At first it was merely local and regional, then global. Tellingly, virtually everyone described the same constellation of symptoms. Symptoms that were being triggered, I began to suspect, by vestibular dysregulation. (1) Sleep disturbance. Not simply awakened, but awakening in a panic (“flight or fight” response). (2) Headache. (3) Tinnitus. (4) Ear pressure. (5) Dizziness. (6) Vertigo. (7) Nausea. (8) Visual blurring. (9) Tachycardia. (10) Irritability. (11) Problems with concentration and memory. (12) Panic episodes associated with sensations of internal pulsation or quivering, which arise while awake or asleep. (This latter involving other, non-vestibular organs of balance, motion, and position sense.)

None of these people had experienced these symptoms to any appreciable degree before the turbines became operational. All said their symptoms disappeared rapidly whenever they spent several days away from home. All said the symptoms reappeared when they returned home.

Many had supported the wind farm project before all this happened. Now, some became so ill, they literally abandoned their homes—locked the door and left.

Taking my cue from a British country doctor who was reporting identical “wind turbine” symptoms among her patients, I did what clinicians call a case series. I interviewed 10 families (38 people) both here and abroad, who had either left their homes or were about to leave. I found a statistically significant correlation between the telltale symptoms and pre-existing motion sensitivity, inner ear damage, and migraine disorder. Each is a risk factor for what I now christened Wind Turbine Syndrome. My data suggest, further, that young children and adults beyond age 50 are also at substantial risk.

The response from ear, nose, throat clinicians (otolaryngologists and neuro-otologists) was immediate and encouraging. One was Dr. F. Owen Black, a highly regarded neuro-otologist who consults for the US Navy and NASA on vestibular dysregulation.

Another was Dr. Alec Salt at the Washington University School of Medicine, who recently published a peer-reviewed study demonstrating that the cochlea (which links to the vestibular organs) responds to infrasound without registering it as sound. Infrasound, in fact, increases pressure inside both the cochlea and vestibular organs, distorting both balance and hearing. Salt thus effectively shatters the dogma that “what you can’t hear, can’t hurt you.”

It can indeed hurt you. The growing uproar among wind turbine neighbors testifies to this inconvenient truth.

My role is over. My waiting room is full. It’s time for governments to study this wind-generated scourge whose cure is simple. A 2 km setback (larger in hilly or mountainous terrain) fixes it. Wind developers, not unexpectedly, refuse to acknowledge the problem. They ridicule it as hysteria and NIMBYism (“Not In My Back Yard!”)—and refuse to build their machines 2 km (1.24 miles) away from homes.

“It’s difficult to get a man to understand something when his salary depends upon his not understanding it,” suggested Upton Sinclair. Perhaps so. In that case, expect more empty houses and (easily avoidable) suffering.

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