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December 4, 2009

BY HAND DELIVERY
Town of Allegany Planning Board, and
Town of Allegany Town Board
Town Hall
52 West Main St.
Allegany, NY

Re: Petition of Concerned Citizens of Cattaraugus County, Inc., regarding the regulation of wind farm noise

Dear Planning Board and Town Board members:

Please accept the following comments in support of the above-referenced petition. Comments on the need to regulate noise effects of wind turbines at distances beyond the 2,500 feet within which the Town's current local law restricts such effects begin on page 6, below. However, as a preliminary matter, the Planning Board and Town Board should also consider whether the benefits of inviting wind energy development to town outweigh potential burdens such as noise impacts.

What benefits would Allegany obtain by hosting wind farms?

The Planning Board has received Erica Heller (The Rocky Mountain Land Use Institute), *Wind and Solar Production and the Sustainable Development Code* (January, 2008), for consideration in its recommendation on changes to the Town's wind project regulations. The Rocky Mountain Land Use Institute report states that local governments should invite wind energy development to obtain economic and environmental benefits:

> **The case for local action**
>
> In addition to helping reduce CO_2 emissions, local governments should draft reasonable standards for wind turbines to protect local wind resources, maintain local autonomy, and diversify energy sources. Moreover, it [development of utility-scale wind projects] benefits communities that control their local power utility.

Id., p. 9.

The potential to achieve reduced carbon emissions with wind energy projects is addressed further below. The other grounds for recommending local governments promote such projects listed here do not apply to Allegany. The Town would not diversify its energy sources because

the electricity generated at a wind farm goes to the regional grid where it serves primarily urban areas in the region. Allegany would not benefit from increased control of local power because the Town does not control any local power utility. The only local benefits are monetary because the local environmental effects of siting a wind farm are all negative.

Wind farms are not sustainable sources of local jobs. Following construction, few permanent jobs are created and these are primarily low wage inspector jobs. Maintenance, repairs, accidents and other problems are generally addressed by out of town contractors and technical experts on staff with the operating company, from out of the area.

The Rocky Mountain Land Use Institute report relies almost entirely on industry sources of information and on the relatively new federal bureaus engaged in promoting renewable energy, such as the National Renewable Energy Laboratory and the Battelle Pacific Northwest Laboratory, divisions of the U.S. Department of Energy (DOE). On this basis the report finds: "Wind resources in the U.S. could provide as much as 20 percent of our total electrical power demand. . . . Benefits of renewable energy include reduced carbon emissions, diversified energy production, avoided utility expansion costs, improved air quality, reduced reliance on foreign oil, and others."

However, other research organizations, including European utility regulators and DOE's primary research arm, the Energy Information Administration (EIA) do not find that wind energy provides substantial benefits. European grid operator (and wind farm developer) E.On Netz reports that "wind farms can only replace traditional power station capacities to a limited degree," specifically about four percent because reliable generation capacity must be operated in reserve.[1] The National Academy of Sciences finds that, because it generates intermittently, a substantial amount of wind power needs to be backed-up by other generators, depending on the distinctive features of the transmission system into which wind power is integrated:

> . . . the cost of [wind energy's] intermittency (in terms of back-up or reserve requirements) will be less if the generation mix is dominated by power plants with fast ramp rates (gas, hydropower) than if it is dominated by coal or nuclear plants, which have high capital costs and slow ramp rates. . . . Denmark, for example, has access to substantial hydroelectric capacity, which it relies on to balance the intermittent output from wind-energy installations.[2]

Accordingly, the Academy concludes that wind power increases rather than decreases the need for reserve power.[3] Thus, wind farms do not significantly contribute to the need to avoid utility expansion costs.

The potential to achieve reduced carbon emissions is similarly overstated. The National Academy of Sciences estimates that by 2020 wind-generated energy could displace about 8% of the capacity of more polluting sources, could displace no more than 2.25% of U.S. man-made CO_2 emissions.[4] In states like New York where substantial hydroelectric power is integrated into

the grid, wind power may displace proven low emissions sources.[5] Little or no emissions reductions from coal combustion can therefore be realized as a result of greater integration of utility scale wind energy.[6]

Wind power generates surprisingly little electricity, and this further reduces its ability to displace carbon emissions. Wind turbine developer GE Energy reported to NYSERDA in 2005 that the "effective capacity" of these turbines *in New York* is 10%, "due to both the seasonal and daily patterns of the wind generation being largely out of phase with the NYISO load patterns."[7] That is, most electricity from wind power is generated during cold winter nights, but electricity load (demand) is greatest during warm summer days. As a result, the use of up to two-thirds of wind-generated electricity is transmitted to the grid at times when it is not needed. Even the 195-turbine Maple Ridge Wind Farm located on the Tug Hill Plateau, a high wind resource area,[8] generates just over 20% of its nameplate design capacity.[9]

To put this in context, a conventional power plant generates about 90% of its 1,000 MW design capacity; with 1.65 MW turbines, the Maple Ridge Wind Farm has a design capacity of 321.75 MW but generates on average little more than 64 MW. It would thus require three Maple Ridge projects to generate the average equivalent of a power plant, and unlike a power plant there would be substantial times when much less or no power at all would be available.

Finally, wind farms do not reduce reliance on foreign oil. Almost all emissions from combustion of oil products comes from the transportation sector.[10] Only about one percent of electric power comes from oil combustion nationally, and about three percent in New York.[11]

Why, then, is there a rush to build wind farms in our area? The best answer is that there are substantial federal and state incentives to do so. In fact, monetary benefits to Allegany would come primarily from state and federal sources of public money, not value created by addition of new energy resources. Planning and research has yet to be brought to bear on the important question, whether all this public money will achieve the desired economic and environment benefits.

Most of the revenue of a wind farm comes from tax credits and grants from the federal and state governments. A recent study finds that when all these tax credits are combined, utility-scale wind projects enjoy a -164% effective tax rate; that is, each year wind farms are credited more than one and one-half times the income required to cover costs, pay taxes and provide a reasonable return on investment.[12]

The availability of lucrative public money drives the way wind farms are financed, through "complex carbon credit structured products" including derivatives and "sub-index arbitrage strategies."[13] In simple terms, wind farms are financed in large part by selling the right to use tax credits to investment partners who, unlike wind farms, have enough income to generate sufficient tax liability to take advantage of the credits, and often transfer the tax credits to subsidiaries unrelated to renewable energy, including oil production facilities.[14]

One of the most important tax credit streams[15] is the Production Tax Credit (PTC), about two cents per kilowatt hour for electricity generated from a wind farm paid annually by the federal government for ten years.[16] Thus a wind farm that generates 20 MW on average[17] over the course of a year generates 175 million KWHs,[18] worth $3.5 million in tax credits per year for ten years. Since federal subsidies and support provided for utility-scale wind energy total $23.37 per MWH,[19] the same wind farm receives over four million in federal assistance, or more than half the revenue received from sales of electricity.[20]

The federal tax code also provides wind farms with a generous double declining balance depreciation over five years.[21] A parallel depreciation tax credit is provided to offset New York corporate tax liability.[22] These depreciation credits continue even if all project expenses are paid off during the five-year term, amounting to an interest-free loan.[23]

When investment incomes declined precipitously last fall, wind industry lobbyists complained to Congress that they could not finance wind projects, so the PTC should be converted into an outright grant. Congress agreed, and in the Stimulus Bill enacted into law last February a provision was added allowing wind farms to take a lump sum grant from the U.S. Treasury for 30% of the project cost in lieu of the PTC, so long as they construct the wind farm by the end 2010 and place the project into service by the end of 2011.[24]

On September 1, 2009, under the first disbursement of the new grant-in-lieu-of-PTC benefit, the Canandaigua Power Partners wind farm in Cohocton (Steuben Co.) got a check for over $74 million from Treasury.[25] Nationally, $503 million was disbursed to wind farms in September to create 2,000 jobs, thus each job created cost taxpayers one quarter-million dollars.[26] On September 22, 2009, another $550 million in new awards was disbursed, again most to wind farms.[27] Over half the federal renewable energy stimulus money disbursed in September went to Spanish wind farm developer, Iberdrola S.A. (which now owns NYSEG), and 84 percent of the total went to foreign wind companies.[28] It is estimated that this program, which unlike Cash-for-Clunkers has no cap, will cost taxpayers $10 billion over the next three years.[29]

In New York, additional revenue comes from the New York State Energy Research and Development Authority (NYSERDA), which has devoted a substantial portion of the Systems Benefit Charge in ratepayers' utility bills to grants to wind farms.[30] Additional revenue is obtained from renewable energy credits (RECs), also called environmental attributes, which Renewable Portfolio Standards (RPS) programs in states like New York award to wind farms and required be purchased by power generators who need to offset their carbon emissions. Environmental attributes sold under RPS programs boost wind power revenue to "about $12 to $15 more per MW than power generated by fossil fuels, before local, state and federal tax credits and exemptions."[31]

Wind farms are exempt from local property taxes in New York under either Real Property Law[32] or, when sponsored by an Industrial Development Agency (IDA), General Municipal Law.[33] Instead wind developers offer to pay about 20% of the amount they would be taxed at

their assessed value.[34] This is a small fraction of the public money from tax credits and government grants that provide the primary source of revenue to a wind farm. This fraction is simply transferred from taxpayers to local governments.

Thus most of the revenue obtained by a wind farm is drawn from the public, based on successful political lobbying, and on balance adds no economic benefit to society. This is a business strategy energy analyst Robert Bradley calls political capitalism, which he finds originated in the energy business with Ken Lay at Enron and survives today in wind farm financing.[35]

What burdens would Allegany shoulder by hosting wind farms?

Against the often exaggerated benefits of wind power should be weighed the environmental burdens, which fall mainly on the host community. The primary potential burden of interest is the effects of wind turbine noise, since that is the subject of the petition before the Planning Board. However, before discussing noise impacts, it is worthwhile to consider the variety of adverse environmental impacts that result from wind farms.

According to the wind industry, adverse visual impacts (including rotating blades, blinking night lights) affect the viewscape up to five kilometers away, depending on topography.[36] Shadow flicker from wind turbine blades spinning in front of a sunrise or sunset is linked to dilation of blood vessels in the eyes and associated headaches (neural oscillation) in healthy people.[37] Habitat fragmentation caused by access roads to wind turbine sites and clear-cutting for transmission lines can be substantial, adversely affecting breeding birds in particular.[38] It has been estimated "that U.S. wind turbines kill between 75,000 and 275,000 birds per year,"[39] and outside of migratory flyways slow-flying raptors such as osprey, eagles and red-tailed hawks appear to be most at risk.[40] Bats are killed by wind turbines in large numbers as a result of collisions with the turbine blades,[41] and because their lungs explode, unable to tolerate the pressure change that occurs when passing through the blades and blade-tip turbulence, a phenomenon known as barotrauma.[42]

Wind farms interfere with wireless, radar and other radio frequencies,[43] affecting weather forecasting in the host community,[44] and prompting the Federal Aviation Administration (FAA) to require use of a screening tool developed by the U.S. Department of Defense to determine whether an area proposed for wind farm development will require an aeronautical study to protect Air Defense and Homeland Security radars.[45] FAA requires obstruction lighting, which causes pulsing red or white lights at night throughout the project area.[46] Emergency medical service helicopters may refuse to land near a wind farm because of dangerous air turbulence or because of FAA lighting, making night time landing unsafe.[47] However, most complaints at existing wind farms and concerns about proposed wind farms address noise impacts.

WIND FARM NOISE

Research into wind turbine noise is relatively new and complex. This research has established two significant conclusions relevant to siting wind farms in rural residential communities: (1) wind farm noise is significantly more annoying than other noise sources at the same decibel (loudness) level; and (2) wind farm noise results in chronic sleep disturbance for a significant number of those who live within a mile away, and chronic sleep disturbance, in turn, results in serious health effects. Noise impacts are therefore not only an aesthetic concern but are also a health concern.[48] To avoid these conclusions, noise assessments by wind developers routinely depart from accepted standards in acoustics.

a. Wind farm noise is distinctively annoying.

A number of reports find that, at the same sound pressure (decibel) level or less, wind turbine noise is experienced as more annoying than airport, truck traffic or railroad noise.[49] Annoyance is more likely when wind turbines are a prominent visual feature of the viewscape.[50] DEC has issued guidelines written for staff who lack a background in acoustics but are often called upon to evaluate noise assessments.[51] The DEC guidance states that impulsive and low frequency sounds will increase annoyance "The amplitude (loudness), frequency (pitch), impulse patterns and duration of sound all affect the potential for a sound to be a noise."[52]

Impulsive sounds caused by wind turbines–those sounds that are rhythmic, modulating, beating or pulsating–are particularly annoying.[53] To compensate for the added annoyance of impulsive sound, the convention is to add a penalty of 5 dBA to modeled sound or to subtract an equivalent amount from the allowable numerical sound level.[54]

The impulsive character of wind turbine noise is caused by air turbulence around the turbine blades.[55] There are a number of explanations for this fact, and more than one may apply at any specific wind turbine site. For example, eddies in the wind, wind shear (different wind speeds at the higher reach of the blades compared to the lower reach), slightly different wind directions across the plane of the blades, interaction among turbines, and the interaction of the blades of a turbine with the tower have each been identified as causes of pulsating wind turbine noise.[56]

Impulsive sound was considered more problematic for older turbines that had rotors mounted downwind from the tower.[57] The sound was reduced by mounting the rotor upwind of the tower, common now on all modern turbines.[58] However, in a landmark study now referred to in all serious discussions of wind turbine noise, van den Berg found the beating sound of wind turbines increases with size because taller modern turbines are subject to wind shear, the occurrence of calm air at ground level and high winds at turbine height.[59] "A high wind shear at night is very common and must be regarded a standard feature of the night time atmosphere in the temperate zone and over land."[60]

In other words, when ground-level wind speed calms after sunset, wind speed at typical hub height for large wind turbines (80 meters, or 262 feet) commonly increases.[61] As a result, turbines can be expected to operate, generating noise, while it remains very quiet down below, where people live. "The contrast between wind turbine and ambient sound levels is therefore at night more pronounced."[62] Wind shear occurred in the van den Berg measurements 47% of the time over the course a year on average, and most often at night.[63]

Wind shear resulting in substantially higher noise levels from a wind farm than predicted in project application studies has recently been confirmed at the Maple Ridge Wind Farm in Lewis County, New York.[64]

Wind shear within the rotor swept area of a wind turbine can also magnify noise impact. As the turbines sweep from top to bottom the blade tip can encounter slightly different wind velocities creating unexpected turbulence that results in rhythmic swishing noise.[65]

Low frequency sound, both audible and inaudible, is caused by wind turbines and is also impulsive. A wind farm can triple the impulse sound caused by wind turbines when the impulses of three or more turbines become synchronized.[66]

Low frequency sounds are also particularly annoying, compared to more audible mid-frequency sounds.[67] Sound measured as dBA is biased toward 4,000 Hz, the center of the most audible frequency range of sound pressure. Low frequency sound is in the range below 500 Hz and is measured as dBC. Sound below 20 Hz, termed infrasound, is generally inaudible but able to vibrate windows, walls and household items.[68]

Low-frequency sound and inaudible infrasound from wind turbines "can penetrate the home's walls and roof with very little . . . noise reduction."[69] Infrasound "may cause structural elements of buildings to vibrate [and these] vibrations may produce higher frequency, audible sound."[70] Acoustic modeling for low frequency sound emissions of ten 2.5 MW turbines indicates "that the one mile low frequency results are only 6.3 dB below the 1,000 foot one turbine example."[71]

Even if wind turbines did not emit impulsive and low frequency sounds, state environmental guidelines indicate the loudness of industrial wind turbines in very quiet rural residential settings is unacceptable. DEC guidelines state:

> (1) "In non-industrial settings the SPL [sound pressure level] should probably not exceed ambient [pre-construction] noise by more than 6 dB(A) at the receptor."[72]
>
> (2) "An increase of 10 dB(A) deserves consideration of avoidance and mitigation measures in most cases."[73]
>
> (3) Among the accepted mitigation measures is: "Increasing the setback

distance."[74]

(4) "SPL increases approaching 10 dB result in a perceived doubling of SPL."[75]

(5) An SPL increase over 20 dB will be experienced as: "Very objectionable to intolerable."[76]

(6) "A noise can intrude only if it differs in character or SPL from the normal ambient sound."[77]

(7) "If the goal is not to raise the future noise levels the new facility would have to operate at 10 dB(A) or more lower than the ambient."[78]

(8) "$L_{(90)}$ is often used to designate the background noise level."[79]

The first of these conclusions justifies a limit of no more than 6 dBA above existing background sound levels. DEC's fifth conclusion indicates that allowing 50 dBA at residences, as recommended by the wind industry, would be "intolerable" if background levels are characteristically about 25 dBA.[80] Unfortunately, based on wind industry recommendations, NYSERDA continues to recommend that New York towns adopt a 50 dBA limit at residences and a 55 dBA limit at property lines.[81]

DEC's fourth, fifth, and sixth conclusions support the view that a sound source that quadruples the existing loudness in the background acoustic environment, including at night will be experienced as particularly annoying.

It is important to recognize that an increase of 6 dBA above pre-construction sound levels (representing over 50% increase in loudness) is enough to cause project sounds to be heard, but not enough to cause any damage to hearing.[82] The annoyance is due to the modulating and low frequency character of the noise, together with its relative loudness in quiet settings, especially at night, not its absolute sound pressure level.[83]

As other standard setting agencies have indicated, setbacks of at least one kilometer (3,280 feet from utility-scale wind turbines) would be necessary to avoid adding more than 6 dBA to the existing sound background.[84] This is consistent with the van den Berg study:

> in quiet nights the wind farm can be heard at distances of up to several kilometers when the turbines rotate at high speed. In these nights, certainly at distances from 500 to 1000 m [1,640 to 3,280 feet] from the wind farm, one can hear a low pitched thumping sound with a repetition rate of about once a second (coinciding with the frequency of blades passing a turbine mast), not unlike distant pile driving, superimposed on a constant broad band "noisy" sound. A resident living at 1 km from the nearest turbine says it is the rhythmic character of the sound that

> attracts attention: beats are clearly audible for some time, then fade away to come back again a little later. A resident living at 2.3 km from the wind farm describes the sound as "an endless train". In daytime these pulses are usually not audible and the sound from the wind farm is less intrusive or even inaudible (especially in strong winds because of the then high ambient sound level).[85]

At these distances, the mid-frequency range sounds diminish because they are more readily absorbed by the air, but the low frequency sounds do not. Wind turbines at such distances will generate "a louder and more low frequency 'thumping' sound and less the swishing sound that is observed close to a daytime wind turbine."[86]

Thus, the annoyance of wind turbine noise is the result of its rhythmic or modulating character, its low frequency component, and its presence during times of calm surface atmosphere, most commonly at night when sound travels farthest and residents expect the greatest degree of quiet.

b. Wind farm noise results in chronic sleep disturbance for a significant number of those who live within a mile away.

It is important to distinguish new and controversial studies that link low frequency noise impacts to impairment of the vestibular system or other organs[87] from well-established findings that wind farm noise is a cause of sleeplessness, and health effects that result from chronic sleeplessness.[88] The discussion in this section is limited to sleeplessness and health problems associated with sleeplessness.

The World Health Organization (WHO) considers sleep disturbance to be an adverse health impact.[89] Chronic sleeplessness results in "primary physiological effects . . . induced by noise during sleep, including increased blood pressure; increased heart rate; increased finger pulse amplitude; vasoconstriction; changes in respiration; cardiac arrhythmia; and an increase in body movements."[90] "Exposure to night-time noise also induces secondary effects, or so-called after effects . . . includ[ing] reduced perceived sleep quality; increased fatigue; depressed mood or well-being; and decreased performance."[91] Waking up in response to nighttime noise decreases as people get habituated to the noise; however, "habituation has been shown for awakenings, but not for heart rate and after effects such as perceived sleep quality, mood and performance."[92]

In 2007 WHO issued Night Time Noise Guidelines (NNGL) to protect the ability to sleep, recommending that to avoid adverse health effects outdoor sound levels in rural areas at night not exceed 30 dBA.[93] Because background sound levels in rural residential areas in New York are commonly about 25 dBA at night,[94] local noise regulations limiting wind turbine noise impacts to no more than 5 dBA above background sound level are required to meet WHO's NNGL goal.

c. The wind industry's approach to noise assessment.

Wind developers commonly adopt an approach to noise assessment that results in finding background sound levels in rural areas are around 45 dBA, wind sound at ground level will mask turbine noise, and therefore total noise impacts will be insignificant for nearly everyone within one mile of a wind farm project. This is a novel approach to acoustics and cannot be sustained on professional grounds.

Background sound level as the baseline against which project impact sound should be assessed requires that transient sounds be excluded from the measurements used to calculate L_{A90}, the average background sound level.[95] This is in contrast to L_{Aeq}, an average sound level favored by wind energy facility developers, "which may include the effects of near-by and short term sounds."[96] Developers include "such things as local traffic, industrial sounds, farm machinery, barking dogs, lawnmowers, children playing and the interaction of the wind with ground cover, buildings, trees, power lines, etc." in their measurement of pre-construction baseline sound levels,[97] but this approach departs from acoustics standards.[98] The relevant consideration is the need to capture the quietest period of time wind farms will operate because that is the time most complaints can be expected. Using a different measure for background, ambient or pre-construction baseline sound will underpredict complaints.[99]

In addition, wind developers commonly "normalize" predicted sound levels at ground level based on wind speeds at turbine hub height, assuming that wind speeds at turbine hub height will generate "masking" noise as the wind at ground level rustles vegetation.[100] However, this ignores the effect of wind shear, which van den Berg and others have found results in no masking effect, because calm air at ground level often coincides with strong winds at turbine hub height.[101]

For example, commenting on a developer's method of adding "masking noise" to measured background sound levels, in an attempt to show that wind project noise will result in an insignificant increase in the community's sound level, James states:

> This interpretation is contrary to the generally accepted understanding of a community's "background sound level." This is a defined term in acoustics. To alter its meaning to be the noisiest conditions and not the quiet conditions as generally accepted for land use planning and evaluating a community's reaction to a new noise source is truly novel. It is clearly at odds with ANSI standards and procedures for assessing background sound levels and for assessing the impact of a new noise source on a community.[102]

Another acoustic engineer has criticized a wind developer's noise assessment for giving the false impression that high frequency insect noise could mask low frequency wind turbine noise.[103]

Wind industry recommendations for noise standards have long been the sole basis for

model local ordinances prepared by the industry and state and local agencies.[104] The noise limits in these model local laws appeared to be reasonable for some years before research became available addressing concerns that, even where there is compliance with these limits there is a high level of complaints.[105] However, now that such research is available and provides confirmation that wind developers' impact assessment methods seriously underestimate wind turbine noise, there can be no excuse for failing to consult this literature.

Should Allegany remove distance limits on the noise protection in its local wind law?

The Allegany Town Board has legislatively determined that project-generated sound levels from a wind farm should be limited to no more than an insignificant change in the existing acoustic environment. However, the Board has not anticipated how far elevated industrial noise from turbines can travel, including low frequency sounds and modulated or pulsating sounds. As discussed above, such sounds can result in significant disturbance at least one kilometer away (3,280 feet), especially inside a dwelling where sound levels can be very quiet, and especially at night when the expectation of quiet is greatest. If the Town intends to protect its residents from such effects, the 2,500 foot distance restriction within which residents can enjoy the protection should be removed.

The added burden on a developer would not be significant because the local law allows the noise increase limit to be waived by demonstrating that owners of neighboring properties who may experience offensive noise levels have granted the developer permission to exceed the limit. *See* Allegany Zoning Ord. II, Art. V, Sec. 5.25(C)(3). In other words, the developer need only negotiate noise or setback easements with owners of property on which the developer would otherwise be unable to achieve compliance.

Removing the 2,500 foot distance restriction within which noise limits apply balances the Town's obligation to safeguard health and welfare–current uses and enjoyment of rural residential property–and economic benefits the Town can expect from a wind project, and would not impose an impossible burden on the developer.

Most importantly, because annoyance from noise can be expected with some frequency well beyond 2,500 feet from a wind farm, if the Town's goal is to preserve the existing peace and quiet in the rural areas of the town, it is not reasonable to limit the application of regulations within that distance. The noise limit protection already adopted by the Town Board should therefore apply without regard to distance.

Respectfully submitted,

/s/
Gary A. Abraham
Attorney for Concerned Citizens of Cattaraugus County, Inc.

gaa
cc: Carol Horowitz, Town Planner

NOTES

1. E.ON Netz GmbH, WIND REPORT 2005, p. 10, available at <http://www.eon-netz.com/pages/ene_en/EEG__KWK-G/Renewable_Energy_Sources_Act_/EEG_plants/Facts_and_figures_relating_to_wind_power/index.htm> ("In order to also guarantee reliable electricity supplies when wind farms produce little or no power, e.g. during periods of calm or storm-related shutdowns, traditional power station capacities must be available as a reserve. This means that wind farms can only replace traditional power station capacities to a limited degree. . . . In concrete terms, this means that in 2020, with a forecast wind power capacity of over 48,000MW (Source: dena grid study), 2,000MW of traditional power production can be replaced by these wind farms.")

2. National Academy of Sciences, ENVIRONMENTAL IMPACTS OF WIND-ENERGY PROJECTS (2007), p. 35, available at <http://www.nap.edu/openbook.php?isbn=0309108349> (hereafter cited as "NAS").

3. NAS, 35, 52, 63-64. *See also* Richard S. Courtney (Center for Science and Public Policy, Washington, D.C.), *Wind Farms Provide Negligible Useful Electricity*, March 2006, p. 13, <http://ff.org/centers/csspp/pdf/20060331_wind.pdf> ("large use of wind farms provides no reduction to the need to operate conventional thermal power stations and makes little or no reduction to emissions from them"); Michael J. Trebilcock (Professor of Law and Economics, University of Toronto), *Wind power is a complete disaster*, NATIONAL POST (Canada), April 8, 2009 ("recent academic research shows that wind power may actually increase greenhouse gas emissions in some cases, depending on the carbon-intensity of back-up generation required because of its intermittent character."); Tyndall Centre for Climate Change Research, *Security assessment of future UK electricity scenarios*, July 2005, pp. 5, <http://www.tyndall.ac.uk/research/ theme2/final_reports/t2_24.pdf> ("Due to a relatively small capacity contribution of intermittent sources [in particular, wind energy sources] a considerable number of conventional plants might be running at low output levels over a significant proportion of their operational time to accommodate this intermittent energy. Consequently these plants will have to compromise on their efficiency resulting in increased levels of fuel consumption as well as emissions per unit of electricity produced."). *See also id.*, 24, 46.

4. NAS, 63-64.

5. On October 15, 2009, New York's Public Service Commission (PSC) adopted rules requiring wind farm developers to demonstrate that their project is merely replacing an existing source of renewable energy such as a hydro plant. PSC, Order Prescribing Study Methodology, Case No. 09-E-0497, October 20, 2009, <www.dps.state.ny.us>; Larry Rulison, *New rule called obstacle to wind power: Advocates say regulation will impede shift to key clean power technology in the Empire State*, ALBANY TIMES UNION, October 26, 2009, <http://www.timesunion.com/AspStories/story.asp?storyID=857320>.

6. David Chandler, *Renewable energy regulations may miss the mark, says MIT graduate student*, MIT NEWS, October 1, 2008, <http://web.mit.edu/newsoffice/2008/renewable-energy-tt1001.html> (research finds "wind farms . . . almost never displace baseload coal-fired plants").

7. GE Energy, THE EFFECTS OF INTEGRATING WIND POWER ON TRANSMISSION SYSTEM PLANNING, RELIABILITY, AND OPERATIONS (REPORT ON PHASE 2), prepared for NYSERDA. March 4, 2005), p. 7.16, available at <http://www.nyserda.org/publications/wind_integration_report.pdf>. Early "wind resource performance data has tended to validate the use of the [2005] GE study." New York State Reliability Council, L.L.C., INSTALLED CAPACITY SUBCOMMITTEE MEETING #76, May 4, 2007, 5, <http://www.nysrc.org/pdf/ICSMeetingMinutes/20070504ICS Minutes_Final.pdf>. NYISO is the state electric grid operator, New York Independent System Operator.

8. Wind resource maps for all of New York State are available at <http://windexplorer.awstruewind.com/NewYork/NewYork.htm>.

9. *Cf.* Federal Energy Regulatory Commission (FERC), *Electric Quarterly Reports (EQRs)*, Download Spreadsheets utility (by quarter and name of company), <http://www.ferc.gov/docs-filing/eqr/data.asp>. This utility provides the actual quarterly generation rate for each wind project which must then be compared to the project's nameplate capacity. Note that actual generation rates may not be equivalent to effective capacity. *See above*, note 7.

10. EIA, *U.S. Primary Energy Consumption by Source and Sector, 2008*, <http://www.eia.doe.gov/emeu/aer/pecss_diagram.html> (95% of U.S. oil consumption occurs in the transportation sector).

11. EIA, *Electric Power Monthly*, January 2009, Table 1.2, <http://www.eia.doe.gov/cneaf/electricity/epm/epm_sum.html> (in 2006, only about one percent of the electricity generated in the United States was produced using oil); EIA, *State Energy Profiles: New York*, available at <http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=NY> (2.5% of New York's oil consumption is used for electricity generation).

12. Gilbert E. Metcalf, *Taxing Energy in the United States: Which Fuels Does the Tax Code Favor?* MANHATTAN INST. (January 2009), p. 5, Table 2, available at <http://www.manhattan- institute.org/html/eper_04.htm>. Metcalfe is Professor of Economics at Tufts University. The effective tax rate for natural gas is 34.4%, for nuclear, -99.5%. *Id.*

13. *Cf.* John Vidal, *The carbon cash-in*, THE GUARDIAN, October 22, 2008, <http://www.guardian.co.uk/environment/ 2008/oct/22/1> (reporting that "the world's leading investment banks meet in London today to discuss how they can 'cash in' on carbon").

14. *Cf.* Baker Botts LLP, *Revenue Procedure Establishes a Safe Harbor for 'Partnership Flip' Structures in Wind Projects*, <http://www.bakerbotts.com/file_upload/SafeHarborforPartnership FlipStructuresinWindDeals.htm> ("A common technique to finance the construction of wind projects is the 'partnership flip' structure, which involves the formation of a tax partnership between a developer and one or more tax equity investors. Under this structure, the tax equity investor is allocated the vast majority of the PTCs for the ten year period during which the PTCs are available for the project. [IRS Revenue Procedure 2007-65] sets forth minimum requirements which, if met, will ensure that the IRS will respect the partnership as a partnership and will not challenge the allocations of PTCs."). *See generally* Stoel Rives LLP, THE LAW OF WIND: A GUIDE TO BUSINESS AND LEGAL ISSUES, 5th ed. (2009), <http://www.stoel.com/showarticle.aspx?show=1185>, ch. 8 (describing in depth lending and financing strategies for wind projects).

15. Angela Neville, *Prevailing Winds: Trends in U.S. Wind Energy*, POWER MAGAZINE, December 1, 2008, <http://www.powermag.com/issues/features/Prevailing-winds-Trends-in-U-S-wind-energy_1573.html> (the number of wind turbines installed dropped quickly each time the U.S. production tax credit expired, in 1999, 2001 and 2003).

16. I.R.C. § 45(a).

17. The capacity factor assigned to wind farms in New York is 10% in summer, 30% in winter; therefore the average annual actual capacity is assumed to be 20 MW. *See* NYISO, 2007 GOLD BOOK, pp. 45, 58, <http://www.nyiso.com/public/webdocs/services/planning/planning_data_reference_documents/2007_GoldBook_PUBLIC.pdf>.

18. 20 MW = 20,000 KW X 8,760 hrs./yr. = 175,200,000 KWH.

19. EIA, FEDERAL FINANCIAL INTERVENTIONS AND SUBSIDIES IN ENERGY MARKETS 2007 (April 2008), *Executive Summary*, p. xvi, <http://www.eia.doe.gov/oiaf/servicerpt/subsidy2/index.html>.

20. This is based on the 100.5 MW Noble Bliss Windpark, which reported to FERC that it generated 22% of its rated capacity over the four quarters from July 2008 to June 2009 for which it was paid $8.1 million. *Cf. above*, note 9.

21. *See generally* I.R.C. § 168. *See also* Glenn R. Schleede, Comments submitted to New York State Energy Planning Board, July 30, 2008, pp. 2-3 <http://www.nysenergyplan.com/presentations/PDF/Glenn R. Schleede.pdf>.

22. *Id.*, p. 4. Summaries and histories for most state subsidies for renewable energy projects are available at Database for State Incentives for Renewables & Efficiency, <www.dsireusa.org>.

23. *Id.*, p. 3.

24. The American Recovery and Reinvestment Act of 2009 (Stimulus Bill), Public Law 111-5, 123 Stat. 364, Sec. 1603 (February 17, 2009). *See generally*, Jeffry S. Hinman, *The Green Economic Recovery: Wind Energy Tax Policy After Financial Crisis and the American Recovery and Reinvestment Act of 2009*, 25 J. ENVTL. LAW & LITIG. 35, at 55-68 (2009); and Stoel Rives LLP, THE LAW OF WIND, *above*, note 14, ch. 9.

25. U.S. Department of Energy (DOE), *Treasury, Energy Announce $500 Million in Awards for Clean Energy Projects,* September 1, 2009 (press release), <http://www.energy.gov/news2009/print2009/7851.htm>.

26. *Id.* It is not clear from DOE's press release whether these would be permanent or temporary (e.g., construction-related) jobs. A typical 100 MW wind farm generates as little as five permanent local positions or as many as sixteen. *Cf.* Larry Flowers, NREL, Wind Energy Update, August 2009, <http://www.windpoweringamerica.gov/pdfs/wpa/wpa_update.pdf> (comparing permanent operations and maintenance jobs generated at wind projects in Iowa, South Dakota, Colorado, Oklahoma and Wyoming).

27. DOE, Treasury, *Energy Surpass $1 Billion Milestone in Recovery Act Awards for Clean Energy Projects*, September 22, 2009 (press release), <http://www.energy.gov/news2009/8038.htm>.

28. Russ Choma (Investigative Reporting Workshop, American University School of Communication), *Overseas firms collecting most green energy money*, October 29, 2009, <http://investigativereportingworkshop.org/investigations/wind-energy-funds-going-overseas/>.

29. Russell Gold, *Wind Farms Set Wall Street Aflutter*, WALL STREET JOURNAL, August 31, 2009.

30. Schleede, *above*, note 21 p. 4 (noting that in 2007 NYSERDA awarded payments over 10 years to nine proposed wind farms owned by three companies averaging $15 per megawatt-hour (MWh) of electric produced, or $0.015 cents per kWh); Steve Cohen, *Promoting Energy Efficiency: Comparing New York State to California,* THE NEW YORK OBSERVER, September 17, 2008, <http://www.observer.com/2008/green/promoting-energy-efficiency-comparing-new-york-state-california-0>.("The System Benefits Charge generated $150 million a year from 2001-2006 and was increased to $175 million per year from 2006-2008. Funding allocations will change in October, when the Public Service Commission increases its annual System Benefits Charge revenue collections from $175 million to $347 million. NYSERDA will receive most of the new funding – $260 million . . ."). For specific wind projects NYSERDA has sponsored, go to <http://www.powernaturally.org/programs/wind/ UtilityScale_LargeWind.asp?i=8>.

31. Stoel Rives LLP, THE LAW OF WIND, *above*, note 14, p. 8-5.

32. RPTL § 487 (making renewable energy property exempt from local property taxes unless the local tax jurisdiction opts out by resolution or local law).

33. GML § 858 (making renewable energy property exempt from local sales, mortgage recording and property taxes whenever an IDA provides financial assistance to the energy project, and regardless of whether affected tax jurisdictions opt out under RPTL § 487).

34. *Cf.* Nancy Madsen, *JCIDA [Jefferson County IDA] crafts tax-exemption formula*, WATERTOWN DAILY TIMES, September 6, 2009, <http://www.watertowndailytimes.com/article/ 20090906/NEWS03/309069966> (payments to IDA by wind farm developer of $8,500 per MW of installed capacity are about 20 percent of "full taxation"). Generally in New York, payments in lieu of taxes to an IDA are split among the school district, the County and the host town roughly 50%-40%-10%, respectively, or about $2,500 per MW to the school, $2,000 to the County and $500 to the town in this example. *See* GML § 858[17].

35. Robert Bradley, *Who Was Ken Lay? (The Senate should know the industry father of U.S.-side cap-and-trade)*, July 7, 2009, MasterResource: A free-market energy blog, <http://masterresource.org/ ?p=3644>.

36. *See* University of Newcastle, *Visual Assessment of Windfarms Best Practice*, SCOTTISH NATURAL HERITAGE COMMISSIONED REPORT F01AA303A (2002), p. 10, <http://www.snh.org.uk/pdfs/publications/commissioned_reports/f01aa303a.pdf>. To screen for adverse visual impacts, Scottish authorities recommend wind farms be set back two kilometers from "the edge of cities, towns and villages." SCOTTISH PLANNING POLICY SPP 6, RENEWABLE ENERGY, March 2007, p. 18, <http://www.scotland.gov.uk/Publications/2007/03/22084213/22>. *See also below*, note 50.

37. Letter from A. Kevin Gleason, Assistant Director, Bureau of Toxic Substance Assessment, NYSDOH, to James P. Sherron, Executive Director, Steuben County IDA (comments on Ecogen LLC, Prattsburgh/Italy Wind Farm proposal), June 7, 2005, p. 4 (on file with the Author).

38. U.S. Fish and Wildlife Service (FWS), INTERIM GUIDELINES TO AVOID AND MINIMIZE WILDLIFE IMPACTS FROM WIND TURBINES, p. 4 (May 13, 2003), available from <http://www.fws.gov/ habitatconservation/wind.html>. FWS must be consulted whenever a wind farm requires Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers. In New York, the Breeding Bird Atlas may be consulted for a list of breeding birds known to breed in specific areas of the state. *Cf.* <http://www.dec.ny.gov/animals/7312.html> (scroll to bottom).

39. Robert Bryce, *Windmills Are Killing Our Birds*, WALL STREET JOURNAL, September 8, 2009. *See also* Donald Michael Fry, Director, Pesticides and Birds Program, American Bird Conservancy, *Testimony before the House Subcommittee on Fisheries, Wildlife and Oceans Oversight Hearing on: "Gone with the Wind: Impacts of Wind Turbines on Birds and Bats,"* May 1, 2007, <http://www.abcbirds.org/newsandreports/releases/070430_testimony.html>.

40. *Cf.* Michael Fry, *Wind power might blow a hole in bird populations*, THE LOS ANGELES TIMES, November 2, 2009, <http://www.latimes.com/news/opinion/la-oe-fry2-2009nov02,0,1954510.story>. *See generally* U.S. House of Representatives, Committee on Natural Resources, Subcommittee on Fisheries, Wildlife and Oceans, Oversight Hearing, *Gone With the Wind: Impacts of Wind Turbines on Birds and Bats*, May 1, 2007, <http://www.gpoaccess.gov/congress/index.html>.

41. Jason W. Horn et al., *Behavioral Responses of Bats to Operating Wind Turbines*, 72:1 THE JOURNAL OF WILDLIFE MANAGEMENT 123 (2008), <http://www.bu.edu/cecb/wind/video/Horn_et_al_2008.pdf>.

42. E.F. Baerwald et al., *Barotrauma is a significant cause of bat fatalities at wind turbines*, 18 CURR BIOL R695 (2008); Gerry Smith, *Wind farms' biggest victims: bats; Researchers say a pressure drop created by turbines can cause bats' lungs to burst*, CHICAGO TRIBUNE, March 1, 2009, <www.chicagotribune.com/features/lifestyle/green/chi-exploding-bats-bd01-mar01,0,6899974.story>; David Figura, *Wind turbine placement should take migrating birds into consideration, ornithologist says*, Outdoors Blog, THE POST-STANDARD (Syracuse, NY), November 8, 2009, <http://blog.syracuse.com/outdoors/2009/11/wind_turbine_placement_should.html> (bat mortality results from both collisions with the rotor blades and "barotrauma"). New York State Department of Environmental Conservation (NYSDEC) recently issued GUIDELINES FOR CONDUCTING BIRD AND BAT STUDIES AT COMMERCIAL WIND ENERGY PROJECTS (August 2009), available at <http://www.dec.ny.gov/energy/40966.html> ("The *Guidelines* outline DEC's recommendations to commercial wind energy developers on how to characterize bird and bat resources at wind energy sites and how to document and estimate bird and bat mortality resulting directly from

turbines, as well as indirect effects such as displacement from otherwise suitable habitat.").

43. B.S. Randhawa, R. Rudd, *RF Measurement Assessment of Potential Wind Farm Interference to Fixed Links and Scanning Telemetry Devices* (March 2009), available at <http://www.ofcom.org.uk/radiocomms/ifi/licensing/classes/fixed/Windfarms/rf_measurement/windfarm_report.pdf>.

44. Richard. J. Vogt et al., *Weather Radars and Wind Farms – Working Together for Mutual Benefit*, presented at the American Wind Energy Association WINDPOWER 2008 Conference, Houston, TX (June 1 – 4, 2008), <http://www.roc.noaa.gov/windfarm/ WindPower2007_final_wheader.pdf>. The authors of this paper include staff at the NEXRAD Radar Operations Center in Norman, Oklahoma, and at NOAA's National Weather Service Headquarters at Silver Spring, Maryland. *See also* Nancy Madsen, *Wind farms interfering with Doppler radar*, DAILY TIMES (Watertown, NY), June 24, 2009 ("Maple Ridge Wind Farm is one of several farms in the state causing problems for the National Weather Service Forecast Office in Buffalo"); *Don Paul Weather Blog*, entry by Don Paul, February 27, 2009, available at <http://blogs.wivb.com/2009/02/20/another-snowmaker-enroute-pattern-change-in-the-distance/>.

45. FAA, <https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp>. The FAA screening tool allows users to input the longitude and latitude of an area and obtain information on potential inference with long range radar, NEXRAD communications, and military operations. *See also Windfarms now a threat to air safety*, NEWS & STAR (West Cumbria, UK), December 11, 2001, <http://www.newsandstar.co.uk/> (reporting on air traffic control service letter to local planning council warning that "wind turbines may prevent radar from seeing aircraft or send false returns that could be interpreted as aircraft . . . pos[ing] a risk to aircraft safety"); Laura Nelson, *Air force clips the wings of UK wind power*, 428 NATURE 111 (March 11, 2004), <http://users.erols.com/iri/EnewsApril5,2004.htm#3> (in the Britain the Ministry of Defence successfully defeated nearly half of the wind farms proposed by 2004 "because of their proximity to air-defence stations").

46. NAS, p. 143 (citing J. Hecklau, *Visual Characteristics of Wind Turbines*, Proceedings, Technical Considerations in Siting Wind Developments (2005), <http://www.nationalwind.org/events/siting/ presentations/hecklau-visual_characteristics.pdf>.

47. *Cf.* Better Plan, Wisconsin, *Flight for Life Won't Land in Wisconsin Windfarm*, <http://betterplan.squarespace.com/flight-for-life-wont-land-in-w/> (links to flyers, "Important Information from *FLIGHT FOR LIFE* about Windmill Farms," and "H is for HELP!," an interview with Flight for Life helicopter pilot).

48. *Contra* James R. Drabick, *Why U.S. States Should Take the Power Back: Avoiding Paralysis in the Siting of Wind Energy Systems*, 36 ELR NEWS & ANALYSIS 10125, 10129 ("Concerns about property values are intertwined with aesthetic objections, the largest driver of citizen opposition to wind energy systems.").

49. Eja Pedersen, *Human response to wind turbine noise: Perception, annoyance and moderating factors*, Diss., Göteborg University 2007), p. 24, <http://dspace.hh.se/ space/handle/2082/1925> (reviewing literature). *See also* Christopher J. Bajdek, *Communicating the Noise Effects of Wind Farms to Stakeholders*, Proceedings of NOISE-CON 2007 (Reno, Nevada), <http://www.hmmh.com/ cmsdocuments/Bajdek_NC07.pdf>; George Kamperman and Richard R. James, *Simple guidelines for siting wind turbines to prevent health risks*, The Institute of Noise Control Engineering of the USA, 117 Proceedings of NOISE-CON 2008 1122-1128, Dearborn, Michigan, <http://www.inceusa.org/>; Richard R. James, A REPORT ON LONG TERM BACKGROUND (AMBIENT) SOUND LEVELS AT SELECTED RESIDENTIAL PROPERTIES, MACHIAS, NY, June 2009, on file with the Author; Minnesota Department of Health, PUBLIC HEALTH IMPACTS OF WIND TURBINES (2009), pp. 19-20 <http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf>. Mr. James was a member of the committee that developed the American National Standards Institute (ANSI) methods applicable to noise assessments.

50. Frits van den Berg et al., *Project WINDFARMperception: Visual and acoustic impact of wind turbine farms on residents*, SCIENCE SHOP FOR MEDICINE AND PUBLIC HEALTH APPLIES HEALTH RESEARCH, University of Groningen (Netherlands), June 3, 2008, p. 61, <http://www.rug.nl/wewi/deWetenschapswinkels/natuurkunde/publicaties/WFp-final-1.pdf> ("It is difficult to separate the visual from the acoustic impact, because they are so closely related: when turbines are closer and bigger they are usually better audible."). *See also id.*, Appendix, p. 23 (more than 50% of survey respondents reported visual effect of a wind farm was negative, "mostly because of the inappropriateness in the landscape and the restlessness caused by the movement.")

51. NYSDEC, ASSESSING AND MITIGATING NOISE IMPACTS, 2001, <http://www.dec.ny.gov/docs/permits_ej_operations_pdf/noise2000.pdf>.

52. *Id.*, p. 3.

53. Pedersen, *Human response to wind turbine noise*, *above*, note 49, p. 24 ("Amplitude-modulated sound has also been found to be more annoying than sound without modulations.").

54. Frits van den Berg, *The sounds of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise*, Diss., Univ.Groningen 2006, p. 106, <http://dissertations.ub.rug.nl/FILES/faculties/science/2006/g.p.van.den.berg/00_titlecon.pdf>; Minnesota Department of Public Health, *above*, note 49, p. 21.

55. *Id.*, pp. 35-36. *See also* Dick Bowdler, *Amplitude Modulation of Wind Turbine Noise. A Review of the Evidence*. 33 Institute of Acoustics Bulletin at 5 (2008), *passim*.

56. Van den Berg, *The sounds of high winds*, *above*, note 54, pp. 35-36.

57. Anthony L. Rogers, et al. (2006). *Wind Turbine Acoustic Noise: A White Paper*, Renewable Energy Research Laboratory, Department of Mechanical and Industrial Engineering University of Massachusetts at Amherst (June 2002, amended January 2006), p. 10, <http://www.ceere.org/rerl/publications/whitepapers/Wind_Turbine_Acoustic_Noise_Rev2006.pdf>.

58. *Id.*, pp. 13, 16; Van den Berg, *The sounds of high winds*, *above*, note 54, p. 36.

59. *Id.*, pp. 36, 81, 85, 142. *See also* Bajek, *above*, note 49; Kamperman and James, *above*, note 49; Jim Cummings, *AEI Special Report: Wind Turbine Noise Impacts*, Acoustic Ecology Institute (Santa Fe, NM) 2009, p. 7, <AcousticEcology.org/srwind.html> ("While overall noise levels per unit of energy output are dropping, today's turbines are far larger than older ones, so total noise output is not necessarily decreasing, and is now mostly generated by the sound of the turbine arms swinging through huge arcs in the air."). *Cf. also* Rogers, *above*, note 57, p. 12) (up to 2006 wind turbine blade tip noise was "not fully understood"); M. Moorhouse et al., *Research into Aerodynamic Modulation of Wind Turbine Noise: Final Report July 2007,* University of Salford (report for Defra), <http://members.kos.net/kenth/> (confirming van den Berg's sound measurements of modulated wind turbine sound levels but finding his explanations of underlying mechanisms need more study).

60. Van den Berg, *The sounds of high winds*, *above*, note 54, p. 104. *See also* Cummings, *Wind Turbine Noise Impacts*, *above*, note 59.

61. Van den Berg, *The sounds of high winds*, *above*, note 54, p. 90.

62. *Id.*, p. 60.

63. *Id.*, p. 96.

64. Clifford P. Schneider, ACCURACY OF MODEL PREDICTIONS AND THE EFFECTS OF ATMOSPHERIC STABILITY ON WIND TURBINE NOISE AT THE MAPLE RIDGE WIND POWER FACILITY, LOWVILLE, NY - 2007, April 10, 2008, p. 3 (on file with the Author) (finding that "[a]t wind speeds below 3.0 m/s, when wind turbines were supposedly inoperative, noise levels were 18.9 and 22.6 dBA above the expected background levels for each of the sites [based on the project FEIS] and these conditions occurred a majority of the time"). Mr. Schneider is a retired DEC fisheries biologist.

65. Van den Berg, *The sounds of high winds*, *above*, note 54, p. 61. *Cf. also* Minnesota Department of Public Health, *above*, note 49, pp. 12-13 and Fig. 5.

66. Bowdler, *Amplitude Modulation of Wind Turbine Noise*, *above*, note 55, 66.

67. Geoff Leventhall, *A review of published research on low frequency noise and its effects. Report for Defra*, May 2003, <http://www.defra.gov.uk/environment/quality/noise/research/ lowfrequency/documents/lowfreqnoise.pdf>.

68. *See* Minnesota Department of Public Health, *above*, note 49, p. 10; Kamperman and James, *above* note 49, pp. 23-24.

69. *Id.*, p. 3.

70. G.P. Van den Berg, G.P., *Do wind turbines produce significant low frequency sound levels?*, 11TH INTERNATIONAL MEETING ON LOW FREQUENCY NOISE AND VIBRATION AND ITS CONTROL, MAASTRICHT, THE NETHERLANDS, 30 August to 1 September 2004, <http://www.wind.appstate.edu/research/audiovisual.php>.

71. *Id.*, p. 12.

72. NYSDEC, ASSESSING AND MITIGATING NOISE IMPACTS, *above*, note 51, p. 14.

73. *Id.*

74. *Id.*, p. 24.

75. *Id.*, p. 14.

76. *Id.*, p. 15.

77. *Id.*, p. 11.

78. *Id.*

79. *Id.*, p. 12. *See also* James, *above*, note 49, p. 2 ("ANSI/ASA standards for measurement of the long term background sound levels" call for the use of the L_{90} measure).

80. *Cf.* Kamperman and James, *above*, note 49, p. 2 (background sound levels at night are in the "range of 20 dBA to 30 dBA"); Cummings, *above*, note 59, p. 6 ("night-time ambient noise levels in rural areas are often 35dB or lower"). Baseline sound levels at four locations in the vicinity of a proposed wind project in Machias, NY, using the L_{90} measure (DEC's eighth conclusion), were found between 24 and 31 dBA and, for low frequency sound, between 47.4 and 49 dBC. James, *above*, note 49, p. 4, table. Baseline sound levels at three locations in the vicinity of a proposed wind project in Italy, NY, using the L_{90} measure, were found between 21.6 and 24.7 dBA. FINAL GENERIC ENVIRONMENTAL IMPACT STATEMENT, COMPREHENSIVE PLAN AMENDMENT AND WIND ENERGY FACILITIES LAW, TOWN OF ITALY, December 2, 2008, p. 88, Table 2.12-1 (on file with the Author). Baseline sound levels at five locations in the vicinity of a proposed wind project in Hartsville and Hornellsville, NY, using the L_{90} measure, were "in the 15 to 25 dBA range . . . during near calm conditions." E.On Climate & Renewables, STEUBEN WIND PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT, *Appendix K Environmental Sound Survey and Noise Impact Assessment*, February 26, 2009, p. 17, <http://www.eon.com/en/unternehmen/32435.jsp>. Baseline sound levels at two locations in the vicinity of a proposed wind project in Cape Vincent, NY, using the L_{90} measure, were found at or below 25 dBA during seven nights measured. Schomer and Associates, Inc., BACKGROUND SOUND MEASUREMENTS AND ANALYSIS IN THE VICINITY OF CAPE VINCENT, NEW YORK, May 11, 2009, p. 33, attached to comments on project DEIS by Thomas J. Fucillo, Esq., May 22, 2009, <http://www.stlawrencewind.com/SEIS/SectionsPDF/Comments/Commentletters5of5.pdf>.

81. NYSERDA, WIND ENERGY: MODEL ORDINANCE OPTIONS (October 2005), 10, available at <http://www.powernaturally.org/Programs/Wind/toolkit.asp>.

82. Kamperman and James, *above*, note 49, p. 5.

83. *Id.* However, it is also important to understand how loud wind turbines can be. A typical 2.0 MW wind turbine has an A-weighted sound power rating of 105.3 dBA. American Wind Energy Assn. (AWEA), INTEGRATING UTILITY-SCALE WIND ENERGY ONTO THE GRID: AN INFORMATIONAL RESOURCE, November 17, 2006, <http://www.awea.org/pubs/factsheets/ 061117_Integrating_Utility_scale_Wind.pdf>.

84. Kamperman and James, note 49, pp. 13-14 (recommending setbacks at least 1 km, and attaching a model wind facility ordinance); Julian Davis and S. Jane Davis, *Noise Pollution from Wind Turbines: Living with amplitude modulation, lower frequency emissions and sleep deprivation*, presented at Second International Meeting on Wind Turbine Noise, Lyon (France) 2007, p. 12 (supporting French National Academy of Medicine standard for setbacks 2 km or more). *See also* Minnesota Department of Public Health, note 49, p. 25 ("if a turbine is subject to aerodynamic modulation because of shear caused by terrain (mountains, trees, buildings) or different wind conditions through the rotor plane, turbine noise may be heard at greater distances" than one-half mile, or 2,640 feet).

85. Van den Berg, *Sounds of high winds*, *above*, note 54, p. 42.

86. *Id.*, p. 65.

87. *See* Marianna Alves-Pereira and Nuno A. A. Branco, *Vibroacoustic disease: Biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling*, 93 PROGRESS IN BIOPHYSICS AND MOLECULAR BIOLOGY 256–279 (2007), <http://www.ncbi.nlm.nih.gov/ pubmed/17014895> (linking the low-frequency component of wind turbine noise is linked to abnormal growth of collagen and elastin in the blood vessels, cardiac structures, trachea, lungs, and kidneys of humans and animals exposed to infrasound (0–20 Hz) and low-frequency noise (20–500 Hz), in the absence of an inflammatory process). *See also* Minnesota Department of Public Health, *above*, note 49, pp. 7-8.

88. *Cf.* Frits van den Berg, *Wind turbines more annoying than expected*, Univ.Groningen 2008, <http://www.rug.nl/edrec/nieuws/Nieuwsberichten/overlastWindturbines>. (reporting on study results that show prevalent sleep disturbance at 45 decibels or higher); Kamperman and James, *above*, note 49, p. 3) ("the International Standards Organization (ISO) in ISO 1996-1971 recommends 25 dBA as the maximum night-time limit for rural communities").

89. World Health Organization, GUIDELINES FOR COMMUNITY NOISE, 1999, ch. 3, *Adverse health effects of noise*, pp. 44-46 <http://www.who.int/docstore/peh/noise/guidelines2.html>.

90. *Id.*, p. 44.

91. *Id.*, pp. 44-45.

92. *Id.*, p. 45.

93. WHO, NIGHT NOISE GUIDELINES FOR EUROPE, 2007, pp. 24-25 <http://ec.europa.eu/health/ph_projects/2003/action3/docs/2003_08_frep_en.pdf> (and recommending an interim limit of 40 dBA in communities "where the NNGL cannot be achieved in a short period for various reasons, and where policy-makers choose to adopt a stepwise approach at the local or national levels."). *See also* James, *above*, note 49, pp. 5-6) (discussing WHO's NNGL); Cummings, *above*, note 59, p. 6 ("if temperature inversions or other atmospheric stability effects that cause excessive noise occur just 10% of the nights, that means that nearby residents may find their sleep disturbed 35 nights a year"). This modifies the finding of Rogers, *above*, note 57, p. 21) ("At the present time, there are no common international noise standards or regulations for sound pressure levels.").

94. *Cf. above*, note 80.

95. James, *above*, note 49, p. 2. *Cf. above*, note 79.

96. *Id.*, p. 5.

97. WHO, NIGHT NOISE GUIDELINES FOR EUROPE, p. 20.

98. Kamperman and James, *above*, note 49, p. 4; James, *above*, note 49, pp. 1-2 (referring to published acoustic standards for assessing background sound levels, and explaining that these standards specify that "the proper metric for describing the pre-operational sound levels is Long-Term Background sound level usually measured using a statistical process to identify the quietest one minute of a 10 minute sample taken during the time when the new noise source is most likely to generate complaints").

99. *Id.*

100. *E.g.*, E.On Climate & Renewables, STEUBEN WIND PROJECT DRAFT ENVIRONMENTAL IMPACT STATEMENT, *Appendix K Environmental Sound Survey and Noise Impact Assessment*, February 26, 2009, pp. 9-18, <http://www.eon.com/en/unternehmen/32435.jsp> ("normalizing" meteorological tower wind speed measurements at turbine hub height to estimate ground level wind speeds during turbine operations); EverPower Renewables, ENVIRONMENTAL SOUND SURVEY AND NOISE IMPACT ASSESSMENT - ALLEGANY WIND FARM PROJECT, December 18, 2008, pp. 3-4 (on file with the Allegany Planning Board) (theorizing that "high levels of background noise due to wind-induced natural sounds, such as tree rustle, would act to reduce or preclude the audibility of the wind farm, while low levels of natural noise would permit operational noise from the turbines to be more readily perceptible," and suggesting "when turbine noise is most significant . . . the level of natural masking noise is normally also relatively high due to tree or grass rustle thus reducing the perceptibility of the turbines").

101. *See* van den Berg, *above*, note 54, p. 56 (when wind velocities are low at a height of 10 meters, the wind velocity at turbine hub height at night is "up to 2.6 times higher than expected"). Interestingly, the wind industry has no trouble recognizing wind shear when estimating an increased capacity factor for taller, modern turbines. *Cf.* American Wind Energy Association, 20 PERCENT WIND ENERGY PENETRATION IN THE UNITED STATES: A TECHNICAL ANALYSIS OF THE ENERGY RESOURCE, October 2007, p. 5-9, <http://www.20percentwind.org/Black_Veatch_20_Percent_Report.pdf> (as hub heights increase, capacity factors will also increase due to wind shear (higher wind speeds at higher hub heights)").

102. Letter from Richard R. James to Gary A. Abraham, February 19, 2009, p. 4 [re: Everpower Renewable wind project in Allegany, New York], on file with the Author. *Cf. also above*, note 98.

103. Schomer, *above*, note 80, p. 5.

104. *See id.*, pp. 2-3. *Cf. also above*, note 81.

105. G.P. van den Berg, *Effects of the wind profile at night on wind turbine sound*, 277:4/5 JOURNAL OF SOUND & VIBRATION 955-970 (November 2004) ("Since the start of the operation of a 30MW, 17 turbine wind park, residents living 500m and more from the park have reacted strongly to the noise; residents up to 1900m distance expressed annoyance."); E. Pedersen and K. Persson Waye, *Wind turbines: low level noise sources interfering with restoration?*, 3 ENVIRON. RES. LETT. 1, 4 (2008) (reporting "support both from experimental and field studies that intrusive sound characteristics not fully described by the equivalent A-weighted sound pressure level contribute to annoyance with wind turbine noise"); National Wind Watch, *Noise Complaints On Rise with New Industrial Wind Power Projects*, April 2, 2007, <http://www.wind-watch.org/press-070402.php>; B.J. Frey and P.J. Hadden, Noise Radiation from Wind Turbines Installed Near Homes: Effects on Health, With an Annotated Review of the Research and Related iIssues (February 2007), <www.windturbinenoisehealthhumanrights.com> (discussing over 50 anecdotal complaints about noise near wind farms in the UK, several more than 1 km away); Renewable Energy Foundation, *Wind Turbine Noise Complaint Data*, February 6, 2009, <http://www.ref.org.uk/Files/jc.lm.salford.data.comment.07.02.09.c.pdf>.