Wind Turbine Noise Adversely Impacts Nearby People and Animals

In violation of the spirit of Act 250, VT has been shamelessly trashing its pristine ridge lines with 500-ft tall, environmentally destructive, noise-making, property-value-reducing, health-damaging industrial wind turbine power plants that produce unsteady, grid-disturbing, variable, intermittent (i.e., non-dispatchable) energy at a cost of about 10 c/kWh (with subsidies), and about 15 c/kWh (without subsidies); NE average wholesale prices have been about 4.5 – 5.0 c/kWh for the past 5 years.

For example, a proposed wind turbine power plant* on a 2,000-ft high ridgeline in Vermont would severely damage the mountain. It would require a 300-ft wide swath of clear-cutting, blasting and leveling, for a winding, 50-ft wide, paved, industrial-grade road, about 3 miles long, to haul 205-ft-long blades, with multiple tractors, to a 2,000-ft elevation. Then the road would continue, up and down, in a winding manner, along the ridge line, with more clear-cutting, blasting and leveling, for about another 4.0 miles, to place the wind turbines about 800 ft. apart (800 x 27 spaces/5280 = 4.09 miles). The road and turbine platform areas would require millions of tons of earthmoving. The minimum impacted forest area would be about 300 ft x 7 miles/(43,560 sq ft/acre) = 255 acres. Any nearby resident, or Legislator, voting in favor of that has to be totally bonkers, IMHO.

* 96.6 MW; (28) 492-ft tall wind turbines; owned by Iberdrola, in Windham/Grafton, Vermont, on land owned by Meadowsend Timberlands, Inc., which is owned by a French family, hiding behind an agent.

NOTE: Major power lines usually require about 100-ft wide, clear-cut "corridors", but they require: 1) no road, blasting and leveling; 2) are not winding their way to 2,000 ft; 3) are not winding up and down along a ridge line for several miles; 5) and are quiet; a huge environmental and societal difference.
http://www.aweo.org/windprojects.php

1) During a rainstorm, the runoff would be enormous and flooding would occur, as happened during several such events on Lowell Mountain.

2) Anyone living within about 1.0 mile likely would not only hear the incessant, relentless, irregular, audible noises, 24/7/365, especially at night, for 25 years, but likely would be exposed to inaudible noises, a.k.a. infrasound. Those nearby people would have their future ruined, their American Dream instantly shattered, and would be having:

– Their property values go into the tank
– Their health damaged, due to lack of sleep and peace of mind
– To live with closed windows and doors, due to year-round IWT noises (great on hot summer days)
– Exposure to infrasound, i.e., vibrations below 20 cycles per second, that are not heard, but felt.

INFRASOUND; 20 Hz or less

A rotor blade passing the mast of an IWT creates a burst of audible and inaudible sound (infrasound) of various frequencies; base frequency about 1 Hz, similar to a person's heart beat, and the harmonics, at 2, 4 and 8 Hz, similar to the natural frequencies of other human organs, i.e., ears, eyes, liver, kidneys, fetus, etc., which start vibrating.

Infrasound frequencies are similar to natural frequencies of house walls, which sets them vibrating, creating standing, inaudible (infrasound) waves INSIDE the rooms of a house. As a result, nearby people find life inside their houses becomes unbearable. Often they abandon their houses, or sell at very low prices.

Infrasound interferes with the body's natural biorhythms, and likely causes adverse health impacts on nearby people and animals, including DNA damage to nearby pregnant women and animals, their fetuses, and newborn offspring.

Infrasound travels long distances. A buffer zone of about 1 mile is required to reduce adverse impacts on people. However, roaming animals would continue to be exposed.

Acoustical consultants usually deal with OSHA-type measurements of every-day noises, but have ZERO experience measuring infrasound, which requires special instrumentation and test set-ups. As a result, the easy way out is to claim infrasound does not exist, or if admitting it does exist, then just claim it does no harm.

Some governments have used infrasound for torture or crowd control; it leaves no marks. This is analogous to house occupants, or roaming animals, being too close to IWTs.

http://www.nrel.gov/docs/fy06osti/39183.pdf
http://wcfn.org/2014/03/31/windfarms-vertebrates-and-reproduction/
http://www.darkgovernment.com/news/infrasound-stress-inducing-weapons/
http://www.windturbinesyndrome.com/2011/the-misuse-of-infrasound-industry-military-and-now-the-cops/
http://api.ning.com/files/xeV7E6EsoyMges0cfhXFaGWk9zQ89*BDtn0miNlOtzkj70FFehgKYsRrkQlS5jRi9InfpbiGW2MCch8X*aBpU4qzdnCaJy-D/Fernandez.pdf
http://howgreenisthis.org/infrasound-low-frequency-noise-and-wind-turbines/

NOISE CODE COMPARISON

1) **POLAND** is considering a proposed a law with a 2.0 km (1.24 mile) buffer zone between a wind turbine and any building. That means at least 65% of Poland would be off limits to wind turbines. Future IWT plants likely would be offshore.
http://watchdog.org/270800/europe-wind-energy-failures-bad-omen-for-vermont/

2a) **BAVARIA**, a state in Germany, just enacted a setback of 10 times turbine height, i.e., 10 x 500 ft = 5,000 ft, almost one mile. In Germany, the IWT nighttime noise limit is not to exceed 35 dBA. The second URL shows what happens when it is sunny and windy in Germany. The excess

energy is dumped onto connected grids at NEAR-ZERO wholesale prices. This has been happening more and more hours of the year. RE insanity running amok.
http://www.germanenergyblog.de/?p=19852
http://www.germanenergyblog.de/?p=19883

2b) **LETCHER TOWNSHIP**, South Dakota, voted for a 1-mile buffer zone. Under the approved ordinance, no large wind energy system could be built within 5,280 feet of the nearest residence of a non-participating homeowner, or within 1,500 feet of the nearest neighbor's property line.
http://www.mitchellrepublic.com/news/local/4051042-letcher-township-establishes-one-mile-wind-tower-setback

3) **DENMARK** has a buffer zone of 4 times total height of wind turbine, about 4 x 500 = 2,000 ft, about 0.61 km (NO EXCEPTIONS), and it ALSO has the following requirements regarding outdoor and indoor noise:

OUTDOOR
- For dwellings, summer cottages, etc.: 39 dBA (wind speeds of 8 m/s, 18 mph) and 37 dBA (wind speeds of 6 m/s, 13 mph)
- For dwellings in open country: 44 dBA (wind speeds of 8 m/s) and 42 dBA (wind speeds of 6 m/s)
http://eng.mst.dk/topics/noise/wind-turbines/wind-turbine-regulations/

The below regulations describe the methods and time periods over which sounds are to be measured:
- On page 4, par 5.1.1 mentions averaging over various periods. Only the WORST average readings of a period are to be considered for compliance.
- On page 4, par 5.1.2 mentions a 5 dB PENALTY must be added to the WORST average readings for a period for clearly audible tonal and impulse sounds with frequencies greater than 160 Hz, which would apply to wind turbine sounds.
- On page 6, par 5.4 mentions limits for indoor A-weighted low frequency noise 10 – 160 Hz, and G-weighted infrasound 5 – 20 Hz.

"If the perceived noise contains either clearly audible tones, or clearly audible impulses, a **5 dB annoyance penalty** shall be added to the measured equivalent sound pressure level" *That means, if a measured outdoor reading is 40 dBA (open country, wind speed 6 m/s), and annoyance is present, the reading is increased to 45 dBA, which would not be in compliance with the above-required 42 dBA limit.* In some cases, a proposed IWT plant would not be approved, because of the 5 dB annoyance penalty. The noise of IWTs varies up and down. The annoyance conditions associated with IWTs occur whenever IWTs are in operation, i.e., 24/7/365, whereas annoyance conditions associated with other noise sources usually occur much less frequently.

INDOOR
- For both categories of areas, the mandatory limit for low frequency noise is 20 dBA (Vermont limit is 30 dBA), which applies to the calculated INDOOR noise level in the 1/3-octave bands 10 – 160 Hz, at both 6 and 8 m/s wind speed. The purpose of the regulation is to ensure neither the usual noise, nor the low frequency noise, will annoy neighbors when the wind turbines operate.
http://eng.mst.dk/topics/noise/wind-turbines/low-frequency-noise-from-wind-turbines/qa-low-frequency-noise-from-wind-turbines/

NOTE: The 5 dB penalty does not apply to indoor and outdoor low frequency and infrasound noises, i.e., 160 Hz or less.
http://referencelaboratoriet.dk/wp-content/uploads/2012/01/rl-1001-Orientering-nr.-45-Environmental-noise-regulations-in-Denmark.pdf , pages 3-4

NOTE: Below are compared the indoor maximum SPLs of the Denmark and Vermont codes. The Denmark code is 3 times stricter. See next note.
Denmark, indoor, windows closed: 20 log (x) = 20, the antilog of x = 10 times reference pressure
Vermont, indoor, windows closed: 20 log (x) = 30, the antilog of x = 31.62 times reference pressure
http://www.osha.gov/dts/osta/otm/noise/health_effects/soundpropagation.html

Denmark's controversial Outdoor to Indoor Noise Attenuation Calculations: The controversy in Denmark is regarding Danish EPA bureaucrats using high attenuation factors for their calculations of outdoor to indoor noise attenuation from 44 dBA (outdoor) to 20 dBA (indoor, windows closed) for frequencies above 63 Hz, which yield calculated indoor noise levels less than 20 dBA. The Danish EPA bureaucrats prefer assuming high factors, because they result in "compliance", which is favorable to IWTs.

However, acoustics engineers have made field measurements (supposedly "too difficult to measure, per EPA"), which indicate many of the houses near IWT plants have lesser attenuation factors resulting in indoor noise levels greater than 20 dBA, i.e., non-compliance, which is not favorable for IWTs. However, the final arbiters should be not bureaucrats in some office, but the long-suffering, nearby people, and they have given vent to their feelings in the street, etc., as in Vermont and elsewhere in the world.

http://www.epaw.org/documents/Denmark_s_dirty_little_secrets.pdf
http://docs.wind-watch.org/Low-frequency-noise-from-large-wind-turbines.pdf
http://vbn.aau.dk/files/62413823/Maastricht_Moeller_et_al_2011.pdf
https://www.windturbinesyndrome.com/wp-content/uploads/2011/06/JASMAN12963727_1.pdf

NOTE: Regarding Danish onshore capacity, about 278 wind turbines were added and 255 decommissioned, during the past 4 years. Assuming 278 x 3 MW (new) – 255 x 0.51 MW (old) = 874 – 131 = 703 MW added during the past 4 years; 703/3096 (end 2011) = 22.7% MW growth over 4 years. Danish offshore capacity grew about 400 MW/1271 MW (end 2011) = 45.9%, over 4 years. Offshore capacity has been growing 2x as fast as onshore, reflecting government policy of at least the last 5 years. See URLs.

http://www.windpower.org/en/knowledge/statistics/the_danish_market.html
http://www.cbuilding.org/sites/default/files/Wind%20Siting%20Regs%20by%20State.pdf , pages 5-7

NOTE: Denmark's government, concerned about too-high cost of offshore wind energy, has cancelled plans for 5 offshore IWT plants, totaling 350 MW. This is a reversal of government policy of at least the last 5 years. That high-cost energy would have meant an even greater surcharge on household electric bills, which, due to long-standing complaints, became politically unacceptable.

Germany's government, similarly concerned about too-high ENERGIEWENDE costs, has significantly reduced feed-in tariffs and is using an auctioning system to rein-in excessive capacity build-outs. See URLs.

http://www.hazardexonthenet.net/article/116485/Denmark-cancels-planned-offshore-wind-farms-because-of-expense.aspx
http://www.germanenergyblog.de/?p=19941

4) NEW HAMPSHIRE's wind turbine code requires the following:
- **Sound:** Wind energy facilities must meet a 'not-to-exceed' standard of 45 dBA from 8am - 8pm and 40 dBA from 8pm - 8am. The sound measurements are to be taken 'on property that is used in whole or in part for permanent or temporary residential purposes.'
- **Shadow Flicker:** A shadow-flicker assessment must be completed for each residence, learning space, workplace, health care setting, public gathering place (outdoor and indoor), other occupied building and roadway, within a minimum of 1 mile of any turbine, based on shadow flicker modeling that assumes an impact distance of at least 1 mile from each of the turbines. Shadow flicker may not occur more than 8 hours per year at any of these locations.
- **Setbacks:** The applicant must complete an assessment of the risks of ice throw, blade shear, tower collapse on any property, roadway, etc. The SEC committee will determine, on a case-by-case basis, whether there is a concern with the setbacks and/or the appropriate distance that should be set.
http://www.windaction.org/posts/44712-new-hampshire-adopts-statewide-wind-siting-rules#.V0KximMqb0e

5) MAINE's wind turbine noise code requires the following:
In 2012, the Maine Board of Environmental Protection adopted noise control regulations that are specific to wind energy developments. Chapter 375.10(I) of Maine DEP regulations specifies sound level limits for wind energy generating facilities as 55 dBA from 7am - 7pm (the "daytime limit"), and 42 dBA from 7pm - 7am (the "nighttime limit") for hourly equivalent sound levels (LAeq) at protected locations.

Maine DEP nighttime limits apply as follows:
- **Within 500 feet of a residence** on a protected location or at the (project) property line if closer to the dwelling. The resulting sound levels at a residence itself are usually lower than at 500 feet from the dwelling or at the property line where the 42 dBA "nighttime limit" applies.
- **Beyond 500 feet**, the daytime limit of 55 dBA applies 24 hours per day.

Maine DEP Chapter 375.10 noise rules establish sound level limits on an hourly basis although compliance for wind energy facilities is evaluated by averaging sound levels over twelve or more ten- minute measurement intervals with turbines operating at full-rated sound output. There are also special provisions and "penalties" that apply when the sound generated by a wind project result in tonal or short-duration, repetitive sounds. This standard is described in more detail in the remainder of this report. See URL.

Maine DEP Chapter 375.10 Section I requires a **5 dB annoyance penalty** be added for certain occurrences of tonal and short duration repetitive (SDR) sounds when determining compliance with hourly sound level limits.
http://www.maine.gov/dep/ftp/WindPowerProjectFiles/NumberNine/application/05_NN_Noise.pdf

6) **VERMONT**, with an ad hoc wind turbine code, i.e., applied on a project-by-project basis, requires a maximum of 45A dB (outdoor), averaged over one hour, as measured at a nearby residence (allows long periods above 50 dBA and many spikes of 60 – 70 dBA), and a maximum of 30 dBA (indoor, windows closed), averaged over one hour. The averaging makes disappear the 50 dBA sounds and even louder spike sounds. This is a much easier standard than Denmark's. See next section.

In both cases, there is no distinction for daytime and nighttime, even though people may want open windows, especially during warm nights. This compares with typical rural nighttime noise of 20 - 40 dBA, and typical urban residential nighttime noise of 58 - 62 dBA. However, in many rural areas of Vermont nighttime noise averages about 20 dBA.

Vermont's code has NO required buffer zone, and NO required infrasound limit, and NO 5 dB annoyance penalty, and an indoor limit of 30 dB; Denmark has 20 dB.

As almost all utility-scale IWTs are 2 - 3 MW, and as almost all such IWTs are in rural settings, government noise codes should use the rural nighttime ambient noise level as THE basis for limiting wind turbine noise levels.

Ever-present, randomly occurring noises, with higher dB values, say up to 60 – 70 dBA, can occur, during that hour, but the "averaging over one hour" makes these noises disappear; hence the reason for Denmark and Maine having a 5 dB annoyance penalty.

These peak noises are most annoying, and they occur mostly at night. They adversely affect the health of nearby people. As a minimum, they deprive nearby people from getting a good night's sleep to recover from the prior day and to get ready for the next day. According to the World Health Organization, restful sleep is a basic requirement for good mental and physical health, as are food, water, air, etc.

NOTE: A similar lack of attenuation exists in Vermont, with nearby residences not attenuating 45 dBA (outdoor) to 30 dBA (indoor, windows closed), according to acoustics tests. See URL. If Denmark's residences cannot attenuate 44 dBA (outdoor) to 20 dBA (indoor, windows closed), and Vermont residences cannot attenuate 45 dBA to 30 dBA (a much easier requirement), then the options are: have smaller wind turbines; locate them further away from residences (a greater buffer zone); upgrade the attenuation of nearby residences; buy out the owners.
http://vce.org/VCE_7250_DeerfieldWind_042716.pdf

CALCULATING AVERAGE NOISE LEVELS OVER ONE HOUR

Sound meters typically sample noises every second, and automatically perform averaging calculations. The sampling is usually done for ranges of AUDIBLE sound frequencies. Such calculations can be performed with the MS Excel spreadsheet program. Sampling rarely measured INAUDIBLE infrasound, i.e., low frequencies at 0.1 Hz to 20 Hz, requires special meters and testing set-ups. See URLs.

1) Sample the sound's dB value every second; 3600 samples in one hour
2) Divide each value by 10
3) Take the antilog of each value of Step 2
4) Sum the antilogs of Step 3
5) Divide the sum of Step 4 by 3600

6) Take the log of Step 5 and multiply by 10 to get the average dB over one hour.

http://www.cirrusresearch.co.uk/blog/2013/01/noise-data-averaging-how-do-i-average-noise-measurements/
https://www.windturbinesyndrome.com/wp-content/uploads/2011/06/JASMAN12963727_1.pdf
https://www.acoustics.asn.au/conference_proceedings/AAS2011/papers/p57.pdf

SOME BASIC CALCULATIONS

Typical rural nighttime ambient noise is 20 - 40 dBA, and urban residential nighttime noise is 58 - 62 dBA. People who live in urban areas have no idea how quiet it is in rural areas. The introduction of 10 to 30, 3 MW, noise-making, IWTs, on 2,000+ft ridge lines, comes as a total shock to nearby rural people. Being high up, the noise carries far, especially the health-damaging, inaudible infrasound, less than 20 Hz. In many rural areas of Vermont, nighttime outdoor noise averages about 20 dBA, as it does in Denmark.

a) If the rural average nighttime outdoor noise is 30 dB, then 20 log (x) = 30, the antilog gives x = **31.62 times** the reference pressure.

The Vermont code, 45 dB, nighttime, (20 log (x) = 45, the antilog gives x = 177.83) allows an SPL = 177.83/31.62 = **5.62 times** greater than rural 30 dB; a very noticeable and annoying increase to nearby residents.

If an outdoor random peak is 51 dB (20 log (x) = 51, the antilog gives x = 354.81), the SPL = 354.81/31.62 = **11.22 times** greater than rural; an extremely noticeable and annoying increase to nearby residents; thus a 6 dB increase, due to random peaks, increases the SPL = 354.81/177.83 = **2 times.**

b) If the rural average nighttime outdoor noise is 20 dB, then 20 log (x) = 20, the antilog gives x = **10 times** the reference pressure.
- The Vermont code, 45 dB, nighttime, allows an SPL = 177.83/10 = **17.78 times** greater than rural 20 dB, i.e., IWT noises are even more annoying.
- The New Hampshire code, 40 dB, nighttime (20 log (x) = 40, the antilog gives x = 100) allows an SPL = 100/10 = **10 times** greater than rural, a very noticeable and annoying increase to nearby residents. VT's code is much worse than NH's and Denmark's.

GENERAL COMMENTS

The sophistication and detail of the Danish wind turbine code is light years ahead of the Vermont code. To compare the Danish noise code with the Vermont code is like comparing apples to watermelons. Denmark has been a leader in wind power for at least 40 years.

After 4 - 5 years of inflicting suffering on nearby people and calling them liars/fabricators, the PSB is claiming, "it is learning". However, the PSB did not need a "learning curve" 4-5 years ago. It could have copied major parts of the Danish code to bring the Vermont code to where is actually protects nearby people.

Denmark holds infrasound is harmful to health of nearby people and animals. Therefore, it has an infrasound requirement in its wind turbine code. The PSB is still in denial. Here is a chart and 4 articles prepared by Rand and Ambrose, two prominent US acoustics engineers, which shows Vermont's extremely high noise limit.

http://vce.org/bbhgebgg.png
https://windwisema.org/wind-turbine-noise-complaint-predictions-made-easy/

Vestas, a Danish conglomerate that supplied the Lowell IWTs, would never get a PSB-type noise code in Denmark, and soon also in Poland and Bavaria. New Hampshire, Maine and Massachusetts have lower dB levels than Vermont. Vermont is lagging regarding protecting its people!

It is an outrage for the PSB, DPS, et al., to claim these environment-destroying, wind turbines are a PUBLIC GOOD for nearby Vermonters, especially when they knew these sound outcomes BEFORE the Lowell IWTs were erected, according to various acoustics engineers, who testified during PSB hearings, and who reviewed my article.
http://theenergycollective.com/willem-post/84293/wind-turbine-noise-and-air-pressure-pulses

It is hypocritical for GMP, Blittersdorf, et al., to crow, with straight faces, about being in "compliance" with the shabby PSB wind turbine noise code. They, and the wind turbine vendors wrote, and the PSB, after meaningless "hearings", adopted that code FOUR YEARS AGO. Recchia, et al., actually defend it. That code is not worth the paper it is printed on. The rewriting of that code, to protect Vermonters, is long overdue.

Vermont's wind turbine saga further deceives and burdens already hard-working, struggling, over-taxed Vermonters, who are forced to swallow such shenanigans (poor Vermont saving the world?), and to endure the shame of the largest EB-5 fraud in the US, while trying to make ends meet in a near-zero-real-growth Vermont economy, with near-stagnant real household incomes, reduced by increases in taxes, fees and surcharges, year after year.
http://watchdog.org/270800/europe-wind-energy-failures-bad-omen-for-vermont/