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Montpelier, VT 05620-2701

Re: VPIRG Comments on Proposed Rule 5.700: Rule on Sound Levels from Wind Generation Facilities

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**Introduction**

The Vermont Public Interest Research Group (VPIRG) would like to thank the Public Service Board (the Board) for the opportunity to file comments on the Proposed Rule 5.700 (the rule) governing sound from wind generation facilities. We appreciate the extensive public process that has led to this proposal and look forward to staying engaged through the rulemaking.

As an organization dedicated to working in the public interest, VPIRG takes questions of public health very seriously. Over the years we have worked on a wide variety of issues that affect the health and wellbeing of Vermonters. Each time we consider our position on a topic that relates to public health we thoroughly review the available research on the topic. When the evidence demonstrates real or likely public health impacts – as in our extensive work on the regulation of toxic chemicals – we strive to prevent or mitigate those impacts.

There are times, however, when we consider issues for which claims about potential public health impacts have been made, and those claims are clearly refuted by the weight of the scientific evidence. Sound from wind turbines is unequivocally one of those issues, and it would be irresponsible for us to advocate for restrictions on wind power based on alleged public health impacts when the available – and extensive – evidence demonstrates such an impact does not exist.

Given our work on climate issues, we are also very conscious that standards restricting or preventing the construction of renewables do not exist in a vacuum. If this rule ultimately prevents wind projects from being built, electricity demand will persist, and that demand will primarily be supplied by fossil fuel sources. There is overwhelming scientific evidence demonstrating that the extraction, refinement, and burning of fossil fuels causes clear and substantial public health impacts. When weighing the evidence on available energy sources, it is quite clear that any impacts from wind (related to sound or otherwise) are minimal when compared to non-renewable alternatives.

### ***The Proposed Rule Would Functionally Ban Wind***

The proposed rule runs counter to both legislative intent and the Board's apparent intent for the proceeding by setting a nighttime sound limit of 35 dB(A) and a restrictive setback, both of which would functionally ban wind in Vermont. VPIRG and our consultant, R. Scott Bodwell of Bodwell EnviroAcoustics, largely support the construction of the rule. However, as we stated at the beginning of this process, wind sound standards are complex and their components are interconnected. The functional results of the standard depend on each element (the sound metric, measurement interval, measurement protocols et al.) working together. While much of this rule is well-constructed, the sound limit and the setback both ensure that this rule, if adopted, would almost certainly result in no future wind projects in Vermont. This rule would severely threaten our ability to meet our state goal of 90% renewable energy by 2050.

A decibel limit functionally works like a non-linear setback from the wind turbines. Decreasing the decibel limit from 45 dB(A) to 35 dB(A) would equate to at least a threefold increase to the effective setback distance.<sup>1</sup> In practice, the proposed rule would result in an even larger increase due to the conservative nature of its modeling protocols. There are relatively few strong wind sites in Vermont to begin with, considering available land with a significant wind resource, accessibility of transmission lines, other site constraints and the current 45 dB(A) sound limit. Increasing the effective setback by more than three times what it is today likely eliminates all or nearly all of the currently available potential wind sites. Once additional siting constraints are considered, this becomes a functional ban on wind.

Based on the limited scientific basis provided by the Board, it appears that this rule was designed to protect neighbors from annoyance rather than to protect public health for those neighbors. Clear evidence shows that a well-defined and regulated external nighttime limit of 45 dB(A)  $L_{eq}$  is fully protective of public health. As we will discuss, the evidence cited by the Board for this rule does not support a limit of 35 dB(A) at night as being protective of public health. Instead, 35 dB(A) is largely referred to as a threshold where some annoyance may occur in a small percentage of project neighbors, though that annoyance is highly correlated to visual annoyance or dislike of the project itself.<sup>2</sup>

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<sup>1</sup> Email from R. Scott Bodwell, Principal, Bodwell EnviroAcoustics, to Ben Edgerly Walsh, Climate and Energy Program Director, Vt. Pub. Interest Research Grp. (Mar. 6, 2017, 10:32 EST) (on file with VPIRG).

<sup>2</sup> See Eja Pedersen & Kerstin Persson Waye, *Perception and annoyance due to wind turbine noise—a dose-response relationship*, 116 J. Acoustic Soc'y Am. 3460 (2004) [hereinafter Pedersen & Persson Waye 2004]; Eja Pedersen &

No other areas of regulation or policymaking sets rules based on protecting a minimal number of citizens from annoyance. As discussed below, neither Act 250 nor Vermont common law adopt such an extreme position. It is the role of the Board to make decisions and regulations based on the public good of the entire state. By functionally eliminating any potential future wind projects, this rule arbitrarily harms our ability as a state to reach the State's goal of 90% renewable energy, as stated in the 2011 and 2016 Comprehensive Energy Plans required by 30 V.S.A §202b<sup>3</sup> and the Vermont Electric Energy Plan required by 30 V.S.A. §202,<sup>4</sup> and the policy objectives found in Titles 30 and 10 of Vermont statutes regarding renewable energy and greenhouse gas emission reductions. This is in clear opposition to the public good of the state of Vermont.

### ***Legislative and Apparent Board Intent Was Not to Ban Future Wind Development***

Section 12(a) of Act 174 states that “the Public Service Board (the Board) shall finally adopt rules... regarding sound from *wind generation facilities approved under 30 V.S.A § 248*”<sup>5</sup> (emphasis added) and that “In developing these rules, the Board shall consider: (1) standards that apply to all wind generation facilities. . . .”<sup>6</sup> This clear language indicates that the legislature intended wind generation facilities to be approved following the adoption of the Board's rule. Put another way, the legislature did not intend the rule to bar future wind generation facilities (or wind generation facilities of a specific size), which this rule would in fact do.

On January 9, 2017, Public Service Board Staff Attorney John Cotter responded to a letter from Annette Smith of Vermonters for a Clean Environment. In that letter, Mr. Cotter stated that “the Board takes the issues surrounding sound from wind facilities very seriously and is fully engaged in its efforts to produce a rule for regulating such sound emissions in a manner that is consistent with protecting public health, but at the same time does not create an impossible barrier to the deployment of wind-powered generation facilities consistent with the State's policy objectives regarding the deployment of in-state renewable energy generation.”<sup>7</sup>

In proposing a 35 dB(A) nighttime sound limit, and in its inclusion of a mandatory setback distance, this rule goes far beyond the Board's intention, as stated by Board counsel, of “protecting public health,” and would, if adopted, create an “impossible barrier” to future wind generation the state.<sup>8</sup> It is additionally counter to legislative intent, since it will functionally prevent future wind projects from being “approved under 30 V.S.A § 248.”<sup>9</sup>

### ***Modeling and Monitoring Protocols Follow Acoustic Best Practices***

As we have stated in comments since October and in our presentation in December, VPIRG supports rigorous and conservative modeling to ensure that actual sound levels are well within the set

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Kerstin Persson Waye, *Wind turbine noise, annoyance and self-reported health and well-being in different living environments*, 64 Occupational & Env. Medicine 480 (2007) [hereinafter Pedersen & Persson Waye 2007].

<sup>3</sup> See Vt. Dep't of Pub. Serv., Comprehensive Energy Plan 2011; Vermont's Energy Future, 3 (2011); Vt. Dep't of Pub. Serv., 2016 Vermont Comprehensive Energy Plan 2 (2016).

<sup>4</sup> VT. STAT. ANN. TIT. 30, § 202 (West 2017).

<sup>5</sup> Energy Development and Improvement Act, 2016, Sp. Sess., No. 174 §12 (June 13, 2016)

<http://legislature.vermont.gov/assets/Documents/2016/Docs/ACTS/ACT174/ACT174%20As%20Enacted.pdf>.

<sup>6</sup> *Id.*

<sup>7</sup> Letter from John J. Cotter, Esq., Staff Attorney, Vt. Pub. Serv. Bd., to Annette Smith, Executive Director, Vermonters for a Clean Env. (Jan. 9, 2017) (on file with VPIRG).

<sup>8</sup> *Id.*

<sup>9</sup> Energy Development and Improvement Act, *supra* note 5.

parameters. As we have demonstrated, modeling similar to what is currently working in Maine has resulted in actual sound levels that are, at most, several decibels below the limit.

The modeling parameters as specified in 5.705(C) of this proposed rule do provide more clarity than the February draft rule, which was an aspect of concern. We appreciate the additional definitions that would allow project developers to understand how the model would be designed ahead of time. However, these proposed model inputs are still more conservative than those working in Maine. In particular, inputs (9) and (10) alone could add up to 5 dB to a model output, which effectively reduces the decibel limit to 30 dB(A). To restate, Maine's nighttime limit is 42 dB(A) (daytime is 55 dB(A)),<sup>10</sup> significantly higher than 35 dB(A).<sup>11</sup> The inherently conservative nature of this type of modeling standard requires projects to in effect meet an even lower decibel standard than the limit, and results in actual sounds significantly quieter than the set limit. Maine's limit of 42 dB(A) is working with the model parameters we cited in our February comments.<sup>12</sup> The current proposal contains more restrictive model inputs as well as the significantly lower nighttime sound limit, and is unworkable.

We also continue to support the sound measurement protocol, including evaluating compliance over at least twelve 10-minute intervals. However, were the decibel limit to be raised, and projects to be permitted under a future version of this rule this rule, we do believe requiring measurements every year for at least the first three years is unnecessary. We continue to recommend requiring monitoring in the first year to establish compliance and every successive fifth year thereafter, which is the schedule that Maine has adopted. If the Board decides to require more frequent monitoring campaigns, we would recommend that these be required only at the turbine sites to ensure the modeled sound power level of the turbines has not changed, and only monitoring at receptors in the case of changes in the sound levels at the turbine site.

We additionally support the other aspects of this rule that are in keeping with acoustic best practices. These include the standard only having an exterior limit. As we explained in our initial proposal, an interior standard "provides little to no additional benefit beyond that of a well-designed exterior standard, while adding both significant inconvenience for residents and significant expense for developers."<sup>13</sup> The rule also proposes to continue regulating sound based on the A-weighted decibel scale and set only a single limit for audible sound. As evidenced by studies of Denmark's low frequency sound limit, low frequency sound from wind turbines is kept at harmless levels when governed solely by an audible sound limit.<sup>14</sup> In addition, it has been widely demonstrated that levels of infrasound from modern wind turbines are well below any harmful levels, and far lower than levels from other common infrasound-emitters.<sup>15</sup>

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<sup>10</sup> While VPIRG does not oppose a differentiated day/night decibel limit, we focus our comments on the nighttime limit, as projects are restricted by the lower nighttime standard rather than the daytime standard.

<sup>11</sup> 06-096 ME. CODE R. Ch. 375, §10 (West 2017).

<sup>12</sup> Vt. Pub. Interest Research Grp., VPIRG Comments on Draft Proposed Rule 5.700 3 (Feb. 3, 2017).

<sup>13</sup> Vt. Pub. Interest Research Grp., VPIRG Proposal and Comments on Implementing a Rule Regarding Sound From Wind Generation Projects 12 (Oct. 24, 2016) [hereinafter VPIRG October Comments].

<sup>14</sup> *Id.* at 16.

<sup>15</sup> See generally, Jørgen Jakobsen, *Infrasound Emission from Wind Turbines*, 24 J. Low Frequency Noise, Vibration & Active Control 145 (2005); T. Evans et al., *Infrasound levels near windfarms and in other environments*, Environment Protection Authority & Resonate Acoustics (2013), <http://www.livingstoncounty-il.org/wordpress/wp-content/uploads/2014/11/PR-Ex.-49-Australian-EPA-Study.pdf>.

There are several areas where we have noted inconsistency or lack of clarity in the modeling and monitoring specifications in the rule, as detailed below:

- We recommend that throughout section 5.705, the term “maximum” be replaced with “full rated,” as derived from language in IEC 61400-11.
- We recommend that in 5.705(F), the Board requires that the map identifies receiver points (residences) or *potential* compliance testing locations, since actual locations should be selected after construction, given changes to the surrounding landscape that can happen over time.
- There is inconsistency between the modeled receiver height of 4 meters (14 feet) and the compliance testing microphone height of 4-5 feet. We recommend that the modeled receiver height match the compliance testing microphone height, and be set at 4-5 feet.
- The complaint criteria found in 5.708(C)(3) and the compliance testing criteria found in 5.708(E) contain different requirements, which is likely to cause confusion for stakeholders. We recommend the requirements be the same in both cases.

In sum, many aspects of this rule are based on acoustic best practices and sound science. However, by pairing these well designed specifications with an unsupported and unsupportable low sound limit and an arbitrary setback distance, the rule is essentially nullified, since it will functionally not allow for the development of wind turbines in Vermont, and thus the majority of the rule will never come into effect.

### ***The Proposed Standard Would Conflict With Act 250 And Common Law Precedent***

As we demonstrate below, the proposed standard is clearly designed to avoid annoyance that a relatively small minority of the population may experience. Adoption of a standard to prevent not health effects, but annoyance by a small minority, contradicts basic regulatory principles in Vermont.

The comparable standard under Act 250’s Criterion 8 is the “Quechee” standard, which governs non-health noise impacts. This holds that noise (or negative visual effect) is an undue adverse impact when it would “shock” an average person – not when it would annoy a small minority.<sup>16</sup> Those who are offended or annoyed by a noise (or visual impact) that does not rise to this level cannot halt a project that otherwise meets society’s standards. The Quechee test also treats impacts as undue when reasonably feasible mitigation *that would not interfere with the purpose of the project* has not been implemented, or when the noise (or visual effects) violate a clear written community standard *designed to protect a specified resource area in the community* (such as a written noise or visual standard designed specifically to protect a scenic view or a park, but not a town-wide noise ordinance).<sup>17</sup>

Similarly, the common law in Vermont protects Landowner A against noise or other impacts caused by Landowner B when the impacts cause *substantial* interference with *a normal person’s* enjoyment of the use of their property. The common law does not prevent Landowner B from using his or her property in a manner that causes any interference at all with Landowner A’s subjective sense of peace and quiet regardless of whether Landowner A is more sensitive than the average person. The common law recognizes that a standard that protects the interests of a sensitive minority would unreasonably interfere with the ability to reasonably use other lands. The Vermont Supreme Court explained this standard in the well-known *Coty v. Ramsey* decision:

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<sup>16</sup> See *In re Hovey Act 250 Permit*, 126 A.3d 510 (Vt. 2015).

<sup>17</sup> *In re in re Lathrop L.P. I*, 121 A.3d 630, 654 (Vt. 2015).

In order to be considered a nuisance, an individual's interference with the use and enjoyment of another's property must be both unreasonable and substantial... W. Prosser, *Law of Torts* § 87, at 577-80 (4th ed. 1971). The standard for determining whether a particular type of interference is substantial is that of “definite offensiveness, inconvenience or annoyance to the normal person in the community...” Prosser, *supra*, at 578. “Substantial harm is that in excess of the customary interferences a land user suffers in an organized society.” 6-A American Law of Property § 28.25, at 73 (A.J. Casner ed. 1954).<sup>18</sup>

In sum, the proposed standard would make Public Service Board regulation of the non-health noise impacts of wind dramatically more restrictive than Act 250 or the law of nuisance. Instead of changing PSB review so that it is on a par with the review that would occur outside of PSB law, the proposed standard creates an unprecedented, far more restrictive standard, that will have the effect of banning all new wind projects. This standard would be unworkable for nearly any class of development, and the Board has failed to demonstrate justification for such an undue burden on wind alone.

### ***The Nighttime Limit of 35 dB(A) is Unprecedented***

There are no other jurisdictions in the U.S. with a comparably low sound limit for wind turbines. In addition, as we have previously discussed, sound limits for all other activity in the U.S. are significantly higher than wind-specific ordinances.

Germany and Denmark are two countries that have been referenced numerous times during this proceeding as examples of low sound limits in countries that continue to be leaders in wind development. The comparison, however, ignores the complete picture around land use and energy in those countries as compared to the United States.

Both Denmark and Germany differentiate sound limits by type of area (Denmark further differentiates by wind speed). In Denmark, the highest limits are for “open countryside” (42/44 dB(A)) and for “heartland, villages, mixed areas” (45 dB(A)) in Germany.

#### **Denmark<sup>19</sup>**

<b>Area</b>	<b>Wind @ 6m/s</b>	<b>Wind @ 8 m/s</b>
open countryside	42 dB(A)	44 dB(A)
noise sensitive land use	37 dB(A)	39 dB(A)

#### **Germany<sup>20</sup>**

<b>Area</b>	<b>Limit at Night</b>
heartland, villages, mixed areas	45 dB(A)
gen. resid. & small urban areas	40 dB(A)
purely residential	35 dB(A)

To understand how these area types are defined, it is important to understand that European zoning regulations are essentially the opposite of the United States’ in regards to sound. In order to encourage urban density, the quietest sound limits are imposed on residential centers – suburbs and urban areas are considered “noise sensitive.” At the other end, their “open countryside” or “heartland” areas are considered working landscapes and have the loudest limits. Looking to Vermont, the sites where turbines have and are likely to be considered in the future given the wind resource (if this proposed rule is modified so as to allow future projects) would be considered “heartland” or “open countryside” and

<sup>18</sup> *Coty v. Ramsey Assocs. Inc.*, 149 Vt. 451, 457 (1988).

<sup>19</sup> Edwin Nieuwenhuizen & Michael Köhl, *Differences in noise regulations for wind turbines in four European countries*, EuroNoise, 333, 334 (2015)

[https://www.mp.nl/sites/all/files/publicaties/Nieuwenhuizen\\_Euronoise\\_2015.pdf](https://www.mp.nl/sites/all/files/publicaties/Nieuwenhuizen_Euronoise_2015.pdf).

<sup>20</sup> *Id.* at 336.

would be subject to the 42-45 dB(A) limits under Denmark or Germany's standard. As we discuss below, when the Massachusetts Department of Environmental Protection (DEP) translated Denmark and Germany's standards for the U.S., they changed those definitions to "sparsely populated areas" and "villages, mixed use" respectively to better clarify the land usage for a U.S. audience.<sup>21</sup>

In addition, compensation for renewable energy is much higher in European countries than it is in the United States, meaning that developers can build projects in Europe that would not be financially viable in the U.S. For instance, European developers may be able to develop a project despite it needing to be significantly curtailed due to sound output. VPIRG supports promoting sensible energy projects that will reach their full potential. We also support well-crafted renewable energy regulations that are protective of public health. However, VPIRG does not support policies that would promote wind projects producing a fraction of their nameplate capacity due to curtailment, especially if the regulation leading to such curtailment is unsupported by the evidence. Increased compensation to support such unnecessary curtailment is also not good public policy.

### ***The Nighttime Limit of 35 dB(A) is Unsupported by the Evidence***

In the following section, we review the seven studies cited in the Board's filings with ICAR and the Secretary of State ("Citation of Source Documentation of Scientific Information"). A thorough review of these studies clearly demonstrates that a limit as low as 35 dB(A) outdoors is not necessary to protect public health.

The studies reference 35 dB(A) exterior levels primarily in the context of self-reported annoyance. The Council of Canadian Academies references a definition of noise annoyance as "'a feeling of displeasure evoked by a noise' and 'any feeling of resentment, displeasure, discomfort and irritation occurring when a noise intrudes into someone's thoughts and moods or interferes with activity.'" (Passchier-Vermeer & Passchier, 2006).<sup>22</sup> Many studies acknowledge that sleep disturbance and other related public health issues can be a secondary impact of annoyance. However, as discussed above, state law and precedent clearly dictates that standards regulating based on annoyance must be designed to protect a reasonable or average person against substantial annoyance, and not to guarantee no annoyance at all by even a small, especially sensitive minority.

### ***Vermont Department of Health: Potential Impact on the Public's Health from Sound Associated with Wind Turbine Facilities***

To begin, the Board references the Department of Health's 2010 literature review, which concluded with the recommendation that sound levels should be kept below the World Health Organization (WHO)'s nighttime guideline of 40 dB(A)  $L_{\text{night,annual}}$ .<sup>23</sup> As we explained in our initial comments in October, a well-designed and regulated standard of 45 dB(A)  $L_{\text{eq}}$  has been proven to meet or exceed the WHO 40 dB(A)  $L_{\text{night,annual}}$  standard.<sup>24</sup>

<sup>21</sup> Jeffrey M. Ellenbogen et al., *Wind Turbine Health Impact Study: Report of Independent Expert Panel*, ES-10 (2012).

<sup>22</sup> Expert Panel on Wind Turbine Noise & Human Health, Council of Canadian Academies, *Understanding the Evidence: Wind Turbine Noise*, 67 (2015), <http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/wind-turbine-noise/windturbinenoisefullreporten.pdf>.

<sup>23</sup> William Bress et al., Vt. Dept. of Health, *Potential Impact on the Public's Health for Sound Associated with Wind Turbine Facilities*, 7 (2010).

<sup>24</sup> VPIRG October Comments, *supra* note 3, at 5.

In a subsequent draft of this review, the Department of Health this year continued to recommend an annual nighttime limit of 40 dB(A), measured at the façade of the dwelling. This draft additionally stated that an *annual* limit of 35 dB(A), measured at the façade of the dwelling, could be considered specifically to “minimize changes in attitude (annoyance) rather than preventing sleep disturbance.”<sup>25</sup> 35 dB(A), measured annually at the façade of the house, is significantly higher than 35 dB(A)  $L_{eq}$  measured 100 feet from the house. To restate, the state’s own experts in public health acknowledged that going lower than 40 dB(A) annually was unnecessary for the protection of public health. They additionally concluded that if protecting against annoyance was deemed necessary, a level of 35 dB(A) measured annually at the façade (significantly less restrictive than the level proposed by the Board), was appropriate.

#### *World Health Organization Guidelines for Community Noise*

The World Health Organization (WHO) Guidelines published in 1999 were designed to accommodate community noise sources, including “road, rail and air traffic; industries; construction and public work; and the neighborhood” as well as indoor sources including “ventilation systems, office machines, home appliances and neighbors.”<sup>26</sup>

The recommended guideline they proposed in this document was “[a]t night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45 dB LAeq, so that people may sleep with bedroom windows open.”<sup>27</sup> This also meets the WHO’s recommended interior standard of 30 dB(A)  $L_{eq}$ , given an assumed outdoor-indoor attenuation of 15 dB(A) with windows open.

Attenuation has been a frequently discussed piece of this proceeding, especially in light of the ongoing noise complaint proceeding at the Brouha residence near the Sheffield turbines. In that case, attenuation testing found that there was only 1 dB(A) outdoor-indoor attenuation in the second floor bedroom.

On this point, VPIRG would assert that in setting regulations, the Board has an obligation to use more than a single case to set an assumed attenuation value, particularly when that single case is unique or nearly so (a bedroom wall facing the turbines with approximately seven feet of windows that can be cranked fully open).<sup>28</sup> Where these WHO guidelines assume an outdoor-indoor attenuation of 15 dB(A), the 2009 guidelines discussed below assume an even higher attenuation value of 21 dB(A) as a “relatively low” value that takes into account windows being slightly open at night.<sup>29</sup> If assuming an attenuation value in setting the exterior decibel level, the Board should base this value on studies of average outdoor-indoor attenuation, and the value should be at least 10 dB(A).

#### *World Health Organization Night Noise Guidelines for Europe*

The WHO revised their Community Noise regulations in 2009, tailoring their focus to nighttime noise levels, with the goal of establishing a target sound limit. Scientists, industry and government

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<sup>25</sup> Vt. Dep’t of Health, Wind Turbine Noise and Human Health: Literature Review 5-6 (Mar. 23, 2017) (unpublished report) (on file with VPIRG).

<sup>26</sup> Birgitta Berglund et al., World Health Organization, *Guidelines for Community Noise*, vii (1999).

<sup>27</sup> *Id.* at xiv.

<sup>28</sup> Letter from James D. Barnes, Acentech Inc., to Aaron Kisicki, Special Counsel, Vt. Pub. Serv. Dep’t. (Sept. 25, 2015) (detailing an Acentech field study on a noise complaint with the Vermont Wind Sheffield Wind Project) (on file with VPIRG).

<sup>29</sup> World Health Org., *Night Noise Guidelines for Europe*, XIV (2009).

stakeholders, and nongovernmental organizations ultimately reached the consensus that 40 dB(A)  $L_{\text{night,outside}}$  was an appropriate night noise guideline.<sup>30</sup> As used in this study,  $L_{\text{night,outside}}$  refers to the hours of 11pm-7am local time as measured over a period of one year.<sup>31</sup> This annual average was chosen because many environmental health effects are typically correlated with sound levels over longer periods of time.<sup>32</sup> As we discussed above, this was ultimately the guideline that the Vermont Department of Health also chose to recommend and projects permitted at 45 dB(A)  $L_{\text{eq}}$  have been shown to meet this long term guideline.

The WHO chose to establish set limits at the “lowest observed adverse effect level” (LOAEL). The WHO noted that there “is no sufficient evidence that the biological effects observed at the level below 40 dB(A)  $L_{\text{night,outside}}$  are harmful to health. . . .”<sup>33</sup> The WHO ultimately determined that 40 dB(A)  $L_{\text{night,outside}}$  is an appropriate threshold which constitutes “a health-based limit value of the night noise guidelines (NNG) necessary to protect the public, including most of the vulnerable groups such as children, the chronically ill and the elderly, from the adverse health effects of night noise.”<sup>34</sup> These guidelines do not support a nighttime limit of 35 dB(A)  $L_{\text{eq}}$ .

*Environmental Protection Agency: Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*

The Environmental Protection Agency information document (EPA Levels Document), published in 1974, recommends using an  $L_{\text{eq}}$  metric, as the Board has currently proposed, or alternatively an  $L_{\text{dn}}$  (day-night) sound level. The EPA Levels Document recommends an  $L_{\text{dn}}$  of 45 dB indoor limit for residential areas.<sup>35</sup> We demonstrated in our November 2016 comments how a wind project modeled to meet a 45 dB(A)  $L_{\text{eq}}$  exterior standard resulted in an actual 10-minute  $L_{\text{eq}}$  of less than 41 dB(A) exterior and an  $L_{\text{dn}}$  of 45 dB(A) exterior.<sup>36</sup> Interior sound levels will be significantly lower, as discussed above.

As we discussed in November, the EPA Levels Document and the method for determining appropriate sound limits,<sup>37</sup> similarly to the WHO guidelines, only considered types of noise sources that generate sound independent of weather and site conditions (transportation and industrial facilities, in the case of the EPA Levels Document). They thus do not take into consideration inherent masking of sound from wind acting on terrain and vegetation when wind turbines are operating at or near full sound output. The EPA Levels Document does not support a 35 dB(A)  $L_{\text{eq}}$  nighttime standard. Even if it did, the document isn’t adequate as a basis for a wind turbine specific regulation.

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<sup>30</sup> *Id.* at VII.

<sup>31</sup> *Id.* at 108, n 2.

<sup>32</sup> *Id.* at X.

<sup>33</sup> *Id.* at 109.

<sup>34</sup> *Id.*

<sup>35</sup> U.S. Env. Prot. Agency Office of Noise Abatement and Control, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate margin of Safety 2* (1974).

<sup>36</sup> See Vt. Pub. Interest Research Grp., VPIRG Reply Comments on Implementing a Rule Regarding Sound from Wind Generation Projects (Nov. 16, 2016).

<sup>37</sup> *Id.* at 4.

*Health Canada: Wind Turbine Noise and Health Study*

The 2014 Health Canada study is a comprehensive, peer-reviewed epidemiological study that specifically investigates wind turbine noise and potential health impacts.<sup>38</sup> The study examined communities in Ontario and on Prince Edward Island that are regularly exposed to varying levels of wind turbine noise (WTN). Overall, the Health Canada study found both “subjectively reported sleep disturbance” and “a multitude of health effects” they reviewed “to be unrelated to WTN levels.”<sup>39</sup>

This report identifies several health symptoms commonly imputed to wind turbine sound, including cardiovascular effects (such as heart disease and high blood pressure), migraines, dizziness (vertigo), ringing in the ears (tinnitus), anxiety, depression, and sleep disturbance.<sup>40</sup> The Health Canada study, through rigorous scientific methodology, ultimately reaches the conclusion that there is no “statistically significant increase in the self-reported prevalence of ... high blood pressure...heart disease...migraines/headaches, dizziness, or tinnitus in relation to WTN exposure up to 46 dB. . . .” among other health issues.<sup>41</sup> Additionally the study found that “[m]edication use (for anxiety, depression, or high blood pressure) was unrelated to WTN levels.”<sup>42</sup> There was a correlation between sleep medication use and WTN, however “the prevalence was higher among the two *lowest* WTN categories {<25 dB and [25–30] dB}” (emphasis added).<sup>43</sup>

The Health Canada study additionally looks at annoyance resulting from wind turbine sound. The report found that between [35 and 40) dB(A), 10% of participants experienced annoyance (that 10% includes all levels of annoyance).<sup>44</sup> That indicates that setting a standard of 35 dB(A) is clearly below the standard needed to protect anyone from any health effects. That standard would additionally not be designed to protect the average listener, but only one in ten listeners, from annoyance. As discussed above, a regulatory standard that avoids annoyance to a statistically small group of citizens and has the functional impact of banning wind is inappropriate and unprecedented.

These findings do not support a 35 dB(A) nighttime limit and do support a limit of 45 dB(A) for protecting public health.

*Massachusetts Department of Environmental Protection Wind Turbine Health Impact Study*

The Massachusetts Department of Environmental Protection (DEP) formed an Independent Expert Panel (the Panel) to study the impacts of wind turbine sound. The Panel’s 2012 report found that “[t]here is limited evidence of an association between wind turbine noise and both annoyance and sleep disruption, depending on the sound pressure level at the location of concern.”<sup>45</sup>

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<sup>38</sup> See generally David S. Michaud et al., *Exposure to wind turbine noise: Perceptual responses and reported health effects*, 139 J. Low Frequency Noise, Vibration & Active Control 1443 (2016).

<sup>39</sup> *Id.* at 1449-50.

<sup>40</sup> *Id.* at 1444.

<sup>41</sup> *Id.* at 1452.

<sup>42</sup> *Id.*

<sup>43</sup> *Id.* at 1450.

<sup>44</sup> *Id.* at 1449.

<sup>45</sup> Jeffrey M. Ellenbogen et al., *Wind Turbine Health Impact Study: Report of Independent Expert Panel*, ES-9 (2012).

The Panel identified a combination of the sound limits used by Denmark and Germany to be “Promising Practices.” The Panel re-defines the land use descriptions to fit U.S. standards in the following table (recreated here):

Promising Practices for Nighttime Sound Pressure Levels by Land Use Type<sup>46</sup>

Land Use	Sound Pressure Level, dB(A) Nighttime Limits
Industrial	70
Commercial	50
Villages, mixed usage	45
Sparsely populated areas, 8 m/s wind*	44
Sparsely populated areas, 6 m/s wind*	42
Residential areas, 8 m/s wind*	39
Residential areas, 6 m/s wind*	37

\*measured at 10 m above ground, outside of residence or location of concern

The Panel’s conclusions do not support a 35 dB(A) nighttime limit. If applied to Vermont, locations of the greatest wind resource, where most turbine projects have or likely would be considered, would fall within the “villages, mixed use” or “sparsely populated areas” categories with nighttime limits between 42 and 45 dB(A).<sup>47</sup> It’s also worth noting that the Panel does not include the lowest end of Germany’s regulations (the 35 dB(A) limit) even for pure residential/dense population areas.

The report additionally notes that considerations regarding limits should “take into account trade-offs between environmental and health impacts of different energy sources, national and state goals for energy independence, potential extent of impacts, etc.”<sup>48</sup>

*Council of Canadian Academies: Understanding the Evidence: Wind Turbine Noise*

In 2015, the Council of Canadian Academies pulled together an expert panel to review the evidence on wind turbine sound and public health.<sup>49</sup> The report concludes that there is a causal relationship between wind turbine sound and annoyance, and a limited possible relationship between wind turbine sound and sleep disturbance, but inadequate information on any other health impacts. The panel did not examine specific wind projects or neighbors and made no specific recommendations for sound levels, but found through their review that most sounds from wind turbines were between 36 and 45 dB(A)  $L_{eq}$  nighttime.<sup>50</sup>

This report does not provide a basis for any specific decibel limit as it makes no recommendations for sound levels to prevent health impacts or annoyance. Given that the report acknowledges wind sounds between 36 and 45 dB(A), and concludes that there is no direct causal relationship from wind turbine

<sup>46</sup> *Id.* at 10.

<sup>47</sup> *Id.*

<sup>48</sup> *Id.* at ES-10-11.

<sup>49</sup> See generally, Council of Canadian Academies, *supra* note 22.

<sup>50</sup> *Id.* at 36.

sound to any impacts other than annoyance, this report specifically does not support a decibel limit of 35 dB(A) nighttime.

*Primary Sources: Peer Reviewed Studies of Wind Turbine Noise*

The Massachusetts DEP study cites four commonly cited peer-reviewed studies, which VPIRG also examined in the course of our research.<sup>51</sup> When taken together, these studies clearly show that the actual number of project neighbors reporting any levels of annoyance is extremely low. In addition, three out of four of the studies reviewed had a relatively small sample size, from which it is difficult to draw any concrete conclusions. The study with the largest sample size (Pedersen & Persson Waye, 2007) found the smallest levels of annoyance among respondents.<sup>52</sup> Review of these studies supports the conclusion that Massachusetts DEP reached in their report, which was that there was “limited epidemiologic evidence suggesting an association between exposure to wind turbines and annoyance.”<sup>53</sup>

The first report (Pedersen & Persson Waye, 2004) describes their 2000 Swedish study of turbine noise and annoyance. They report that 20% of the 40 study respondents (or 8 people) in the 37.5-40 dB(A) category, and 36% of the 25 respondents (or 9 people) in the >40 dB(A) range reported being “very annoyed.”<sup>54</sup> Interpreted another way, the data show that 73% and 56% of respondents were either not annoyed or only slightly annoyed for the 37.5-40 dB(A) and >40 dB(A) categories respectively (the remaining 7% and 8% respectively defined themselves as “rather annoyed”).<sup>55</sup>

The second peer-reviewed study (Pedersen & Persson Waye, 2007), demonstrated that even fewer project neighbors experienced annoyance, despite a larger sample size. Of 1309 people sampled, only 754 responded.<sup>56</sup> Of the 754 respondents, only 31 in total reported annoyance of any kind.<sup>57</sup> Breaking these numbers down by category, 6% of 71 people in the 37.5-40 dB(A) range and 15% of 20 people in the >40 dB(A) range reported annoyance.<sup>58</sup> This amounts to 4 and 3 people, respectively.<sup>59</sup>

The third study (Pedersen et. al., 2009) extended into even higher decibel ranges, but reached the same conclusion that, in actuality, very few people reported being “very annoyed.”<sup>60</sup> Outdoors, in the decibel ranges of 35-40 dB(A), 40-45 dB(A), and >45 dB(A), 10 of 159, 11 of 93, and 4 out of 65 people reported being “very annoyed,” respectively.<sup>61</sup>

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<sup>51</sup> Ellenbogen et al., *supra* note 45, at 15.

<sup>52</sup> See Pedersen & Persson Waye 2007, *supra* note 2, at 482 tbl. 1.

<sup>53</sup> Ellenbogen et al., *supra* note 45, at ES-5

<sup>54</sup> Pedersen & Persson Waye 2004, *supra* note 2, at 3464.

<sup>55</sup> *Id.*

<sup>56</sup> Pedersen & Persson Waye 2007, *supra* note 2, at 482 tbl. 1.

<sup>57</sup> *Id.* at 484.

<sup>58</sup> *Id.*

<sup>59</sup> *Id.*

<sup>60</sup> See generally, Eja Pedersen et al., *Response to noise from modern wind farms in The Netherlands*, 126 J. Acoustic Soc’y Am. 634 (2009).

<sup>61</sup> *Id.* at 637 tbl. II.

The final peer-reviewed study cited in the Massachusetts DEP review (Shepherd et al., 2011) examines an extremely small sample size (56 households) and an even smaller pool of respondents (39 people).<sup>62</sup> Overall, 23 people in total described themselves as annoyed by the sound from turbines.<sup>63</sup> However, the study fails to break this number down by decibel level range, making complaint prevalence indistinguishable between lower and higher sound levels.

Nothing in these results supports a 35 dB(A) nighttime limit for the purposes of protecting public health – but even if it was determined to be appropriate for a rule to protect against annoyance, the balance of findings in these four studies clearly indicate (as the Massachusetts DEP report also concluded) that annoyance levels are not significant at the levels of sound studied.

### ***Setbacks are Duplicative and Unnecessary***

In response to the Board’s January 9, 2016 request for additional comments, we submitted a lengthy discussion of why setbacks are an inefficient and imprecise method of restricting perceived sound from wind turbines by neighbors. As we stated, “[d]istance is just one of many variables that determines sound levels at a neighboring residence.”<sup>64</sup> We illustrated, using models from two completed wind projects, how sound levels at the end of the turbine string decreased significantly more rapidly than sound levels in the middle of the string. Those illustrations further illustrated how topography and direction can change sound levels in a non-linear manner, further challenging the utility of a straight line setback.<sup>65</sup>

A setback paired with a decibel limit is duplicative and will only serve to restrict project potential even further. In the cases where the decibel limit is not the determining factor, a project may be restricted simply because a home is within the setback radius (despite modeled sounds at that home being well below the decibel limit). If the decibel limit was increased but the setback distance remained, this would likely still block a large majority of the possible wind sites in Vermont.

Finally, we are concerned that the phrasing of the setback requirement is overly broad. Section 5.703 (A) and (B) each state that “each” or “every” “sound-producing element of the facility will be set back. . . .” It is unclear whether this refers to the substation, transmission line, operations buildings, and turbine access roads in addition to the turbines. If so, this setback has the potential to be even more restrictive than initially considered.

We recommend eliminating the setback from the final rule, or making it an optional, alternative requirement to the decibel limit.

### ***Conclusion and Recommendations***

We have greatly appreciated the attention and effort that the Board has put into this proceeding thus far. It is a clear acknowledgement of the importance of this rule to our state and its residents. However, we are gravely concerned with the direction this proposed rule has taken. It is counter to legislative

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<sup>62</sup> Daniel Shepherd et al., *Evaluating the impact of wind turbine noise on health-related quality of life*, 13 *Noise & Health* 333, 335-36 (2011).

<sup>63</sup> *Id.* at 337.

<sup>64</sup> Vt. Pub. Interest Research Grp., *VPIRG Comments on Implementing a Rule Regarding Sound From Wind Generation Projects 1* (Jan. 17, 2017).

<sup>65</sup> *Id.* at 2.

intent and the public good of the state. It is unprecedented, unsupported by the evidence, and would arbitrarily ban future wind projects.

We recommend that the Board amend their proposed rule filing by increasing the nighttime decibel limit to 45 dB(A) and removing the setback requirement. A nighttime limit of 45 dB(A) is supported by the evidence on the subject and would allow future wind projects to be built in Vermont. However, we also do believe that a nighttime level as low as 42 dB(A) would be workable, if the modeling parameters were made to match those in Maine, as it is proven to work in a terrain and climate similar to Vermont's.

Thank you for your consideration of our recommendations. We look forward to being engaged throughout the rest of the rulemaking process.