

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA**

**IN THE MATTER OF THE APPLICATION BY PREVAILING WIND PARK, LLC
FOR A PERMIT FOR A WIND ENERGY FACILITY IN BON HOMME, CHARLES MIX,
AND HUTCHINSON COUNTIES, SOUTH DAKOTA, FOR PREVAILING WIND
PARK ENERGY FACILITY**

SD PUC DOCKET EL-18-026

**PREFILED REBUTTAL TESTIMONY OF DR. JEFFREY ELLENBOGEN
ON BEHALF OF PREVAILING WIND PARK, LLC**

September 26, 2018

1 **I. INTRODUCTION**

2

3 **Q. Please state your name and business address.**

4 A. My name is Dr. Jeffrey Ellenbogen. My business address is 906 Dogwood Hill
5 Court, Towson, Maryland 21286.

6

7 **Q. Did you provide Direct Testimony in this Docket?**

8 A. No.

9

10 **Q. Please describe your background and current employment.**

11 A. I am a medical physician with a license to practice medicine in Maryland. I have a
12 bachelor's degree from the University of Michigan, a medical degree from Tufts
13 University, and a master's in medical science from Harvard Medical School. I
14 finished my medical doctorate in 2000, received my medical license in 2001, and
15 have been practicing medicine since that time. Between 2013 and 2018, I served as
16 a practicing attending physician at Johns-Hopkins Hospital, specializing in neurology
17 and sleep medicine. In January 2018 I resigned from Johns-Hopkins Hospital to
18 dedicate myself full-time to my consulting business, Ellenbogen Consulting, LLC,
19 which focuses on sleep and brain health.

20

21 I am providing testimony on behalf of Prevailing Wind Park, LLC ("Prevailing Wind
22 Park"). My qualifications are attached as Exhibit 1.

23

24 **Q. What is the purpose of your Rebuttal Testimony?**

25 A. The purpose of my Rebuttal Testimony is to respond to intervenor testimony
26 regarding the impacts of wind turbines on human health, particularly with respect to
27 sleep. I provide testimony regarding my participation in an evaluation of the
28 potential health impacts of wind turbines on humans sponsored by the
29 Massachusetts Department of Environmental Protection and the Massachusetts
30 Department of Public Health (together, the "Massachusetts Agencies"). I also
31 discuss how I had the opportunity to test the findings of the study through

32 independent medical exams I performed on four individuals who alleged health
33 impacts from wind turbines.

34

35 **II. WIND TURBINE HEALTH IMPACT STUDY**

36

37 **Q. In the course of your work, have you had the opportunity to study the alleged**
38 **health impacts of wind turbines?**

39 A. Yes. In 2011, I was approached by the Massachusetts Agencies and asked to join a
40 group of people to evaluate the potential health impacts of wind turbines on humans.
41 As a result of that evaluation, the document attached as Exhibit 7 to Dr. Mark
42 Roberts' Supplemental Direct Testimony, titled *Wind Turbine Health Impact Study:*
43 *Report of Independent Expert Panel* (January 2012) ("Massachusetts Study" or
44 "Study"), was released.

45

46 **Q. Please describe the purpose of the Massachusetts Study.**

47 A. The Massachusetts Agencies charged us with bringing together a group of experts
48 to perform an independent evaluation of the scientific and medical literature
49 regarding wind turbines and their potential impact on human health, as well as to
50 solicit information from the public to hear about any potential issues not already
51 reflected in the literature. The Massachusetts Agencies asked us to ensure that we
52 did not leave any stones unturned with respect to potential plausible medical
53 problems that could be a consequence of wind turbines. Specifically, we were
54 charged with the following tasks:

55 • Identify and characterize attributes of concern and identify any
56 scientifically documented or potential connection between health impacts
57 and wind energy turbines;

58 • Evaluate and discuss information from peer-reviewed scientific studies,
59 other reports, popular media, and public comments received by the
60 Massachusetts Agencies concerning the nature and type of health
61 complaints commonly reported by individuals who reside near existing
62 wind farms;

- 63 • Assess the magnitude and frequency of any potential impacts and risks to
64 human health associated with the design and operation of wind energy
65 turbines based on existing data;
66 • For the attributes of concern, identify best practices that could reduce
67 potential human health impacts; and
68 • Issue a report summarizing findings.

69

70 **Q. Who else served on the panel that prepared the Study?**

71 A. In addition to myself, the following individuals served on the Study panel (“Panel”):¹

- 72 • Sheryl Grace, PhD; MS Aerospace & Mechanical Engineering, Associate
73 Professor of Mechanical Engineering, Boston University;
74 • Wendy J. Heiger-Bernays, PhD; Associate Professor of Environmental
75 Health, Department of Environmental Health, Boston University School of
76 Public Health; Chair, Lexington Board of Health;
77 • James F. Manwell, PhD Mechanical Engineering; MS Electrical &
78 Computer Engineering; BA Biophysics; Professor and Director of the Wind
79 Energy Center, Department of Mechanical & Industrial Engineering
80 University of Massachusetts, Amherst;
81 • Dora Ann Mills, MD, MPH, FAAP; State Health Officer, Maine 1996-2011;
82 Vice President for Clinical Affairs, University of New England;
83 • Kimberly Sullivan, PhD; Research Assistant Professor of Environmental
84 Health, Department of Environmental Health, Boston University School of
85 Public Health; and
86 • Marc G. Weisskopf, ScD Epidemiology; PhD Neuroscience; Associate
87 Professor of Environmental Health and Epidemiology, Department of
88 Environmental Health & Epidemiology, Harvard School of Public Health.

89

¹ The qualifications and affiliations are as of the date of the Massachusetts Study.

90 **Q. What methodology did the Panel employ to prepare the Study?**

91 A. We conducted an extensive review of the scientific literature, as well as other
92 reports, popular media, and public comments received by the Massachusetts
93 Agencies. We met three times as a group and held additional conference calls to
94 clarify points of discussion. An independent facilitator supported these discussions.
95 Each Panel member provided written text based on the literature review and
96 analyses, and draft versions of the report were reviewed by each Panel member.
97 The Panel reached consensus for the final report and its findings.

98

99 **Q. Did the Massachusetts Agencies direct you to arrive at a particular conclusion**
100 **as a result of the Massachusetts Study?**

101 A. Absolutely not. Indeed, one of the commissioners directed us to be very broad in
102 our approach. If there was a problem, he wanted to know about it. We understood
103 that our purpose was to seriously consider and examine each of the potential
104 concerns raised by the public as part of the Study.

105

106 **Q. Please summarize the conclusion of the Massachusetts Study.**

107 A. Overall, the Study concluded that wind turbines do not pose a risk to human health.
108 The Study included specific findings related to several topics, including, but not
109 limited to, noise and shadow flicker.

110

111 **Q. Please explain the Study's key finding with respect to noise.**

112 A. We concluded that there is insufficient evidence that noise from wind turbines is
113 directly causing health problems or disease. Most epidemiological literature on
114 human response to wind turbines relates to self-reported annoyance, and this
115 response appears to be a function of some combination of the sound itself, the sight
116 of the turbine, and attitude towards the wind turbine project. We recognize that, for
117 some people, wind turbines annoy them, be it the sound, sight, presence, or
118 complex notions of economics, but there were no direct physiological effects on
119 health in humans from wind turbines. None of the limited epidemiological evidence
120 reviewed suggested an association between noise from wind turbines and a wide

121 range of topics we considered: pain, stiffness, diabetes, high blood pressure,
122 tinnitus, hearing impairment, cardiovascular disease, and/or headache/migraine.

123

124 In addition, claims that infrasound from wind turbines directly impacts the vestibular
125 system have not been demonstrated scientifically. The vestibular system is a
126 physical system that is responsible for helping a person figure out where he or she is
127 in space – *i.e.*, balance and position sense. There was concern among people that
128 this system could be affected by the vibrations produced by a wind turbine. We did
129 not find evidence in the human or animal literature to support that vibrations of the
130 kind produced by a wind turbine could influence the vestibular system.

131 The study also specifically evaluated the merits of “wind turbine syndrome,” and
132 found no basis for a set of health effects from wind turbines.

133 **Q. Please explain the Study’s finding with respect to shadow flicker.**

134 A. Scientific evidence suggests that shadow flicker does not pose a risk for eliciting
135 seizure as a result of photic stimulation. To explain in more detail, what is known
136 about photic-stimulated epilepsy (in other words, seizures as a result of flashes of
137 light) is that they happen as a result of frequencies greater than 5 hertz (“Hz”),
138 usually substantially higher. Because of the nature of the speed and size of wind
139 turbines, the frequency of any shadow flicker will be about 0.5-1 Hz, which is well
140 below the range that would elicit a seizure even in someone who is vulnerable to
141 photic stimulation seizures. I feel very comfortable that shadow flicker from wind
142 turbines does not cause seizures for several reasons. First, flicker of any kind does
143 not cause seizures in the general population, And it only causes seizures in the
144 minority of people who have epilepsy. Further, even among those who have
145 epilepsy for which their seizures are sensitive to photic stimulation, the frequency of
146 shadow flicker from wind turbines is not at the frequency that induces seizures.

147

148 **Q. Have other studies since the Massachusetts Study reached similar**
149 **conclusions?**

150 A. Yes. As Dr. Mark Roberts testified in his Supplemental Direct Testimony, repeated,
151 peer-reviewed scientific studies from numerous organizations and agencies across
152 numerous countries around the world have similarly found no association between
153 wind turbines and health effects. For example, a very large study, “Health Canada,”
154 was published in 2016.² In it, researchers examined self-reported and objective
155 measures of stress associated with wind turbine noise (“WTN”) of more than one
156 thousand people “exposed to outdoor calculated WTN levels up to 46 dBA.” They
157 concluded that this exposure to noise from wind turbines “had no apparent influence
158 on any of these endpoints” [of stress].

159

160 **III. INDEPENDENT MEDICAL CLAIMS**

161

162 **Q. Since the Study was released, have you had the opportunity to test the**
163 **Study’s conclusions?**

164 A. Yes. From a medical and scientific point of view, wind turbine-caused illness, or
165 what has been called “wind turbine syndrome,” does not exist. This Massachusetts
166 panel of experts and many other experts around the world have made the same
167 conclusion. However, some people in the community feel that it does, likely due to
168 its promotion by a book called *Wind Turbine Syndrome*. As a result, there are
169 people who have raised concerns, despite expert opinion to the contrary. There was
170 a group of people who raised such a concern with a wind farm in Michigan and
171 brought a lawsuit against the owner, and I had the opportunity to collect a full history
172 and perform a full examination of two couples. I also had the opportunity to view
173 their neighborhoods.

174

² Michaud, David S., et. al. “Personal and situational variables associated with wind turbine noise annoyance.” *J. Acoust. Soc. Am.* 139 (3), March 2016.

175 **Q. Please describe the results of these independent medical examinations.**

176 A. I examined four individuals. In all four instances, I concluded that these people were
177 not getting the medical treatment they needed because they were incorrectly
178 assigning the cause of their health problems to wind turbines.

179
180 The first individual was a 53-year old industrial designer who complained of
181 insomnia and palpitations in his chest at night and was convinced that the wind
182 turbine near his house was causing these problems. In examining and talking with
183 him, I understood that in recent years, he had gained a substantial amount of weight
184 and experienced snoring and sleep apnea. As it turned out, this gentleman almost
185 certainly had obstructive sleep apnea. In addition, I understand that this person
186 wound up later having medical tests that showed an abnormal heart rhythm
187 unrelated to the wind farm.

188 The second individual was a 45-year-old science teacher at a junior high school who
189 was worried about wind turbine syndrome, so she left her job in her home
190 neighborhood and took a new job that required a substantial commute, resulting in
191 her waking up at approximately 4:30 a.m., a full two hours earlier than her typical
192 pattern. Her ensuing sleepiness, anxiety, and forgetfulness were most likely
193 attributable to her substantial sleep deprivation, not the wind turbines.

194 The third individual was a 52-year-old bookkeeper who complained of headaches. I
195 measured her blood pressure, and it was very high. Untreated high blood pressure
196 often causes headaches. She had a history of depression that was untreated at the
197 time of my evaluation and she more recently had substantial snoring at night which
198 could easily have been untreated, obstructive sleep apnea which she acknowledged,
199 but did not pursue because of the focused assumption that she had wind turbine
200 syndrome.

201
202 Finally, the fourth individual was a 60-year-old farmer with balance problems and
203 sleep problems. Regarding his balance, upon examination, I determined that he had
204 a serious neuropathy. This resulted in an inability to feel his feet which was causing

205 his difficulty with balance. In addition, this individual acknowledged he had a
206 substantial alcohol problem, which is one of the leading causes of neuropathy.
207 Alcohol can also impact balance by causing degeneration of the cerebellum, an area
208 of the brain that helps with balance and coordination. Regarding his sleep, the
209 issues he was experiencing were no different than those diagnosed several decades
210 earlier for which he was given antidepressant medication and sedatives, both of
211 which he stopped taking more recently. That sleep problem was recently made
212 worse by an increase in his alcohol consumption at night, which caused him to need
213 to urinate in the middle of the night. Further, he had pain in his shoulders which he
214 described as disruptive to his sleep. Taken together, there was no worsening of his
215 chronic sleep problem after the wind turbines were installed in his neighborhood,
216 and there were compelling reasons for his disrupted sleep that did not involve wind
217 turbines.

218

219 **Q. What did you conclude from these independent medical exams?**

220 A. Each of these individuals attributed their health problems to wind turbines. However,
221 wind turbines were not the cause of the identified health issues, and in my opinion,
222 the misapplied blame to wind turbines prevented these individuals from seeking and
223 obtaining much-needed medical treatment for their underlying conditions.

224

225 **Q. Did you provide testimony in the lawsuit that these individuals brought?**

226 A. No. The case settled soon after I completed the independent medical examinations.

227

228 **IV. RESPONSE TO INTERVENOR TESTIMONY**

229

230 **A. Response to Prof. Alves-Pereira.**

231

232 **Q. Prof. Alves-Pereira states that, “perhaps more worrisome, families in ILFN-**
233 **contaminated homes *are sleeping* while enveloped within an environment that**
234 **is bombarding their bodies with mechanical agents of disease.” (Alves-**
235 **Pereira Direct, lines 374-375) (emphasis in original). How does this relate to**
236 **the Project?**

237 A. I have reviewed Prof. Alves-Pereira’s testimony and there is no reasonable basis to
238 presume that infrasound from the wind turbines in the Prevailing Wind Park Project
239 (“Project”) will pose any risk to human health.

240

241 **B. Response to Dr. Punch.**

242

243 **Q. Dr. Punch asserts that “a substantial proportion of people living in the vicinity**
244 **of the proposed Project can be expected to experience not only annoyance,**
245 **but also a variety of adverse health effects” including, among other things,**
246 **sleep disturbance. (Punch Direct, lines 100-08). What is your response?**

247 A. Based on the sound levels proposed for the Project (below 45 dBA), it is my expert
248 opinion that such sound levels will neither interfere with sleep nor pose a risk to
249 human health. Dr. Punch’s statement misrepresents the facts and is the kind of
250 statement that may have the effect of causing people to be annoyed by wind
251 turbines.

252

253 **Q. Dr. Punch further asserts that he estimates that “around 15%-25% of exposed**
254 **residents” will experience extreme annoyance and sleep disturbance because**
255 **of the Project. (Punch Direct, lines 124-26). Is that a reasonable estimate of**
256 **the problem?**

257 A. This estimate is a gross exaggeration, both in the number of people affected and the
258 degree of the effect. The experience of annoyance to wind turbines is highly

259 subjective and personal. As noted in the Massachusetts Study (p. 54), annoyance
260 appears to be coupled to many factors, including sound, site and the attitude toward
261 turbines. If residents are misinformed that the turbines will cause negative health
262 effects, or if they are told, as they are here by Dr. Punch, that 1 in 5 people will
263 “experience extreme annoyance and sleep disturbance because of the Project,” then
264 they are more likely to find the turbines of the Project annoying.

265

266 **Q. Dr. Punch states that studies “have established a closer relationship between**
267 **subjective responses to community noise and cardiovascular outcomes when**
268 **the annoyance is sleep-related than when it is non-sleep-related.” (Punch**
269 **Direct, lines 135-38). What is your response?**

270 A. Dr. Punch relies a 2009 World Health Organization (“WHO”) report. In the same
271 paragraph of the WHO report, which he misquotes, it also says “[w]ith respect to
272 night noise exposure, nearly no information is available from epidemiological studies
273 on the cardiovascular effects of long-term noise exposure of the bedroom during the
274 night.” (p. 74). More relevant to this Project, there is no data to link cardiovascular
275 disease outcomes related to sleep with wind turbines. It is my expert opinion that
276 noise at the levels proposed for the Project will not lead to adverse health outcomes
277 or sleep disturbance.

278

279 **Q. Dr. Punch asserts that “[w]ind turbine noise is a significant disruptor of**
280 **sleep.” (Punch Direct, line 288). Do you agree?**

281 A. I disagree. I am not aware of any study demonstrating objective findings that support
282 a claim that wind turbine noise significantly disrupts sleep, particularly at the levels of
283 the Project. It makes reasonable sense that, if the noise were to be very high, then
284 sleep might be disrupted. But the levels for the Project below 50 dBA are well within
285 my expectation that sleep will not be disturbed.

286

287 **Q. Relying on Dr. Schomer, Dr. Punch asserts that “wind turbine noise should be**
288 **limited to an average level of 36-38 dBA, based on a 24-hour measurement**
289 **period” to minimize or avoid sleep disturbance. (Punch Direct, lines 317-18).**

290 **Is it your opinion that noise requirements less than 45 dBA are necessary to**
291 **avoid impacts to sleep?**

292 A. No. Noises in the mid-40s dBA represent reasonable levels that are not of
293 substantial concern for sleep.

294

295 **C. Response to Mr. James.**

296

297 **Q. Mr. James asserts that the project “has a significant potential to cause**
298 **adverse health effects related to sleep disturbance.” Do you agree?**

299 A. No, I do not agree. The sound level for the proposed Project is well within
300 reasonable limits that I expect will neither cause adverse health effects nor sleep
301 disturbance.

302

303 **Q. Mr. James attaches a document titled *Noise: Windfarms* to his testimony as**
304 **Exhibit 2 (the “Shepherd Paper”). Are you familiar with the Shepherd Paper?**

305 A. Yes. The paper makes inaccurate, unsubstantiated claims and relies heavily on
306 data of limited quality, including individual claims “reported in the press and on the
307 internet...” (p. 7). Many of the claims have been criticized or shown to be
308 unsubstantiated by expert panels and data elsewhere.

309

310 **Q. Please discuss your thoughts on the sections of the Shepherd Paper which**
311 **address sleep.**

312 A. I agree with their comment in figure 1, that “fear of noise-induced annoyance and
313 sleep disruption” is a “barrier to social acceptance” of wind turbines. However, I
314 believe that the basis for this fear is not founded on fact, and is more a function of
315 unsubstantiated or exaggerated claims of annoyance, health problems, or problems
316 with sleep. This is partly a function of relying on statements such as the following,
317 made by Shepherd et al: “...there is little research on the effects of wind turbine
318 noise on sleep. However, there is no doubt that wind turbine noise can and does
319 disturb the sleep of those living nearby.” (p. 7).

320

321 **Q. The Shepherd Paper contains various references to “correlation” and**
322 **“causation.” What is the difference between correlation and causation?**

323 A. Correlation and causation are not synonymous. The blurring of the line between
324 these two words can often leave people confused about what action to take to avoid
325 an undesirable outcome. For example, wearing bifocals is correlated with heart
326 disease. Wearing bifocals, however, is not causal to heart disease. And fixing eye
327 problems will in no way reduce heart disease. The correlation does exist, but not
328 because eye disease results in heart disease, but rather, because individuals who
329 wear bifocals tend to be older and being older poses a greater risk of having heart
330 disease. Mr. James and his colleagues appear to blur the line between correlation
331 and causation, but it is essential to understand and acknowledge this important
332 distinction.

333

334 **V. CONCLUSION**

335

336 **Q. Please summarize your testimony.**

337 A. The testimony Prof. Alves-Pereira, Mr. James and Dr. Punch provide raises
338 illegitimate claims of adverse health impacts associated with wind turbines. Their
339 testimony is not supported by science and, in my view, does not help inform this
340 process.

341

342 Based on my medical experience in neurology and sleep medicine, and knowledge
343 of the scientific literature, the Project, as proposed, will not impact health or affect
344 sleep.

345

346 **Q. Does this conclude your Rebuttal Testimony?**

347 A. Yes.

348 Dated this 26th day of September, 2018.



349

350

351 Dr. Jeffrey Ellenbogen

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