Fordham Environmental Law Review

Volume 28, *Number* 2 2017 *Article* 3

SPRING 2017

Feeling the Noise: Proposed Standards and Alternatives to Wind Energy Nuisance Litigation

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FEELING THE NOISE: PROPOSED STANDARDS AND ALTERNATIVES TO WIND ENERGY NUISANCE LITIGATION

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INTRODUCTION

Wind turbine noise has provided a recurrent basis for opposition to wind energy project siting. As a consequence, public concerns about noise exposure, including adverse health outcomes, have resulted in nuisance suits and other costs and delays that impede the development of wind energy in the United States. As public debate about wind turbine siting and health risks continues, the controversy has generated no shortage of scientific research and legal commentary. Although the precise public health implications of wind turbine noise exposure remain unresolved in the scientific literature, environmental noise exposure has been associated with a range of adverse health effects in other contexts. Regardless, it is likely that complaints from community members living in close proximity to wind energy project sites can be expected irrespective of a scientific consensus now that many people have developed fears about wind turbines.

As the wind energy industry continues to expand throughout the United States, courts must have a solid foundation from which to evaluate nuisance claims generated from wind turbine noise. While courts should give ample consideration to the benefits of wind energy,

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the industry's social utility should not require that development be permissible at any cost. Nuisance suits may result in expenses that slow the development of wind energy in some areas, but they can also serve a higher public purpose such as helping to inform local regulations, encouraging better permitting and siting decisions, and also fostering technological advances to mitigate noise exposure. Nonetheless, it would be best to avoid litigation in order to hasten the development of wind energy, both domestically and abroad.

This note draws upon a scientific understanding of noise to inform standards in nuisance law and to argue that wind developers should offer direct economic incentives to community members living in proximity to wind turbine projects as a means of limiting litigation. To do so, this note examines wind turbine noise from both scientific and legal perspectives. Part I provides a background on wind energy and its benefits, and provides a basis for why the growth of this industry will continue in the United States. Part II examines noise as a stressor and health hazard, clarifying how environmental noise exposure serves as a contributing factor to direct and indirect health outcomes. Parts III and IV discuss the characteristics of noise from wind turbines and provide an overview of the epidemiological evidence for health outcomes associated with noise exposure from wind turbines. Part V provides a general overview of nuisance law, the role of science, and the various standards and doctrines courts apply, including the "balancing of the equities" doctrine in which public benefits are taken into consideration. Part VI gives an overview of the limited nuisance litigation involving noise from wind turbine projects, discussing courts' application of the nuisance doctrine. Part VII recommends a legal standard informed by case law, scientific evidence, and social utility that courts could use when evaluating nuisance claims. Finally, Part VIII considers proposed alternatives and methods of limiting litigation, including legislation to immunize wind farms from nuisance suits, before arriving at an alternative based on economic incentives in the form of financial payments to community members.

I. BACKGROUND ON WIND ENERGY

The benefits of wind energy and other forms of renewable energy are clear. Unlike fossil fuels, wind is not a finite resource and can

provide an infinite and sustainable supply of power.[1] Domestic development of wind energy lessens dependency on foreign energy sources that sometimes come from politically unstable areas, thus improving national security and providing economic benefits. The wind energy industry creates numerous jobs and benefits businesses in the wind energy supply chain, such as those that manufacture blades, drivetrains, and other advanced technologies.[2] The industry also benefits local communities and businesses by providing energy cost savings and increased household and business incomes.[3] Most importantly, wind energy provides significant environmental and public health benefits since it results in very few emissions of greenhouse gases and other harmful air pollutants.[4] Wind energy plays an indispensable role in providing for a low carbon future that helps mitigate the environmental, economic, social, and public health burdens of climate change.[5]

In light of these benefits, legislative bodies have created goals and incentives to hasten the development of renewable energy technologies. Congress has been able to issue a combination of tax credits, loan guarantees, and other incentives to developers of wind and other renewable energy projects,[6] although some noteworthy

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1. The U.S. Department of Energy estimates that wind energy could supply up to 35% of the country's end-use electricity demand by 2050. *See* U.S. DEP'T OF ENERGY, WIND VISION: A NEW ERA FOR WIND POWER IN THE UNITED STATES xxxii (2015).

2. Office of Energy Efficiency & Renewable Energy, *Wind Manufacturing and Supply Chain*, U.S. DEP'T OF ENERGY (2016), http://energy.gov/eere/wind/wind-manufacturing-and-supply-chain.

3. U.S. ENVTL. PROTECTION AGENCY, ASSESSING THE MULTIPLE BENEFITS OF CLEAN ENERGY: A RESOURCE FOR STATES 6 (2011).

4. Using the U.S. EPA's Avoided Emissions and Generation Tool (AVERT), the U.S. Department of Energy estimated that wind energy reduced carbon dioxide (CO_2) emissions by 115,000,000 metric tonnes in 2013, the equivalent to CO_2 emissions from 270 million barrels of oil. In the same year wind energy reduced sulfur dioxide emissions by 157,000 metric tonnes and nitrogen oxide emissions by 97,000 metric tonnes. *See* U.S. DEP'T OF ENERGY, *supra* note 1, at xxxvii.

5. *See*, *e.g.*, Nick Watts et al., *Health and Climate Change: Policy Responses to Protect Public Health*, 386 THE LANCET 1861 (2015).

6. The Federal Business Energy Investment Tax Credit (ITC), for instance, provides a tax credit equal to 30% of expenditures for solar and wind energy systems. *See Business Energy Investment Tax Credit (ITC)*, U.S. DEP'T OF ENERGY, https://energy.gov/savings/business-energy-investment-tax-credit-itc

renewable energy bills introduced at the federal level have failed to become law.[7] Most growth in the renewable energy sector has been initiated at the state level through Renewable Portfolio Standards (RPSs), which most states have adopted.[8] RPSs generally require electricity generators to produce a particular percentage or sell a certain amount of power generated from renewable source to consumers in the state.[9] Federal and state incentives combined with growing public awareness and support have increased the need for new wind farms, and in recent years wind power has become the fastest-growing source of new electric power generation in the United States.[10]

Despite numerous, quantifiable benefits, wind energy development is not without its opponents, at least in some circumstances. There have been a variety of concerns about which opponents have complained. Some adversaries have objected to the ecological impact of wind turbines on migratory birds and endangered species,[11] while others

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[https://perma.cc/BVQ3-W2CJ]. Section 1703 of Title XVII of the Energy Policy Act of 2005 also started the DOE Loan Guarantee Program for renewable energy projects, which often face barriers in the transition to full commercial development because they are higher risk for investors. *See Loan Guarantee Program*, U.S. DEP'T OF ENERGY, https://energy.gov/savings/us-department-energy-loan-guarantee-program [https://perma.cc/859T-HWMA].

7. *See e.g.*, Renewable Electricity Standard Act, S. 1264, 114th Cong. (2015). This bill, sponsored by Senator Tom Udall of New Mexico, was introduced on May 11, 2015, but was never enacted.

8. U.S. Energy Info. Admin., *Most States Have Renewable Portfolio Standards*, TODAY IN ENERGY (Feb. 3, 2012), https://www.eia.gov/todayinenergy/detail.php?id=4850 [https://perma.cc/7CSY-WJ5W]. According to a report by Lawrence Berkeley National Lab, in 2016, renewable portfolio standards existed in 29 states and Washington, D.C., applying to 55% of total U.S. retail electricity sales. An additional eight states that do not have mandatory renewable portfolio standards have adopted voluntary standards and goals. GALEN BARBOSE, U.S. RENEWABLES PORTFOLIO STANDARDS: 2016 ANNUAL STATUS REPORT 5 (2016).

9. JOSHUA P. FERSHEE, THE LAW OF CLEAN ENERGY 80 (Michael B. Gerrard ed., 2011).

10. U.S. Energy Info. Admin., *U.S. Wind Generation Increased 27% in 2011,* TODAY IN ENERGY (Mar. 12, 2012), https://www.eia.gov/todayinenergy/detail.php?id=5350 [https://perma.cc/4QXD-7QGB].

11. *See*, *e.g.*, Union Neighbors United, Inc. v. Jewell, 83 F. Supp. 3d 280, 282 (D.D.C. 2015). In this case a nonprofit advocate challenged the issuance of an incidental take permit for a 100-turbine wind farm in Ohio that would have the

have focused on the aesthetic impact of turbines on a landscape.[12] Like other forms of energy production, wind power has been accompanied by some attention to environmental health risks. Some health concerns have focused on physical hazards emanating from wind turbine designs, such as structural failure, thrown blades, ice throws,[13] and the shadow flicker effect created when the sun hits rotating turbine blades.[14] However, most health concerns stem from noise exposure, which has generated a growing body of scientific research.

As domestic wind energy has expanded, opponents have challenged local board or state agency approval of permits,[15] or have used nuisance law to impede wind energy project construction. In addition to transaction costs, litigation can tie up the permitting process and create preliminary injunctions to be issued until the subject of the litigation has been resolved. The nuisance mechanism has historically been described as the "most common method of asserting an environmental right."[16] As some commentators observe, though, nuisance actions may now ironically be used to undermine environmental progress by impeding the development of renewable energy projects, thereby prolonging our reliance on fossil fuels.[17] Some lawsuits brought against wind projects have alleged that noise

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potential to kill Indiana bats, which were listed as an endangered species in 1967. *Id*. at 283.

12. *See*, *e.g.*, Rankin v. FPL Energy, LLC, 266 S.W.3d 506, 510 (Tex. App. 2008). In this case the plaintiffs complained about the aesthetic impact of a wind farm in Texas as part of a nuisance claim. *Id*.

13. *See*, *e.g.*, DAVID WAHL & PHILIPPE GIGUERE, GE ENERGY, ICE SHEDDING AND ICE THROW – RISK AND MITIGATION (2006).

14. DEP'T OF ENERGY AND CLIMATE CHANGE, UPDATE OF UK SHADOW FLICKER EVIDENCE BASE 5 (2011).

15. Wind project developers are generally required to obtain permits from at least one government agency and depending on the jurisdiction may need to work with permitting entities at the federal, state, and local levels. Permitting is a major step in the development process and will address numerous aspects of the wind energy project, including its size, infrastructure (e.g., roads and transmission lines), and ownership. NATIONAL WIND COORDINATING COMMITTEE, PERMITTING OF WIND ENERGY FACILITIES: A HANDBOOK 10-11 (2002).

16. Note, *Aesthetic Nuisance: An Emerging Cause of Action*, 45 N.Y.U. L. REV. 1075, 1077 (1970).

17. Stephen Harland Butler, *Headwinds to a Clean Energy Future: Nuisance Suits Against Wind Energy Projects in the United States*, 97 CAL. L. REV. 1337, 1372 (2009).

constitutes a nuisance and have produced mixed results. This has left courts with very little precedent to consider for any future litigation, particularly for nuisance suits brought against utility-scale wind farms.

In the end, some of the public health concerns that have led to complaints against wind farms may be justifiable in certain contexts, while others are not. The environmental and public health impacts of wind energy remain controversial, in part because the industry is still relatively new in the United States. Scientific research takes time and is costly, and our empirical understanding of the environmental and public health impacts of wind turbines is mostly limited to preliminary research and anecdotal reports.

II. ENVIRONMENTAL NOISE AND HEALTH

To explore the potential health effects of noise exposure from wind turbines, it is first important to understand how sound is perceived and how noise can operate on the human body. Noise is simply defined as "unwanted sound,"[18] a definition that hints at its underlying subjectivity. A person's noise exposure is not only influenced by the external stimuli (e.g., sound level), but also by other modifying factors, such as sensitivity, coping ability, and pre-existing conditions.[19] Consequently, both objective noise exposure (sound level) and a person's subjective perception shape potential health outcomes due to the psychological and psychophysiological processes that mediate the physical effects of noise.[20]

Direct, receptor-mediated mechanisms,[21] such as hearing, as well as perceptual mechanisms, including cognitive and emotional responses,

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18. *Clean Air Act Title IV – Noise Pollution*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/clean-air-act-overview/clean-air-act-title-iv-noise-pollution [https://perma.cc/D92Z-5CG6].

19. COUNCIL OF CANADIAN ACADEMIES, UNDERSTANDING THE EVIDENCE: WIND TURBINE NOISE xvi (2015).

20. Daniel Shepard et al., *Exploring the Relationship between Noise Sensitivity, Annoyance and Health-Related Quality of Life in a Sample of Adults Exposed to Environmental Noise*, 7 INT'L. J. ENVTL. RES. PUB. HEALTH 3579, 3580 (2010). Psychophysiological processes involve interplay between the mind and the body and psychophysiological disorders occur when mental conditions create or worsen physical symptoms. *Id.*

21. Receptor-mediated mechanisms for noise are physical mechanisms mediated by effects on auditory receptors, such as the inner ear, and together with exposure

can lead to both acute health outcomes (e.g., annoyance, sleep disruption) and chronic health outcomes (e.g., hypertension, cognitive impairment, and endocrine disruption).[22] These outcomes can, in turn, elevate the long-term risk for additional health effects, including cardiovascular disease,[23] adiposity,[24] and birth outcomes.[25]

Noise has been studied in a number of environmental contexts since the 1930s,[26] and at certain levels noise is recognized as a health hazard.[27] Many large-scale epidemiological studies,[28] which often examine noise from airports, road traffic, and railways, have identified associations between environmental noise exposure and adverse health

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factors determine health effects. These are direct, physical mechanisms rather than perceptual ones. *See* COUNCIL OF CANADIAN ACADEMIES, *supra* note 19, at 58.

22. *Id*. Acute health outcomes are health impacts or effects characterized by a relatively quick onset and short duration, whereas chronic health outcomes are permanent or continuous. *See* WORLD HEALTH ORGANIZATION CENTRE FOR HEALTH DEVELOPMENT, A GLOSSARY OF TERMS FOR COMMUNITY HEALTH CARE AND SERVICES FOR OLDER PERSONS 5 (2004).

23. Wolfgang Babisch et al., *Noise Annoyance – A Modifier of the Association Between Noise Level and Cardiovascular Health?*, 50 SCI. TOTAL ENV'T. 452, 452-53 (2013).

24. Jeppe Schultz Christensen et al., *Road Traffic and Railway Noise Exposure and Adiposity in Adults: A Cross-Sectional Analysis of the Danish Diet, Cancer, and Health Cohort*, 124 ENVT'L HEALTH PERSPECTIVES 329 (2016). Adiposity refers to an excess accumulation of fat in a site or organ and the term is commonly used to refer to the state of being obese.

25. Gordana Ristovska et al., *Reproductive Outcomes Associated with Noise Exposure – A Systematic Review of the Literature*, 11 INT'L J. ENV'T RES PUBLIC HEALTH 7391 (2014) ("There is some suggestive evidence of adverse associations with environmental noise from both occupational and epidemiological studies, especially for low birth weight.").

26. *See*, *e.g.*, E. Lawrence Smith & Donald A. Laird, *The Loudness of Auditory Stimuli Which Affect Stomach Contractions in Healthy Human Beings*, 2 J. ACOUST. SOC. AM. 94 (1930).

27. WORLD HEALTH ORG., GUIDELINES FOR COMMUNITY NOISE xvi (1999).

28. In epidemiological studies, scientists observe and analyze patterns and causes of diseases and other health outcomes in populations. Environmental noise exposure studies are observational in nature and usually compare data collected from different groups at a point in time (cross-sectional) or attempt to find correlations at a population level (correlational/ecological). New Health Advisor, *Types of Epidemiological Studies*, NEW HEALTH ADVISOR FOR DAILY HEALTH CARE, http://www.newhealthadvisor.com/Types-of-Epidemiological-Studies.html [https://perma.cc/9WY9-HYWE].

outcomes.[29] Historically, the public health implications of noise exposure have received far less attention in the United States than in Europe, where the World Health Organization (WHO) has estimated that Western Europeans lose 1.0-1.6 million disability-adjusted life-years from traffic noise, mostly due to sleep disturbance and annoyance.[30]

Public health concerns related to exposure to certain types of noise rest on a solid foundation of empirical evidence and biological understanding. Annoyance, sleep disruption, and stress are frequently cited as the most common responses to environmental noise among populations,[31] but epidemiological studies have also found associations between environmental noise exposure and other previously mentioned health outcomes. Noise sensitivity in an individual can be influenced by noise dependent factors – including the type, frequency, and intensity of the noise – as well as subjective factors – including the age and personality of an individual.[32] As described further in Part IV, the psychological, subjective component of noise complicates both the epidemiological study of environmental noise exposure as well as the determination of recommended thresholds.

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29. Evidence shows positive associations between road traffic noise and cardiovascular effects, such as ischemic heart disease, blood pressure, and hypertension. WORLD HEALTH ORG., BURDEN OF DISEASE FROM ENVIRONMENTAL NOISE: QUANTIFICATION OF HEALTHY LIFE YEARS LOST IN EUROPE 16 (2011). Some of these risk factors have also been shown to be elevated in populations exposed to certain levels of noise from airports and railways. *See*, *e.g.*, Lars Jarup et al., *Hypertension and Exposure to Noise Near Airports: the HYENA Study*, 116 ENVTL. HEALTH PERSP. 329 (2008); *see also* Mette Sørensen et al., *Exposure to Road Traffic and Railway Noise and Associations with Blood Pressure and Self-Reported Hypertension: A Cohort Study*, 10 ENVTL. HEALTH 92 (2011).

30. *Id*. at 102. This includes EU Member States and other western European countries, but not the whole WHO European Region due to a lack of data in southeast Europe. *See id*. at xv. A disability-adjusted life year (DALY) is defined as a year of healthy life lost and is a measurement used to quantify the burden of disease in a population. *See* Health Statistics and Information Systems, *Metrics: Disability-Adjusted Life Year (DALY)*, WORLD HEALTH ORGANIZATION, http://www.who.int/healthinfo/global_burden_disease/metrics_daly/en/ [https://perma.cc/VB97-NC9R].

31. Stephen A. Stansfeld, *Noise, Noise Sensitivity and Psychiatric Disorder: Epidemiological and Psychophysiological Studies*, 22 PSYCH. MED. 1, 1 (1992).

32. Alain Muzet et al., *Environmental Noise, Sleep and Health*, 11 SLEEP MED. REV. 135, 137 (2007).

III. WIND TURBINE NOISE SOURCES AND CHARACTERISTICS

Wind turbines produce two types of audible sound: mechanical and aerodynamic. Physical moving parts in motors, gearboxes, and generators produce mechanical sounds, while aerodynamic sounds are caused by air moving over the rotating blades.[33] Aerodynamic sounds are the predominant source of noise from modern utility-scale wind turbines and have therefore received the most attention.[34] Aerodynamic sources of sound from the blades of wind turbines create noises that are both repetitive and variable in nature.[35] These regular changes in sound pressure level over time are referred to as "amplitude modulation" and are experienced differently than mechanical noises, which tend to be more constant.[36]

Wind turbines also produce other types of sound – some of which are inaudible – that operate differently than other types of sound on the human body. Wind turbines create low-frequency noise (LFN), which generally occurs below a frequency of 100 to 150 Hertz (Hz).[37] At very low frequencies this sound is referred to as infrasound (< 20 Hz),[38] and has led to some complaints about "pressure sensations" or an experience of "feeling the noise."[39]

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33. *See* COUNCIL OF CANADIAN ACADEMIES, *supra* note 19, at 32.

34. *Id*. (citing ERICH HAU, WIND TURBINES: FUNDAMENTALS, TECHNOLOGIES, APPLICATION, ECONOMICS (2d ed. 2006); JAMES F. MANWELL ET AL., WIND ENERGY EXPLAINED: THEORY, DESIGN AND APPLICATION (2d ed. 2010)).

35. Nate Seltenrich, *Wind Turbines: A Different Breed of Noise?*, 122 ENVTL. HEALTH PERSP. A21, A23 (2014) ("Wind turbine noise . . . is often deemed more annoying than the hum or roar of transportation noise because of its repetitive nature and high variability in both level and quality – from 'swoosh' to 'thump' to silence, all modulated by wind speed and direction").

36. COUNCIL OF CANADIAN ACADEMIES, *supra* note 19, at 33.

37. *See id*. at 27. A hertz (abbreviated Hz) is the standard unit of measurement used to measure frequency. Sound frequency is measured by the number of pressure waves per second.

38. People generally have a very high threshold for infrasound and usually cannot hear this frequency at sound pressure levels less than 70-100 dB. *See id*. at 29. Sound pressure levels are measured in decibels (dB) and measure the amplitude of sound. *See id*. at 130.

39. DEP'T OF THE ENV'T (NORTHERN IRELAND), LOW FREQUENCY NOISE: TECHNICAL RESEARCH SUPPORT FOR DEFRA NOISE PROGRAMME 3 (2001).

It can be difficult to characterize sound levels associated with wind turbines because of the amount of variation that occurs both in the mechanisms that produce sound and in the ways in which sound is transmitted.[40] Measuring sound pressure levels (sound exposure) is difficult given that receivers must be tailored to specific environmental conditions.[41] Sound levels are influenced by numerous factors besides distance to the source, including wind patterns, wind speed, topography, and atmospheric conditions. Additionally, the standard A-weighted average sound level used for measuring sound fails to account for lower frequencies and amplitude modulation.[42] Thus, it can be difficult to compare wind turbine sound levels and thresholds to other types of community noise that do not share some of the same characteristics, including noise from roadways and railways. These attributes of wind turbine noise have presented further challenges for both the epidemiological study and regulation of noise from wind turbines.

IV. EPIDEMIOLOGICAL STUDIES OF WIND TURBINES

The body of peer-reviewed literature evaluating the potential health outcomes associated with wind turbines continues to grow, with mixed results. Still, key themes have emerged amidst this disparate and relatively limited body of research. As an observational science, epidemiology is subject to various inherent and methodological limitations. The evidence provided by individual studies must be considered against the overall body of peer-reviewed research. To this end, systematic and critical reviews and meta-analyses provide the best means of exploring potential associations between wind turbine noise and health outcomes. However, the results of review articles themselves have been somewhat inconsistent due to the limited amount of original research and the various scopes and methodologies employed by each review.

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40. *See generally* David Hessler, *Measuring and Analyzing Wind Turbine Noise*, *in* WIND TURBINE NOISE (D. Bowdler & G. Leventhall eds., 2011).

41. *See* COUNCIL OF CANADIAN ACADEMIES, *supra* note 19, at 34.

42. *See id*. at 96. A-weighted decibel sound level measurements are an expression of the relative loudness of sounds as perceived by the human ear. The A-weighted system is the most common standard used to measure sound, but it de-emphasizes sounds at low and very high frequencies. *See id*. at 128.

A. Scientific Studies on Wind Turbine Noise

A review by Knopper and Ollson found that the scientific literature indicated annoyance was associated with wind turbine noise, but was more strongly related to other factors, including visual impact, personal attitude to wind turbines, and noise sensitivity.[43] The authors were unable to locate a direct causal link between people living in proximity to wind turbines, noise exposure, and physiological health effects.[44] However, establishing a causal effect would not have been possible based on the available epidemiological evidence at the time of the review, or even at present. The authors acknowledge that wind turbine noise can lead to annoyance and some associated health outcomes (e.g., sleep disturbance), but claim this is more likely due to the influence of other changes in the physical environment rather than turbine-specific variables, such as audible noise, low-frequency sound (sound between 20 Hz and 200Hz) or infrasound.[45]

Onakpoya et al., conducted a systematic review and meta-analysis on the effect of wind turbine noise on sleep and quality of life using eight cross-sectional studies with a combined total of 2,433 participants.[46] The findings, based on what the authors describe as moderate reporting quality, provided evidence that exposure to wind turbine noise may be associated with an increased likelihood of annoyance, sleep disturbance, and changes in quality of life.[47] On the other hand, McCunney et al., arrived at a somewhat different conclusion in a critical review that examined 14 peer-reviewed epidemiological and experimental studies.[48] Although the authors found that some epidemiological studies did show associations between living near wind turbines and annoyance, no clear or consistent association was found between noise from wind turbines

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43. *See* Loren D. Knopper & Christopher A. Ollson, *Health Effects and Wind Turbines: A Review of the Literature*, 10 ENVTL. HEALTH 1, 3 (2011).

44. *See id*. at 8.

45. *See id*.

46. *See* Igho J. Onakpoya et al., *The Effect of Wind Turbine Noise on Sleep and Quality of Life: A Systematic Review and Meta-Analysis of Observational Studies*, 82 ENV'T INT'L. 1, 1 (2015).

47. *See id*.

48. *See* Robert J. McCunney et al., *Wind Turbines and Health: A Critical Review of the Scientific Literature*, 56 J. OCC. ENVTL. MED. e108, e108 (2014).

and any health outcomes.[49] The authors also noted that annoyance, as a complex, subjective phenomenon may be more related to individual characteristics than noise from turbines.[50]

B. The Nocebo Effect

Wind turbines and other industrial sources of noise can also produce negative feelings in some individuals that may not necessarily relate to the noise itself. For instance, negative feelings engendered by aesthetic concerns can create stress in an individual, which can then influence how that person perceives a particular sound. This response can contribute to a feedback loop of stress, sleep disturbance, and other associated health outcomes mentioned in Part II.[51] Some believe this may cause certain individuals to be more prone to health impacts, such as stress or annoyance, because they may anticipate a negative outcome. This is known as the "nocebo effect," where negative thoughts or feelings about particular stimuli actually produce negative health outcomes (the opposite of the placebo effect).[52]

Chapman et al., tested the psychogenic, "communicated disease" hypothesis to determine whether the nocebo effects play an important role in reported health problems associated with wind turbines.[53] The authors examined complaint records about noise and health from residents living near 51 wind farms throughout Australia and discovered the large majority of health complaints were made after

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49. *See id*.

50. *See id*. at e127.

51. *See* Shepard et al., *supra* note 20, at 3590. In this type of feedback loop, for instance, individual stressors that influence perception could create more annoyance or sleep disturbance, which could create more stress, and so on and so forth.

52. Sara Planès et al., *The Nocebo Effect of Drugs*, 4 PHARMA RESEARCH PERSPECTIVES 1, 1 (2016). Examples of nocebo effects examined by scientists include patient concerns about pain, side effects, and effectiveness of administered drugs. *See id*. at 2. For instance, a patient may be more likely to experience pain when undergoing a procedure if he or she receives a verbal suggestion from the physician about the expectation of pain compared to if he or she does not. Similarly, it is possible that residents may be more likely to experience health outcomes associated with noise exposure, including annoyance or stress, if such outcomes are suggested.

53. *See* Simon Chapman et al., *The Pattern of Complaints about Australian Wind Farms Does Not Match the Establishment and Distribution of Turbines: Support for the Psychogenic, 'Communicated Disease' Hypothesis*, 8 PLOS ONE 1, 1 (2013).

2009 when "wind turbine syndrome" was introduced.[54] However, as McCunney et al., indicate, this study does not advance a greater understanding of the health effects of wind turbines since registering a formal complaint is a "complex sociopolitical action"[55] that does not necessarily serve as a proxy for measuring actual health outcomes. Still, it may be impossible to completely rule out the nocebo effect, which has been established in other areas of epidemiologic study.[56]

C. Research Limitations

Potential exposure to infrasound and LFN complicate interpretations of the available body of evidence. People may not always hear sounds that wind turbines produce, but this does not mean that their ears do not detect the sound and respond to it in ways that can potentially lead to adverse health outcomes, such a noise-induced hearing loss.[57] Some research has suggested that infrasound may cause amplitude modulation or pulsation of sounds that are heard, effectively changing how sensitive a person is to noise.[58] It may also stimulate subconscious pathways that produce other reactions in the body, such as eye movement and muscle tension, which can lead to sleep disruption.[59] Research has shown effects of infrasound on blood pressure, pulse rate, and serum cortisol levels in experimental contexts, although at much higher exposure levels than those associated with wind

54. *See id* at 2. A physician characterized "wind turbine syndrome" in a self-published book as a set of symptoms associated with exposure to wind turbines, including nausea, vertigo, blurred vision, unsteadiness, and difficulty reading. NINA PIERPONT, WIND TURBINE SYNDROME: A TWENTY-MINUTE CRASH COURSE (2012).

55. McCunney et al., *supra* note 48, at e124.

56. Seltenrich, *supra* note 35, at A23 (citing Winfried Häuser et al. *Nocebo Phenomena in Medicine: Their Relevance in Everyday Clinical Practice*, 109 DEUTSCHES ÄRZTEBLATT INT'L. 459 (2012) (noting that in an experimental study a group of patients who were informed a test could lead to a slight increase in pain reported stronger amounts of pain compared to a group with neutral information about the test).

57. *See* Alec N. Salt, *Wind Turbines can be Hazardous to Human Health*, http://oto2.wustl.edu/cochlea/wind.htmlm [https://perma.cc/B3WX-8B7T].

58. *See id*.

59. *See id*.

turbines.[60] While Bolin et al. reviewed several LFN wind turbine studies and found no evidence that infrasound contributed to adverse health outcomes, including annoyance or sleep disruption,[61] to date, there have been no long-term studies conducted regarding prolonged human exposure to infrasound from wind turbines. Although the effects of wind turbine infrasound remain unproven and unsubstantiated, they also remain unexplored.

Most researchers investigating potential health outcomes associated with exposure to wind turbines recommend conducting additional experimental and observational studies.[62] Wind energy proponents and opponents will be limited in their reliance on empirical data until more studies are performed. Epidemiological results have come from cross-sectional studies, which are limited and only observe a given population at a specific point in time. Case control and cohort studies are needed to better determine whether or not wind turbines are directly responsible for health outcomes.[63] Positive associations between proximity to wind turbines and health outcomes show correlation, but this does not prove causation. On the other hand, causation cannot exist without correlation. Absent more robust, long-term studies we are limited in our understanding. A lack of data, however, does not imply that adverse health outcomes are not occurring in some populations living in close proximity to wind turbines.

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60. *See*, *e.g.*, A. Danielsson & U. Landstrom, *Blood Pressure Changes in Man During Infrasonic Exposure: An Experimental Study*, 217 ACTA MEDICA SCANDINAVICA 531 (1985).

61. Karl Bolin et al., *Infrasound and Low Frequency Noise from Wind Turbines: Exposure and Health Effects*, 6 ENVTL. RES. LET. 1, 1 (2011).

62. *See*, *e.g.*, Onakpoya et al., *supra* note 46, at 8.

63. *See*, *e.g.*, Seltenrich, *supra* note 35, at A24 (noting that most studies to date have been cross-sectional making it "impossible to assess causality" and that many researchers have called for "long-term studies that assess the health of a community before a turbine project is ever proposed and then continue to follow up during operation"). Case control studies compare a group of people who have a disease to a group of healthy people who do not (the controls) and compare data in relation to the exposures both groups had in order to determine differentiating factors. Cohort studies compare similar populations that have had different exposures to determine whether changes in exposure influence the likelihood of a particular adverse health outcome. *See* New Health Advisor, *supra* note 28.

V. OVERVIEW OF NUISANCE LAW

Despite scientific uncertainty about the effects of wind turbine noise exposure, courts and juries must make determinations in nuisance litigation based on the best data currently available. These determinations are ultimately based on whether the noise is causing an unreasonable discomfort or annoyance to a person of ordinary sensibilities. It is not difficult to envision situations where wind turbine noise could cause discomfort or annoyance, even if only based on individual characteristics and the influence of other changes in the physical environment. However, it is not clear to what extent it should matter that this discomfort might be caused or influenced by subjective factors or the mere anticipation of negative responses, nor is it always clear what a reasonable reaction to noise from wind turbines might be.

While courts have defined the term "nuisance" in different ways depending on the controlling facts of a case, the term is generally understood to mean a wrongful, nontrespassory invasion or interference of another's interest in the use and enjoyment of land.[64] To be actionable as a nuisance, the invasion must produce some kind of material annoyance, inconvenience, discomfort or harm,[65] and generally must be marked by some degree of permanence.[66]

A nuisance can be of two varieties: private or public. The latter involves unreasonable interference with a right that is common to the general public,[67] whereas the former pertains to a person's interest in the private use and enjoyment of land. Nuisance suits can be anticipatory, meaning that a plaintiff can bring a claim before the nuisance exists and before the plaintiff has experienced any harm from the alleged nuisance. Common types of nuisances include pollution, noise, odors, and vibrations.[68] Under the law of nuisance, plaintiffs can either sue for damages or an injunction when another party has interfered with the plaintiff's use of his or her property.[69]

Not all kinds of invasions or interferences will rise to the level of a nuisance. Courts will consider various factors, outlined in the

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64. *See* 58 AM. JUR. 2d, NUISANCES § 1 (2016).
65. *See* Booker v. Foose, 216 W. Va. 727, 730 (2005).
66. *See* Wood v. Neuman, 979 A.2d 64, 78 (D.C. 2009).
67. AM. L. INST., RESTATEMENT OF TORTS § 821(B)(1) (2d ed. 1979).
68. JESSE DUKENMINIER ET AL., PROPERTY 642 (6th ed. 2006).
69. RICHARD R. POWELL, POWELL ON REAL PROPERTY §64.07(1) (1997).

following subsection, related to both the alleged nuisance and the harmed party in determining liability.[70] However, even if a nuisance is established, a party can raise various defenses, such as the doctrine of "coming to the nuisance." This line of defense can be used when the offending party is already engaging in the activity alleged to be a nuisance.[71] Although coming to the nuisance does not bar recovery, it does factor into a court's determination of whether or not the activity in question was reasonable.[72] The reasonableness determination lies at the center of nuisance law.

A. Balancing of the Equities

A nuisance can be described as an unreasonable interference in which the gravity of the harm to the plaintiff outweighs the utility of the defendant's conduct.[73] In determining whether conduct is unreasonable, courts will examine various factors related to both the gravity of the harm and the utility of the conduct. The gravity of harm entails consideration of various factors related to the harm itself, including its extent and character, as well as the nature of the use or enjoyment that has been invaded, including its social value and whether it is suitable to the character of the locality.[74] Courts may also consider whether the harmed party would experience any type of burden in avoiding the harm, essentially inquiring whether or not it is

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70. *See* AM. L. INST., RESTATEMENT OF TORTS § 826 cmt. c, e (2d ed. 1979).

71. For example, the Pennsylvania Supreme Court denied an injunctive action brought by a tenant who had voluntarily moved into in a manufacturing neighborhood against an offending factory across the street from a nuisance the plaintiff claimed was created by noise and other annoyances. *See* Austin v. Converse, 67 Atl. 921, 923 (Pa. St. 1907). Similarly, the Court of Appeals in Kentucky suggested that because plaintiffs had moved to a nuisance could be considered a factor in "determining the equities of the case" brought by the operators of a motel, residence, and swimming pool who voluntarily built these structures near a livestock market that emitted noises and offensive odors. Curry v. Farmers Livestock Mkt., 342 S.W.2d 134, 138 (Ky. 1961).

72. *See* Ferdinand S. Tinio, "*Coming to Nuisance" as a Defense or Estoppel*, 42 A.L.R. 3d 344 (1972).

73. *See* WILLIAM PROSSER, PROSSER ON TORTS § 72 (2d ed. 1955).

74. *See* AM. L. INST., RESTATEMENT OF TORTS § 827 (2d ed. 1979); *see also* Oak Haven Trailer Court, Inc. v. Western Wayne Cty. Conservation Ass'n, 3 Mich. App. 83, 89 (Mich. Ct. App. 1966) (noting the importance of the locality).

avoidable from the perspective of the person harmed.[75] The gravity of harm depends upon the quantity of harm suffered by the plaintiff, the nature of the harm, and the circumstances under which the harm occurred.[76]

Consideration of the utility of the conduct incorporates several factors, including the social value of the conduct in question, the suitability of the conduct to the locality, and the impracticability of preventing or avoiding the interference.[77] Specifically, courts examine whether the conduct that causes the intentional invasion of another's interest in the use and enjoyment of land has any utility and, if so, how much utility.[78] Under the balancing of the equities test, courts weigh the gravity of the harm against the utility, and will generally find a nuisance to exist if the harms outweigh the benefits.

B. Ordinary Sensibilities

The applicable standard for determining whether or not a noise constitutes a harm is based on its effect on persons of ordinary sensibilities.[79] For a person of ordinary sensibilities to experience a nuisance, an invasion or interference must be "definitely offensive, seriously annoying, or intolerable" to normal persons living in the community.[80] The key is normality, which is not intended to encompass the standards of hypersensitive individuals, but rather the "standard of normal persons or property in the particular locality."[81] These standards apply to ordinary people in the community as opposed to individuals who happen to be there at the time.

It is not always clear what qualifies as "normal," especially when an alleged nuisance involves only personal discomfort or annoyance. Often, reactions that may not rest on a solid foundation of empirical

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75. *See* AM. L. INST., RESTATEMENT OF TORTS § 827 cmt. e (2d ed. 1979).

76. *See id*. at cmt. b.

77. *See* AM. L. INST., RESTATEMENT OF TORTS § 828; *see also* Dauberman v. Grant, 198 Cal. 586, 591 (1926) (noting the significance of the defendant's ability to avoid the invasion).

78. *See* AM. L. INST., RESTATEMENT OF TORTS § 828 cmt. b; *see also* Fla. E. Coast Props., Inc. v. Metropolitan Dade Cty., 572 F.2d 1108, 1112 (5th Cir. 1978) (noting consideration of the utility of the defendant's conduct).

79. Kaiser v. Western R/C Flyers, Inc., 239 Neb. 624, 624 (1991).

80. *See* 58 AM. JUR. 2d, NUISANCES § 74 (2016).

81. *See* AM. L. INST., RESTATEMENT OF TORTS § 821(F) cmt. d (2d ed. 1979).

evidence might influence the alleged harm. These reactions must still be weighed when determining what qualifies as normal or ordinary sensibilities. As a comment to the Restatement (Second) of Torts specifies, fears and other mental reactions of the community should be taken into account in determining whether the harm would be suffered by a normal member of the community, "even though they may be without scientific foundation or other support in fact."[82] As illustration, the comment describes a leprosy sanitarium located in the vicinity of a group of private residences that may constitute a nuisance due to the fear that it creates contagion, even though it is virtually impossible to communicate the disease through normal contact.[83]

It is not hard to see how this standard could apply to wind turbine projects. As discussed in Part IV, the body of existing scientific evidence is inconclusive, making it difficult to determine how much annoyance, sleep disturbance, or other effects wind turbines might actually produce among residents. However, residents' fears regarding adverse health outcomes from a constructed or proposed wind turbine project still carry weight in determining whether or not the project is a nuisance. Even if the vast majority of research does not support a finding of adverse health outcomes related to noise exposure from wind turbines, the fear itself that people in a particular community experience could still weigh in favor of finding that a nuisance exists. Given that some epidemiological evidence suggests that adverse health outcomes are associated with noise from wind turbines, plaintiff allegations of nuisance may have more merit and be less likely to be dismissed as a matter of law. In some cases, developers may be less inclined to develop wind projects because of this heightened risk of liability.

VI. WIND TURBINE NUISANCE LAW PRECEDENT AND ANALYSIS

There have been many nuisance suits brought against wind projects,[84] but since most of these lawsuits were settled, few have

82. *Id*. at cmt. f.

83. *See id*.

84. According to a 2014 report published by the Energy and Policy Institute, there were 49 hearings regarding wind turbine noise and health in at least five English speaking countries (Canada, New Zealand, the United States, the United Kingdom,

resulted in written court opinions. Some of these published opinions involve noise complaints, therefore providing guidance on how certain courts have approached these nuisance claims.[85] Although these cases rely on particular sets of facts and are relatively limited in their instructive value, they provide a useful foundation for determining the ways in which noise from wind turbine projects can constitute a private nuisance claim.

A. Rose v. Chaikin

Rose v. Chaikin provides a prime example of how wind turbine noise can be unreasonable. In *Rose*, a New Jersey court enjoined the operation of a sixty-foot wind generator that was built about ten feet from a neighbor's property line in a "contiguous residential neighborhood" after plaintiffs complained of physical symptoms from noise exposure, including "tension" and other "stress related symptoms."[86] The *Rose* court analyzed the noise created by the wind turbine, finding that it was "offensive because of its character, volume and duration," and also considered the tranquil character of the neighborhood.[87] In a balancing of the equities test, the court also considered the social utility of the wind turbine, but found that it was outweighed by the harm to the plaintiffs.[88]

Although *Rose* can be viewed as a loss for wind energy proponents, the court reached the appropriate outcome based on the facts of the case. As the court noted, the overall benefit in this case was fairly small, given that the benefit derived from the single wind turbine defendant erected was for the limited purpose of conserving energy and saving on defendant's electric bills.[89] The court's decision suggests that when determining the intrusive quality of noise,

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and Australia) since 1998. *See* MIKE BARNARD, WIND HEALTH IMPACTS DISMISSED IN COURT 6 (Gabe Elsner & Matt Kasper eds., 2014).

85. This section analyzes two of the more seminal cases involving noise complaints and wind turbines and is not meant to be exhaustive in its survey of the case law. Outcomes have been mixed, although most courts in the United States have ruled in favor of wind farms in cases involving wind energy, noise, and health. *See id*. at 40-47.

86. Rose v. Chaikin, 453 A.2d 1378, 1380 (N.J. Super. Ct. Ch. Div. 1982).

87. *Id*. at 1382.

88. *See id*. at 1383.

89. *See id*.

significant attention should be paid to the locality or neighborhood, and the overall benefit or harm the local community sustains. It seems fairly obvious that building a sixty-foot wind turbine in a quiet, residential neighborhood would create a nuisance. Accordingly, the court acknowledged the broader benefits of wind energy projects, but specified that scientific advancements with social utility are not necessarily permissible at any cost.[90]

B. Burch v. NedPower Mount Storm, LLC

In *Burch v. NedPower Mount Storm, LLC*, plaintiff homeowners sought to enjoin the defendants from building and operating a proposed wind farm that called for 200 wind turbines on the basis that it would create a private nuisance.[91] The highest court in West Virginia found that the landowners' allegation of noise was cognizable as an abatable nuisance[92] and referred to earlier precedent that "[w]here an unusual and recurring noise is introduced in a residential district, and the noise prevents sleep or otherwise disturbs materially the rest and comfort of the residents, the noise may be inhibited by a court of equity."[93] The court reversed a trial court's dismissal of a wind nuisance claim and held that a prospective injunction should be available to plaintiffs on remand.[94]

C. Comparison of the Rose and NedPower Cases

There are key differences between *Rose* and *NedPower*, which constitute two of the first nuisance suit opinions on wind turbine noise in the United States. In *Rose*, the wind turbine was built in very close proximity to the plaintiff, while in *NedPower* the plaintiffs' residences ranged from a half-mile to two miles from the proposed turbines. In *Rose*, the plaintiffs had already experienced various health outcomes, from a single wind turbine, while in *NedPower* the wind farm had not yet been constructed, so it is unclear as to whether it would have a negative impact on the plaintiffs. The Public Service Commission (PSC) had also granted *NedPower* a "certificate of convenience and

90. *See id*. at 1382
91. *See* Burch v. NedPower Mount Storm, LLC, 647 S.E.2d 879, 893 (2007).
92. *See id*. at 892.
93. Ritz v. Woman's Club, 114 W. Va. 675, 173 S.E. 564 (1934).
94. *See* Burch, *supra* note 91, at 893.

necessity to construct and operate a wind power electric generating facility,"[95] which was predicated on the Commission's opinion that the wind farm would be built in a responsible manner and that wind turbines are "very quiet machines, generating less than 30dBA, comparable to people whispering in a quiet room."[96]

Despite these differences, the *NedPower* court still found for the plaintiffs, which some legal commentators have criticized as an inappropriate ruling and a step back for wind advocates.[97] However, since the *NedPower* court only reversed a summary judgment motion and did not actually find a nuisance it remains unclear whether or not these types of claims will result in favor of the plaintiff.

The limited case law suggests that noise can serve as a significant factor in finding a nuisance. One can understand why, since noise is a familiar concept that courts have considered in other industrial contexts. Courts have reached different conclusions as to whether noise constitutes a nuisance in particular circumstances, but they generally follow principles from the Restatement (Second) of Torts, as discussed in Part V.

VII. PROPOSED STANDARDS FOR WIND TURBINE NOISE SUITS

There is currently a limited and disparate body of domestic case law involving wind turbine noise, but the number of these cases can be expected to increase as the wind industry expands in the United States. Consequently, it is important to postulate ways to address wind turbine noise in future nuisance suits.

It is difficult to determine whether wind turbine-imposed interferences are unreasonable because noise exposure contains a very large subjective component. Courts must decide what constitutes substantial interference to a person of ordinary sensibilities. This can be complex in light of the significant variation in how individuals perceive and respond to audible and inaudible sounds. Complicating

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95. *Id*. at 884.

96. Butler, *supra* note 17, at 1358 (citing Public Service Commission of West Virginia, NedPower Mount Storm LLC, Case no. 02-1189-E-CN (2003). dBA is the abbreviation of A-weighted decibel sound levels. *See* COUNCIL OF CANADIAN ACADEMIES, *supra* note 19, at 128.

97. *See* Butler, *supra* note 17, at 1357.

the matter is that nuisances can be found to exist based on, at least in part, the perceptions of people living in a particular community, even if these perceptions are not supported by science.

Courts have considered various factors when applying standards in other facts and circumstances where a nuisance is alleged due to noise. These factors have included the character of the noise, volume, duration, time it occurs, and the number of people affected, among others.[98] There is a large body of case law that addresses nuisance from electric and other industrial plants.[99] It is reasonable, then, to presume that the general standards at work in these cases will also apply to wind turbines. For this reason, clarifying these factors and suggesting additional ones is an important exercise that will assist courts and provide guidance for future cases involving wind turbine noise.

The complexities of noise exposure are fact-intensive and will often require a jury to determine the existence and precise extent of a harm. However, courts must first determine whether a nuisance is actionable and whether there are legal grounds for the lawsuit. Many courts may not be familiar with all relevant factors involved in a balancing of the equities, such as the way humans perceive sound or the social utilities of wind energy development. The following factors draw upon the relevant case law, scientific evidence, and social benefits related to wind energy to help courts determine the gravity of harm and utility of a particular project, and thus whether or not a nuisance exists as a matter of law.

A. Proposed Factors for Determining the Gravity of Harm of a Wind Project

Determining the gravity of harm presented by noise from a wind turbine project can be difficult in light of the numerous subjective, indeterminate factors discussed above. To improve this determination, a fact-intensive balancing test should include at least the following

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98. *See* 58 AM. JUR. 2d, NUISANCES § 112 (2016); *see also* Smilie v. Taft Stadium Bd. Of Control, 201 Okla. 303, 307 (1949) (noting the "volume, frequency and duration" of the noise in determining whether it was sufficient to "cause actual physical discomfort to persons of ordinary sensibilities").

99. *See*, *e.g.*, Boomer v. Atlantic Cement Co., 309 N.Y.S.2d 312 (1970). The Court of Appeals of New York granted an injunction for a nuisance caused by pollution and noise from a cement plant. *See id.* The case provides a concrete example of how courts typically balance utility and harm. *See id.*

when a court seeks to determine whether noise from a wind turbine project is or will be unreasonable: (1) the location, surroundings, and suitability of the project in the locality; (2) the distance of the affected party to the noise source; (3) the number of parties affected by the project; (4) the time when the noise occurs; (5) the status of the project (planned or completed); (6) state agency determinations or authorizations; (7) compliance with applicable noise ordinances; (8) the sensitivity and vulnerability of the community to noise; and (9) the availability and feasibility of noise reduction technologies.

Courts have already considered some of these factors in the context of wind turbine projects and other industrial activities. However, courts may not always be able to make a determination based solely on one or more traditional factors, such as the suitability of the locality or the time when the noise occurs. In some cases, they may not want to limit themselves to this narrow set of factors and may want to consider additional factors related to the particular qualities of wind turbine noise or its potential impact on particular populations. In other cases, courts should dismiss noise complaints that clearly lack merit. Having a more comprehensive set of factors may enable them to do so by improving a court's ability to accurately assess the nature of the harm (or lack thereof). Legal commentators, for instance, have suggested the *NedPower* court inappropriately applied the nuisance doctrine to the facts at hand and should not have reversed the trial court's dismissal of the nuisance claim.[100] The factors proposed above offer a more comprehensive method that will improve courts' abilities to adequately determine the gravity of harm alleged by a particular set of facts.

B. Proposed Factors for Determining the Utility of a Wind Project

Determining the utility of the wind energy project can also be difficult for courts since energy production does not take place in a vacuum. Fewer wind energy projects will result in an increased reliance on fossil fuels, which are associated with numerous

100. *See* Butler, *supra* note 17, at 1365 (noting "the facts alleged showed a marginal risk of any noise whatsoever, and the allegations of nuisance due to noise should have been dismissed as a matter of law").

environmental and public health hazards, including noise.[101] To improve this determination process, courts should consider the following factors and then weigh these against the gravity of harm: (1) the amount of power being supplied by the wind energy project; (2) the project's contribution to state or national renewable energy goals or mandates; (3) the number of jobs created by the project; (4) the cost of delaying the project; (5) the direct and indirect economic implications of the project; and (6) the availability of alternative project sites.

The utility of the wind project should weigh prominently in a balancing of the equities test since the societal benefits of wind energy are so substantial. In this regard, courts may decide to be more favorable to developers of wind energy compared to other industries, such as oil and gas. Courts seem to be aware of the social utility of wind energy, and even the *Rose* court mentioned the benefit of alternative sources of energy in a case that involved only one turbine. However, a more comprehensive set of factors will provide courts with a better, more nuanced understanding of the utility of a particular wind turbine project. This will aid courts in a balancing of the equities for future wind turbine noise nuisance suits and help create more well-reasoned and appropriate outcomes in litigation.

C. Additional Considerations

Courts must also consider other facts when determining whether or not a nuisance could exist, such as whether or not the plaintiffs came to the nuisance. While this defense does not serve as a complete bar to recovery in other contexts, it should weigh particularly heavily for an alleged nuisance from wind turbine noise. Courts should also regard the type of relief the plaintiff is seeking and look for ways to compensate plaintiffs through monetary damages rather than injunctions. This approach would provide relief to the plaintiff while also preserving the utility of the wind project.

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101. *See*, *e.g.*, Jake Hays et al., *Public Health Implications of Environmental Noise Associated with Unconventional Oil and Gas Development*, 580 SCI. TOTAL ENV'T. 448 (2017); *see also* MARYLAND INSTITUTE FOR APPLIED ENVIRONMENTAL HEALTH, FINAL REPORT: POTENTIAL PUBLIC HEALTH IMPACTS OF NATURAL GAS DEVELOPMENT AND PRODUCTION IN THE MARCELLUS SHALE IN WESTERN MARYLAND 22 (2014).

D. The Costs of Litigation

Litigation results in significant costs and delays and may serve as a serious impediment to the development of wind energy. These costs apply not only to wind developers and investors, but also to local governments that have to supply resources to defend decisions to either issue or refuse a permit for wind farms on appeal. Delays result in additional indirect costs, including a continued reliance on fossil fuels, which contributes to a number of social, economic, environmental, and public health burdens. To the extent that litigation can be quelled or even eliminated, it should be. Courts should pay particular attention to the utility of wind projects in a balancing of the equities test. However, the high social utility of wind energy does not mean that it should be permissible at any cost. Litigation may also produce its own social utility by promoting better mitigation techniques, siting requirements, and technological developments to limit exposure to noise from wind turbines.

VIII. ALTERNATIVES TO LITIGATION

Commentators who have considered the impact of litigation on wind energy development have generally proposed two broad approaches to limiting litigation. The first, hereafter referred to as the "legislative approach," is largely inspired by right-to-farm statutes[102] and is designed to immunize wind developers against nuisance claims. The second, hereafter referred to as the "economic incentive approach," is designed to promote acceptance and limit conflict by providing economic incentives in the form of financial payments to community members. In light of recent developments and scientific evidence regarding noise exposure, additional consideration and analysis of the legislative approach and the economic approach is warranted.

The following sections articulate why an economic approach to limiting litigation may be preferable to a legislative approach. In short, the economic approach addresses the root cause of litigation,

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102. Right-to-farm statutes immunize qualifying farmers from nuisance suits brought by people who move into agricultural areas. *See* Kyle Weldon & Elizabeth Rumley, *States' Right-To-Farm Statutes*, THE NATIONAL AGRICULTURAL LAW CENTER, http://nationalaglawcenter.org/state-compilations/right-to-farm/ [https://perma.cc/XAS2-XCUS].

opposition to wind farms, by providing incentives for the community. The legislative approach, however, only treats the symptom (litigation) and may actually undermine the public acceptance and development of wind farms in the United States.

A. The Legislative Approach: Right-to-Wind Statutes

Legal commentators have suggested looking to right-to-farm statutes as models and partial solutions to wind farm litigation.[103] As background, these statutes were designed to protect agricultural producers from nuisance suits brought by neighbors who objected to living in close proximity to agricultural activities. These statutes generally were passed in the 1970s and 1980s as a result of urban sprawl, but now exist in all fifty states, with some degree of variance.[104] Typically, these statutes provide that "an agricultural operation or activity shall not be considered a nuisance if the nuisance derives from changed conditions in the area surrounding the operation and if the operation was established first and operated for a defined period of time."[105] Since these statutes only immunize agricultural practices that are already in existence, they essentially merely codify the coming to the nuisance doctrine discussed above.[106]

Commentators have suggested that states could adopt analogous "right-to-wind" statutes that would combine a license statute with immunity from nuisance suits.[107] This would force wind developers to obtain a permit that would require them to meet setback and maximum noise level requirements, among others, that would help ensure the project would not become a nuisance to residents based on a state agency determination.[108] This would go beyond the codification of the

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103. *See*, *e.g.*, Ryan Kusmin, *Sucking the Air Out of Wind Energy: Nuisance Litigation and its Effect on Wind Energy Development*, 89 WASH. U. L. REV. 707 (2011); *see also* Renner Kincaid Walker, *The Answer, My Friend, is Blowin' in the Wind: Nuisance Suits and the Perplexing Future of American Wind Farms*, 16 DRAKE J. AGRIC. L. 509 (2011).

104. *See* Weldon & Rumley, *supra* note 102.

105. Harrison M. Pittman, Annotation*, Validity, Construction, and Application of Right-to-Farm Act*, 8 A.L.R. 6th 465 (2005).

106. *See id*.

107. *See* Kusmin, *supra* note 103, at 729.

108. *See id*. at 729-30.

coming to the nuisance doctrine to provide immunity to wind energy developers before projects are actually constructed.

There are both practical and theoretical problems with providing immunity from nuisance suits for wind developers through "right-to-wind" statutes. First, wind energy development is a relatively new phenomenon and in most cases, wind energy will be coming to communities. Right-to-farm statutes, on the other hand, were designed to protect agricultural practices that were pre-existing as people moved out of cities to more rural parts of the country. This difference alone should not necessarily preclude right-to-wind statutes, but it does indicate how different they are in design and how unlikely they are to be implemented. Even in their current form as a codification of the coming to the nuisance doctrine, right-to-farm statutes are very controversial due to a number of unintended effects. For instance, in some cases, right-to-farm statutes have been used to exempt large corporations and industrial-scale livestock operations from environmental and public health regulations.[109]

Second, and related to this last point, right-to-wind statutes could effectively impede the development of technologies aimed to mitigate noise exposure from industrial wind turbines. If developers are forced to comply with whatever standards are determined to be suitable based on the available science at the time, it is unclear how they would be incentivized to make wind turbines quieter and less disruptive to communities. Without regulation and litigation efforts in the automotive industry, for instance, we might still be stuck with safety standards and features from the 1950s. Many wind developers are already attempting to employ the best state-of-the-art technologies available to make turbines as silent as possible. The fact that they are developing these technologies has to do, at least in part, with the negative incentives provided by community complaints and the threat of litigation.

Third, as Parts III-IV provide, it is difficult to measure sound levels associated with wind turbines. It can be difficult to predict what the actual impacts will be since there are so many influencing factors,

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109. Gary Truitt, *Indiana's Right to Farm Law Under Attack*, HOOSIER AG TODAY (Oct. 18, 2015), http://www.hoosieragtoday.com/indianas-right-to-farm-law-under-attack/ [https://perma.cc/Y8XW-NWV7].

some of which are subjective. Weather conditions and geography influence the level of noise, making it difficult to establish empirically justifiable setbacks given the significant variance both in how noise is transmitted and perceived. Nuisance law also suggests that "normal," and therefore reasonable, sound levels do not need to be grounded in science. Noise estimates and recommended setbacks are therefore limited in their ability to prevent what courts could potentially find to be a nuisance.

Fourth, right-to-farm laws do not prevent litigation entirely, but only limit it by serving as an affirmative defense that makes it less likely for these lawsuits to succeed.[110] There is little reason to think that right-to-wind laws would be able to function any differently. Although the laws would be advantageous to wind developers, they would still result in costs and delays. Stated differently, the laws would not necessarily provide immunity from litigation and address the underlying problem, unless they precluded judicial review.[111] Otherwise, parties would have the ability to appeal the license administratively, which would essentially just shift litigation from general courts to administrative ones. This would further burden the state agency, which would not only have to embark on an onerous permitting procedure to qualify the wind project, but also defend the permit in the administrative court system.

Finally, and perhaps most importantly, laws that seek to immunize wind developers from litigation do not address the fundamental cause of litigation: opposition to wind farms. Rather than deal with this root cause, current laws seek to address noise as the symptom this root cause creates. Curtailing litigation by legislative means will only serve to destroy trust between communities and wind developers by taking away access to the court system. Case studies indicate the importance of trust in the social acceptance of wind farms,[112] and without trust the community's perception of negative externalities will likely outweigh perceived benefits. This perceived unfairness and lack of trust could

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110. *See* Baylen Linnekin, *Right-to-Farm Debate Heats Up*, REASON (Oct. 24, 2015), http://reason.com/archives/2015/10/24/right-to-farm-debate-heats-up [https://perma.cc/9AUG-M9BX].

111. *See* Kusmin, *supra* note 103, at 731 n.186.

112. *See* Nina Hall et al., *Societal Acceptance of Wind Farms: Analysis of Four Common Themes Across Australian Case Studies*, 58 ENERGY POLICY 200, 203 (2013).

very well diminish public support for wind energy development and create further, unforeseen obstacles going forward. For this reason, a less antagonistic approach that seeks to achieve social acceptance and community engagement, rather than avoidance, is preferable.

B. The Economic Incentive Approach

Unlike the legislative approach, the economic incentive approach addresses the root cause of litigation by providing direct economic benefits to community members. There are a variety of financial agreements between wind energy developers and community stakeholders that are used to increase support and achieve what is referred to as a "social license to operate."[113] For instance, wind energy developers make direct payments to landowners for the use of their land for siting turbines, which can be attractive to farmers and others living in rural communities. Additionally, developers sometimes offer incentives to the community as a whole in the form of less expensive electricity, funds, or local job creation or direct payments to individual landowners. They may also provide for community co-ownership of the project by providing investment opportunities and discounts for community members.

Often, however, there are no financial benefits provided to neighbors living near wind turbines who are subjected to many of the same conditions as landowners leasing their land (e.g., noise, visual impacts, etc.). Unsurprisingly, local residents who are not gaining financially are more likely to register noise complaints compared to landowners who are leasing their land. As a participant in one survey noted, "[i]t's amazing how if you're getting money off something it doesn't actually worry you."[114] This point is intuitive, but is also supported by empirical evidence that suggests annoyance felt by residents living near wind turbines is lower among those who received economic benefits.[115]

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113. *Id*. at 207.

114. NINA HALL ET AL., EXPLORING COMMUNITY ACCEPTANCE OF RURAL WIND FARMS IN AUSTRALIA: A SNAPSHOT 38 (2012).

115. *See* Sabine A. Janssen et al., *A Comparison between Exposure-Response Relationships for Wind Turbine Annoyance and Annoyance Due to other Sources*, 130 J. ACOUST. SOC. AM. 3746 (2011) (noting that surveys suggest that "annoyance was lower among residents who received economic benefit from wind turbines . . . .").

C. Quantifying the Cost of Living Near Turbines

The feasibility of incentivized economic approaches may have to do with the fact that the externalities associated with living near wind turbines may be quantifiable. One legal commentator has advocated for the payment method by drawing inspiration from the results of a Danish study evaluating the costs associated with the visual and noise impacts of wind turbines.[116] The results of the study indicate that there are costs associated with living near wind turbines and, at least to a certain extent, these costs may be quantifiable.[117] Jordal-Jørgensen used survey data from interviews with 342 residents living close to wind turbines in Denmark to calculate the cost of the nuisance based on the residents' willingness to pay to remove the turbines.[118] The study found that the 13% of residents who considered the turbines to be a nuisance were willing to pay each year to remove them.[119] The study also found that home buyers were willing to pay more to live further away from wind turbines by comparing the prices of similar houses located near turbines with those located further away. On average, homes located close to a wind turbine farm with 12 turbines cost roughly $20,700 less than homes that did not lie close to wind turbines.[120]

The results of this study are limited based on the low quality of the data, but the work does point to economic strategies for ameliorating nuisances from wind turbine projects. Again, these solutions make particular sense in light of what the epidemiological evidence suggests about noise.[121] Residents who are leasing their property to wind

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116. Susan Lorde Martin, *Wind Farms and NIMBYs: Generating Conflict, Reducing Litigation*, 20 FORDHAM ENVTL. L. REV. 427, 468 (2010).

117. *See* Jørgen Jordal-Jørgensen, *Social Assessment of Wind Power: Visual Effect and Noise from Windmills—Quantifying and Valuation,* WINDACTION (Apr. 1996), http://www.windaction.org/posts/38126-social-assessment-of-wind-power-visual-effect-and-noise-from-windmills-quantifying-and-valuation#.WCYjHneZORs [https://perma.cc/8R3K-YGG4].

118. *See id*.

119. At the time of this study this was calculated at an average of DKK 982 per household in 1996, which amounts to roughly $215 USD, accounting for inflation.

120. The study suggested houses near the wind project with 12 turbines were DKK 94,000 cheaper, which amounts to roughly $20,700 USD, accounting for inflation.

121. The way a sound is perceived depends on a number of individual characteristics that influence how one responds to a particular noise and whether the

developers and have a financial interest in the development of a particular project are less likely to find wind turbines to be a nuisance. Therefore, it seems that if wind developers offer payments to nearby residents to compensate them this may lower the likelihood of an adverse response to the noise and the subsequent likelihood of a nuisance suit.

D. Precedent for Payments to Residents

There is precedent for wind developers paying residents who do not have turbines located on their land in the United States. In Cloud County, Kansas, for instance, a project developer (Horizon Wind Energy) offered farmer landowners $20 per acre each year for land that did not have wind turbines located within several square miles of the wind park.[122] The neighboring farmers also received payments from the power purchase agreement with the participating utility company, Westar Energy.[123] More recently, a Spanish wind developer, Iberdrola Renewables, offered individual payments to 815 registered voters in the towns of Windham and Grafton in Vermont, which would host a project consisting of 24 turbines.[124] The voters, who will ultimately determine the fate of the proposed project, would receive a total of $14.1 million over 25 years.[125] The extent to which commercial agreements that provide direct payments to neighboring landowners are used is not entirely clear, at least in part because they frequently include non-disclosure agreements.[126] These examples offer two types of arrangements that seek to foster community support by distributing benefits across the community.

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noise may lead to other adverse health outcomes. *See* COUNCIL OF CANADIAN ACADEMIES, *supra* note 19.

122. *See* Ryan Thomas Tranhan, Note, *Social and Regulatory Control of Wind Energy—An Empirical Survey of Texas and Kansas*, 4 TEX. J. OIL GAS & ENERGY L. 89, 98 (2008).

123. *See id*. at 99.

124. *See* Katharine Q. Seelye, *Vermont Wind Needs Support, So Company Offers to Pay Voters*, N.Y. TIMES (Oct. 12, 2016), http://www.nytimes.com/2016/10/13/us/vermont-wind-project-needs-votes-so-company-offers-to-pay-voters.html?_r=0 [https://perma.cc/DXW5-H2WD].

125. *See id*.

126. *See* THE SENATE SELECT WIND TURBINES SECRETARIAT, SELECT COMMITTEE ON WIND TURBINES FINAL REPORT 67 (2015).

E. The Rent Proximity Model

Financial agreements in which wind developers offer payments to community stakeholders are incorporated into what are known as "shared-benefits models."[127] These models entail the delivery of certain benefits to a set of stakeholders in the community other than those directly participating in the development of the wind project (e.g., landowners leasing land).[128] These approaches seek to address opposition to wind farms rather than the symptoms by creating fairer terms for community stakeholders. The proposed concept for wind farm development known as the "Proximity Rent" model offers another example of what a feasible economic approach might look like that distributes benefits throughout the community.[129]

The Proximity Rent model was first proposed as a type of shared-benefits model by Luke Osborne, who works for the wind energy industry in Australia.[130] Rather than offering community members shares or investment opportunities in a local wind project, this model goes one step further to provide rent to neighbors according to the amount of their land that falls within a certain distance of the wind turbines. This distance is determined by a specified radius and the rent rate is negotiated between the wind developer and the community.[131] Not only would this compensate neighbors by providing a direct benefit that would otherwise be absent, but it would help to foster community participation, trust, and procedural justice, which are important elements of the social acceptance of wind farms.[132]

Despite its strengths, the Proximity Rent model is not without limitations, especially when viewed in light of noise exposure. For one, noise is influenced by a number of moderating factors that depend on the subjective traits and response of the individual, meaning that the distance from a source offers an incomplete proxy for gauging impacts due to exposure. Noise may have a greater impact on a neighbor living further from a wind turbine project due to that neighbor's sensitivity,

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127. LUKE OSBORNE, A PRACTICAL SHARED-BENEFITS MODEL FOR WIND FARM – THE PROXIMITY RENT MODEL 3 (2014).

128. *See id*.

129. *Id*. at 1.

130. *See id*. at 2.

131. *See id*. at 3.

132. *See* Hall et al., *supra* note 112, at 200.

coping ability, or pre-existing conditions. However, this neighbor would be compensated equally or less than a neighbor living closer to the project who may not experience the noise as severely. Additionally, by attempting to equate rent with real or perceived impacts, the model may imply that community members are being compensated for a risk. This awareness may contribute to the extent to which individuals experience noise, which is shaped by psychological processes and possibly influenced by the mere anticipation of a negative outcome from a particular stimuli (nocebo effect).

In the end, however, economic approaches such as the Proximity Rent model appear to be a more reasonable option for avoiding litigation than immunizing wind developers from nuisance suits. If no direct benefits were offered to community members living in close proximity to wind turbines projects, the externalities these projects create, such as noise, would understandably become the predominate concern of these community members. Providing economic incentives to the community could potentially mitigate the health impacts of noise exposure because of the way noise is experienced, whereas immunizing wind developers could do just the opposite. Fairness and openness are important parts of developing social acceptance of wind energy and legislation that provides the industry with a shield from litigation will only serve to diminish trust between the wind developer and community stakeholders.

CONCLUSION

The epidemiological evidence for health outcomes associated with exposure to noise from wind turbines is mixed. While the results of studies have not been entirely consistent, key themes have emerged and some initial evidence suggests that living near wind turbines may increase the likelihood of some health outcomes, including annoyance, sleep disturbance, and changes in quality of life. Indeed, researchers acknowledge the influence of individual attitudes and personal factors in accounting for these health impacts and the nocebo effect may be at least partially responsible for reported outcomes. Until better studies are developed to assess the impacts of noise from wind turbines, the relationship between wind turbine noise and health outcomes will remain controversial.

Regardless, a biological understanding of noise and empirical findings from epidemiological studies can be used to inform standards in nuisance law. There are a number of factors that courts should consider in balancing the gravity of the harm with the social utility in nuisance litigation that involves actual or potential noise exposure from wind turbines. This guidance can eliminate some of the costs and delays involved in litigation by providing courts a clear means of determining nuisance as a matter of law and resolving disputes without the need for a trial. Courts should give significant consideration to the broader policy implications of wind energy, although the social utility provided by this industry should not come at any cost. Litigation should remain an option, but it is one that would still be best to avoid for everyone. It can, however, become more expedient with better guidance and legal standards, which this note has hoped to advance.

Legal standards offer some clarity, but because they are fact intensive, they can nevertheless produce a great deal of uncertainty for wind energy developers and investors. These uncertainties may continue to challenge the wind energy industry and ultimately impede the development of this important form of renewable energy. As a means of avoiding litigation, the best approach is for wind developers to consider offering direct economic incentives to community members living in proximity to wind projects. This option has already been utilized and also gains support from the scientific literature. Economic incentives offer perhaps the most sensible, cost-effective option for wind energy developers to continue to provide one of the most meaningful paths forward in society's global transition away from fossil fuels. In the end, the need for cleaner, less impactful sources of energy is one that even the most virulent opponents of wind energy can agree upon.