

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF THE APPLICATION	)	NOTICE OF APPLICATION; ORDER
BY DAKOTA RANGE I, LLC AND	)	FOR AND NOTICE OF PUBLIC
DAKOTA RANGE II, LLC FOR A PERMIT	)	INPUT HEARING; NOTICE OF
OF A WIND ENERGY FACILITY IN	)	OPPORTUNITY TO APPLY FOR
GRANT COUNTY AND CODINGTON	)	PARTY STATUS
COUNTY, SOUTH DAKOTA, FOR THE	)	
DAKOTA RANGE WIND PROJECT	)	EL18-003

On January 24, 2018, the South Dakota Public Utilities Commission (Commission) received an Application for a Facility Permit for a wind energy facility (Application) from Dakota Range I, LLC, and Dakota Range II, LLC (together Dakota Range or Applicant). The Applicant proposes to construct a wind energy facility to be located in Grant County and Codington County, South Dakota, known as the Dakota Range Wind Project (Project). The Project would be situated within an approximately 44,500-acre project area ten miles northeast of Watertown, South Dakota (Project Area). The total installed capacity of the Project would not exceed 302.4MW nameplate capacity. The proposed Project includes up to 72 wind turbine generators, access roads to turbines and associated facilities, underground 34.5-kilovolt (kV) electrical collector lines connecting the turbines to the collection substation, underground fiber-optic cable for turbine communications co-located with the collector lines, a 34.5 to 345-kV collection substation, up to five permanent meteorological towers, and an operations and maintenance facility. The Project would interconnect to the high-voltage transmission grid via the Big Stone South to Ellendale 345-kV transmission line which crosses the Project site. The Project is expected to be completed in 2021. Applicant estimates the total construction cost to be \$380 million.

The Commission has jurisdiction over this matter pursuant to SDCL Chapters 1-26 and 49-41B and ARSD Chapter 20:10:22.

Pursuant to SDCL 49-41B-15 and 49-41B-16, **the Commission will hold a public input hearing on the Application on March 21, 2018, at 5:30 p.m., CDT, at Waverly-South Shore School Gymnasium, 319 Mary Place, Waverly, S.D.**

The purpose of the public input hearing will be to hear public comments regarding the permit Application and the Project. At the hearing, Applicant will present a brief description of the Project, following which interested persons may appear and present their views, comments, and questions regarding the Application. A copy of the Application is on file with the Grant and Codington County Auditors pursuant to SDCL 49-41B-15(5) and at the Commission's office in Pierre. The Application and all other documents in the case, including detailed maps of the Project, may be accessed on the Commission's web site at www.puc.sd.gov under Commission Actions, Commission Dockets, Electric Dockets, 2018 Electric Dockets, EL18-003 or by contacting the Commission in person at the Capitol Building, 500 E. Capitol Ave., Pierre, SD, or by phone at (605) 773-3201 or (800) 332-1782.

Pursuant to SDCL 49-41B-17 and ARSD 20:10:22:40, the parties to this proceeding are currently the Applicant and the Commission. Any person residing in the area of the Project; each municipality, county, and governmental agency in the area where the Project is proposed to be sited; any non-profit organization formed in whole or in part to promote conservation or natural beauty, to protect the environment, personal health or other biological values, to preserve historical sites, to promote consumer interests, to represent commercial and industrial groups, or to promote the orderly development of the area in which the Project is to be sited; or any interested person, may be granted party status in this proceeding by making written application to the Commission. Applications for party status will be available at the public input hearing or

may be obtained from the Commission's web site or by contacting the Commission. **Applications for party status must be received by the Commission on or before 5:00 p.m., CDT, on March 26, 2018.** The Commission will also be accepting comments in writing from anyone, either by mail, personal delivery, or e-mailing the Commission right up until the time of the decision. You only need to apply for party status if you want to participate formally in the case by putting on actual testimony or other factual evidence, conducting discovery, cross-examining witnesses, making legal arguments, and to preserve your right to appeal to the courts if you do not believe the Commission's decision is legally correct.

Following the public input hearing, the Commission may schedule a formal evidentiary hearing conforming to SDCL Chapter 1-26 to consider any issues raised by any intervening party, the Commission's staff, or the Commission itself. At the formal hearing, all parties will have the opportunity to appear, present evidence, and cross-examine the other parties' witnesses and exercise all other rights afforded by SDCL Chapters 1-26, 49-1, and 49-41B and ARSD Chapters 20:10:01 and 20:10:22, including rights of appeal to the courts. Absent a contested issue, the Commission will schedule the matter for a decision at a regular or ad hoc meeting of the Commission.

For approval, the Applicant must show that the proposed Project will comply with all applicable laws and rules, will not pose a threat of serious injury to the environment nor to the social and economic condition of inhabitants or expected inhabitants in the siting area, will not substantially impair the health, safety or welfare of the inhabitants, and will not unduly interfere with the orderly development of the region with due consideration having been given to the views of governing bodies of affected local units of government. Based upon these factors, the Commission will decide whether the permit to construct should be granted, denied, or granted upon such terms, conditions, or modifications of the construction, operation, or maintenance as the Commission finds appropriate. It is therefore

ORDERED, that the Commission will hold a public input hearing on the Application and Project on **March 21, 2018, at 5:30 p.m., CDT, at Waverly-South Shore School Gymnasium, 319 Mary Place, Waverly, S.D.** It is further

ORDERED, that pursuant to SDCL 49-41B-17 and ARSD 20:10:22:40, **applications for party status must be filed on or before 5:00 p.m., CDT, on March 26, 2018.**

Pursuant to the Americans with Disabilities Act, these hearings will be held in physically accessible locations. Please contact the Public Utilities Commission at (605) 773-3201 or (800) 332-1782 at least 48 hours prior to the hearing if you have special needs so arrangements can be made to accommodate you.

Dated at Pierre, South Dakota, this 31st day of January 2018.

CERTIFICATE OF SERVICE The undersigned hereby certifies that this document has been served today upon all parties of record in this docket, as listed on the docket service list, electronically or by mail. By: <u>Karen E. Cremer</u> Date: <u>1/31/18</u> (OFFICIAL SEAL)
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BY ORDER OF THE COMMISSION:

Kristie Hegen
KRISTIE HEGEN, Chairman

Gary Hanson
GARY HANSON, Commissioner

Chris Nelson
CHRIS NELSON, Commissioner

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

Print

**IN THE MATTER OF THE APPLICATION BY)
DAKOTA RANGE I, LLC AND DAKOTA RANGE)
II, LLC FOR A PERMIT OF A WIND ENERGY)
FACILITY IN GRANT COUNTY AND)
CODINGTON COUNTY, SOUTH DAKOTA, FOR)
THE DAKOTA RANGE WIND PROJECT)**

APPLICATION FOR PARTY
STATUS

EL18-003

(Name of Applicant, this will be the person or entity named as a party)

petitions the Public Utilities Commission to be granted party status in the above-referenced facility permit proceeding.
Pursuant to SDCL 49-41B-17 and ARSD 20:10:22:40

Briefly explain your interest in this permit proceeding. Form is limited to 1000 characters.
(Example: Landowner in project area).

Signature of Applicant

Print or Type Name

Address: _____

Phone Number

E-mail Address

Name of Organization (if applicable)

Date

Subscribed and sworn to before me this _____ day of _____, 2018.

Notary Public

(Seal)

My Commission expires: _____

NOTE: Consistent with SDCL 49-41B-17 and ARSD 20:10:22:40, this application must be filed with the Public Utilities Commission on or before 5:00 p.m. CST, March 26, 2018, unless the deadline is extended by the Commission.

Executive Director
South Dakota Public Utilities Commission
500 E. Capitol Ave.
Pierre, SD 57501-5070
Electronic Filing: <http://puc.sd.gov/EFilingOptions.aspx>

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South Dakota Public Utilities Commission Information Guide to Siting Energy Conversion & Electric Transmission Facilities

This guide is intended to offer a simple overview of the Public Utilities Commission's process in making a decision to approve or deny the construction of an energy conversion facility, AC/DC conversion facility, wind energy facility, or electric transmission facility in South Dakota. This guide is informational and does not address all situations, variations and exceptions in the siting process and proceedings of the PUC. For additional information, see South Dakota Codified Laws Chapter 49-41B (www.legis.sd.gov/Statutes/Codified_Laws) and South Dakota Administrative Rules Chapter 20:10:22 (www.legis.sd.gov/rules).

PUC Authority

The South Dakota Legislature gave the PUC authority to issue permits for energy conversion, AC/DC conversion, wind energy and electric transmission facilities. An energy conversion facility is a generation facility, other than a wind generation facility, capable of generating 100 megawatts or more of electricity. In considering applications, the commission's primary duty is to ensure the location, construction and operation of the facilities will produce minimal adverse effects on the environment and the citizens. The commission determines these factors based on definitions, standards and references specified in South Dakota Codified Laws and Administrative Rules. For energy conversion facilities, AC/DC conversion facilities and transmission facilities, the PUC has one year from the date of application to make a decision; six months for wind energy facilities.

The commission strives to issue a reasoned decision and conditions where appropriate that uphold the law and discourage a potentially expensive and lengthy appeal process.

In rendering its decision, the commission may grant the permit, deny the permit, or grant the permit with terms, conditions or modifications of the construction, operation or maintenance as the commission finds appropriate and legally within its jurisdiction. The commission does not have authority to change the route or location of a project. The decision of the commission can be appealed to the circuit court and, ultimately, to the South Dakota Supreme Court.

The PUC is not involved in the easement acquisition process that occurs between applicants and landowners. Likewise, the PUC does not have a role in the eminent domain process, which is handled in the circuit court system. Landowners with concerns

about these issues should seek advice from their personal attorney.

Applicant Responsibility

The applicant that seeks the PUC's approval must show its proposed project:

- will comply with all applicable laws and rules;
- will not pose a threat of serious injury to the environment nor to the social or economic condition of inhabitants or expected inhabitants in the siting area;
- will not substantially impair the health, safety or welfare of the inhabitants; and
- will not unduly interfere with the orderly development of the region with due consideration having been given to the views of the governing bodies of affected local units of government.

PUC Staff Role

PUC staff members assigned to work on a siting case typically include one attorney and multiple analysts. Staff attorneys have educational and practical experience in administrative law, trial procedure and business management principles. Staff analysts have expertise in engineering, research and economics. Some of the work the staff does involves reviewing data and evidence submitted by the applicant and intervenors, requesting and analyzing opinions from experts, and questioning the parties. The staff considers the information relative to state laws and rules and presents recommendations to the Public Utilities Commissioners.

Public Involvement

South Dakotans, as well as anyone else with an interest in a siting case, have a variety of ways to stay informed and involved. Read more on back.

Review the electronic docket. A docket is the continually updated collection of documents filed with the commission for a particular case. Dockets are accessible under the Commission Actions tab on the PUC website, www.puc.sd.gov. Dockets are labeled to correspond with their type and filing date. For example, the Dakota Range Wind Energy Facility docket is EL18-003; EL for electric, 18 for the year 2018 and 003 to indicate it was the third electric docket filed with the commission in 2018.

Attend a public input hearing. The PUC will hold a public input hearing on a siting case, with 30 days notice, as physically close as practical to the proposed facility site. At the hearing, the applicant describes its project and the public may ask questions and offer comment. PUC commissioners and staff attend this hearing. The discussion is documented and becomes part of the record.

Submit comments. Members of the public are encouraged to submit written comments about an active siting case to the PUC. These informal public comments are reviewed and considered by the PUC commissioners and staff. Comments should include the docket number or siting project name, commenter's full name, mailing address, e-mail address and phone number. These comments should be emailed to puc@state.sd.us or mailed or hand-delivered to PUC, 500 E. Capitol Ave., Pierre, SD 57501. Comments are posted in the "Comments" section of the docket within a reasonable time after having been received. The commenter's name, city and state will be posted along with their comment. Comments received from businesses, organizations or other commercial entities (on letterhead, for example) will include the full contact information for such.

Please follow these guidelines when submitting written comments to the PUC:

- For comments sent by email, the maximum file size is 10 MB. If you have questions, please contact South Dakota PUC staff at 605-773-3201 (Monday – Friday, 8 a.m. – 5 p.m. Central Time).
- For comments sent by U.S. mail or hand delivered, no more than twenty (20) 8.5" x 11" pages, including attachments and support materials, should be submitted with a comment. Sheets with printing on both sides are counted as two pages.
- A reference document, article or other attachment not written by the person commenting should clearly identify the source of

the content. The inclusion of any copyrighted material without accompanying proof of the commenter's explicit right to redistribute that material will result in the material being rejected.

- In instances where individual comments are deemed to be a duplicate or near duplicate copies of a mass message campaign, the PUC will post only a representative sample and list the name, city and state of the commenter.
- Comments containing threatening language or profanity will be rejected.
- Multimedia submissions such as audio and video files will not be accepted as written comments.
- Electronic links will not be accepted.

Become an intervenor. Individuals who wish to be formal parties in a siting case may apply to the PUC for intervenor status. The intervention deadline is clearly indicated within the docket. Intervention is appropriate for people who intend to actively participate in the case through legal motions, discovery (requests for facts or documents), the written preparation and presentation of actual evidence, and in-person participation in a formal hearing. Intervenors are legally obligated to respond to discovery from other parties and to submit to cross-examination at a formal hearing. Individuals seeking only to follow the progress of a siting case or to offer comments for the PUC's consideration need not become intervenors.

Communicate on record. Verbal communication between a commissioner and a person with an interest in a matter before the commission that does not occur in a public forum or as part of the official record should be avoided. Those who communicate in writing with a commissioner about an open or imminent docket matter should understand that their comments will become part of the official record and subject to review by all parties and the public. Likewise, comments made at a PUC public proceeding or submitted to the commission relative to a docket matter become part of the record, open to review by all parties and the public. Because commissioners have a decision-making role in docket matters, any discussion with a commissioner about an open or imminent docket must take place in an open forum, such as a public meeting, with notice given to all parties.

South Dakota Public Utilities Commission

500 E. Capitol Ave., Pierre, SD 57501

1-800-332-1782; 605-773-3201

www.puc.sd.gov; puc@state.sd.us

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05/2018

EL18-003 - In the Matter of the Application by Dakota Range I, LLC and Dakota Range II, LLC
for a Permit of a Wind Energy Facility in Grant County and Codington County, South Dakota,
for the Dakota Range Wind Project - Public Input Hearing
South Dakota Public Utilities Commission

Wednesday, March 21, 2018

Waverly-South Shore School Gymnasium, Waverly, SD

Please Print Legibly

Name	City/State
Brenna Gunderson	Lake Elmo, MN
Diana Lau	Summit S.D.
Alan Moe	Watertown, SD
MARK COMES	Watertown, S.D.
Dwight Lowell Dockter	S. Shore
Brad Howell	Watertown SD
Jon Meyer	South Shore, SD
Patrick Lynd	Waverly, SD
Penny Jhyen	Waverly SD
BRAD MEIER	RAWLINS SD
Kenneth Comes	Waverly SD
Shawn Kruger	Watertown SD
Jeff Berrigan	Mpls MN
Alice Moyer	WTH SD
Tom Zellmer	Woodbury, MN
Jarrod Knastrop	WTH, SD
Allen Snipp	WTH
Burt Jones	WTH
Greg Richter	WTH SD

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Please Print Legibly

Name	City/State
Michael Florey	Clark SD.
Wanda Lau	Watertown SD
JAMES HOLCOMBE	WATERTOWN SD.
Bill Lindner	Watertown, S.D.
Philip Taecker	South Shore, SD
TRY VANDUSEN	WATERTOWN, SD
Carol Vandusen	Watertown SD
Bridget Johnson	Waverly
Jim Thyen	Waverly
THOMAS HAGEN	Watertown
Mark Leddy	Min. Bank, SD
SHANNON WHITON	MINNEAPOLIS, MN
Marli Beckner	Stockholm
Kyle Thyen	Waverly, SD
Pat Flowers	Forest Lake, MN.
Joel Kustrup	Watertown
Diane Redlin	South Shore
Joe Brenneman	Sioux Falls
Bob SPAETZ	LA BOLA SD.

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 Waverly-South Shore School Gymnasium, Waverly, SD
 Please Print Legibly

Name	City/State
ROLAND JORGENSEN	CHOKIO, MN
Jim Berg	Stockholm SD
Alexis Lau	Watertown SD
JOHN LAU	Watertown SD
Cheryl Lindner	Watertown SD
Brian Stollenberg	Wth SD
Carol Zillgitt	Wth, S.D.
Nick Johnson	Baltic, SD
Paul Johnson	Wth SD
Barb Waldron	Wth, SD
Justin K. Gill	Bradley, Crater
Tony Kanner	Wth SD
Kathy Dager	Watertown, SD
Roger Amdahl	South Shore SD
Clay Kanner	South Shore SD
Dan Crisler	Watertown, SD
Benjamin Dolen	Ortley, SD
Jerry Redwin	South Shore, SD
Lee GABEL	WATERTOWN, SD

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Waverly-South Shore School Gymnasium, Waverly, SD

Please Print Legibly

Name	City/State
Ronald R. Capp	Pipestone MN
Andrea Capp	Summit, SD
Timothy Capp	Summit, SD
Alan E. Capp	South Shore, SD
Ken Johnson	Watertown, SD
Bruce Borgen	Watertown SD
CHRIS KUNKLE	ROSEVILLE, MN
Sean Coyte	Miller, SD
LINDA HEYDUK	WAVERLY
RICHARD HEYDUK	WAVERLY
Marlene Hansen	Kearney, NE
Tom Hanson	" " "
Jeff Kuntz	midland
Elizabeth Redetzke	SS South Shore, S.D.
Dylan Lau	Watertown
Lami Bunde	Watertown SD
Josh Akers	Bismarck, ND
Jordan Tech	Waverly, SD
Tom Nelson	Waverly SD

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Waverly-South Shore School Gymnasium, Waverly, SD

Please Print Legibly

Name	City/State
Kelly Owen	Starkweather SD
Derek Nelson	Strandburg SD
Nancy Johnson	Milbank SD
Matt Farrell	Marrin, SD
Steve Hall	Watertown, SD
Kalin Hocker	Watertown SD
Naren David	Henry SD.
Tom Dagel	Waverly S.D.
Sarina Coull	Watertown SD
Don Schertz	Wt
Larry Bammel	Fergus Falls, MN
Bobbie Behr	M. Bank, SD
Ted Redtke	SOUTH SHORE S.D
Alexis Hansen	Clear Lake, SD
Brook Piro	Summit, SD
Don Jellis	Wt SD
Mark Kriese	Summit SD
Andree Tesch	Waverly SD
Larry Schlager	Clack

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Please Print Legibly

Name	City/State
Neal Homan	Labolt, SD
Kathy Tyler	Big Stone City SD
Tim Tyler	" "
Leo Konras	Watertown SD
Allen Andahl	Summit, SD
STEVE SCHAEFER	HAWCCK, MN.
Jim Wohlleber	Summit S.D
Dave Wieber	Ledywood N.D
Deek Wieber	Ledywood N.D.
Coletta Buchholz	Watertown SD
Mark Buckholz	Watertown SD
Eugen Roden	South Shore SD
Jane Roden	South Shore SD
Mike Tanner	Watertown
David & Joan Strong	Strandburg, SD
Matt Whitney	Watertown
Jeff Haverly	Rapid City. GOEL
Gordon Kane	Summit
Jim Bestow	Watertown

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South Dakota Public Utilities Commission

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Waverly-South Shore School Gymnasium, Waverly, SD

Please Print Legibly

Name	City/State
Joyce Hauck	Milbank SD
Paul Sumner	Summit
George D. Holby	Long SD
Jim & Carol Miller	Burns, ND
ROGER MOHR	WIN SD
Corey Amdahl	Summit, SD
Jim Amdahl	Summit S.D.
Valerie Amdahl	Summit, S.D.
Bruce Schukedong	Watkins SD
Fred Schukedong	Watkins S.D.
WAYNE SOREN	LAKE PRESTON SD
KURT JENSEN	SUMMIT SD
AMBER CHRISTENSEN	STRANDBURG SD
Alvin Kanan	Goodwin SD
Jim Canner	Waverly SD
Greg Comes	" "
Paul Hargis	Strandburg
Terri Haverly	Rapid City, SD
Linda Kane	Summit SD

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Please Print Legibly

Name

City/State

Anton Mack

Watertown SD

Nelle Smith

Minneapolis, MN

Chad Feik

So. Shore, SD

Jim Newcomb

Red Feather Lakes, CO 80545

Jim Lindgren

South Shore, SD

LES Groot

Sioux Falls, SD

Greg Wall

Strandburg SD 57265

Merlin Buide

Watertown, SD 57201

Lu Nelson

Lyons, NE

Marsha Shuppi

Axon SD

Dregg Beck

Alva SD

Norman Bisognel

Waubesa SD

Rick Hartley

Watertown SD

Kevin Krakow

Strandburg, SD

Jared Krakow

Strandburg, SD

Jamie Dolen

South Shore, SD

Richard Fransen

Watertown

Kevin Owen

Stockholm

Deb Hornan

Labott, SD

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Please Print Legibly

Name	City/State
Allen Kasperson	WATER TOWN, SD
Christian Reinche	Milbank, SD
Wayne Bongheinduck	Waverly, SD
Terrell	South Shore, SD
Thyle Mogen	Twin Brooks, SD
Kristi Mogen	Twin Brooks SD
Warren Jeth	South Shore & SD
Alan R. Westenberg	Sioux Falls, SD
Richard & Diane Pike	
Quince Pelle	Branda SD
Linda Lundgren	South Shore, SD
Kenneth & Elaine Bunde	Florence S.D.
TAVAKA LAND TRUST	SOUTH SHORE SD
Darlis Bunde	Wth, S.D.
Sally Jo Sorensen	Summit S.P.
Michael Crawford	Summit, S.D.
Leonard Stenges	Milbank SD
Rand Stenges	Milbank, SD.
Ruby Holborn	Wary, SD

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Waverly-South Shore School Gymnasium, Waverly, SD

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Name	City/State
Brian Comes	Waverly, SD
Dan Thyen	Waverly, SD
Melissa Lynch	Waverly, SD
Wade Falk	Stockholm, SD
Myron Johnson	WYN, SD
Jeff Buckholz	South Shore, SD
Ken Nagel	Watertown, SD
Marvin Andell	Ortley, SD
Dean Pawlowski	FERGUS FALLS, MN
Lance Hener	Summit, SD
Wade Bauer	South Shore, SD
Anthony Baker	↓ South Shore, SD
Steve Kolbeck	Brandon, SD
Beth Scholt	St Paul MN
Dave Beyer	Reville, SD
John Homan	Watertown, SD
Vince Meyer	Millbank SD
Dot Meyer	Millbank SD
Bill & Jean Street	" "

Please Print

Name

City/State

Dan Seurer

Watertown SD



Dakota Range Wind Project
302.4 MW
South Dakota



Dakota Range Wind Project Overview

Capacity = 302.4 MW

Land = 100% of land under easement, approximately 44,500 acres

Proposed Facility

- Up to 72 turbines in Grant and Codington Counties
- Access roads, collector lines, and fiber-optic cables
- Operations and maintenance (“O&M”) facility
- Up to 5 permanent meteorological towers
- Project substation

Site Selection

- Strong wind resource
- Available transmission
- Community and landowner support
- Compatible land use

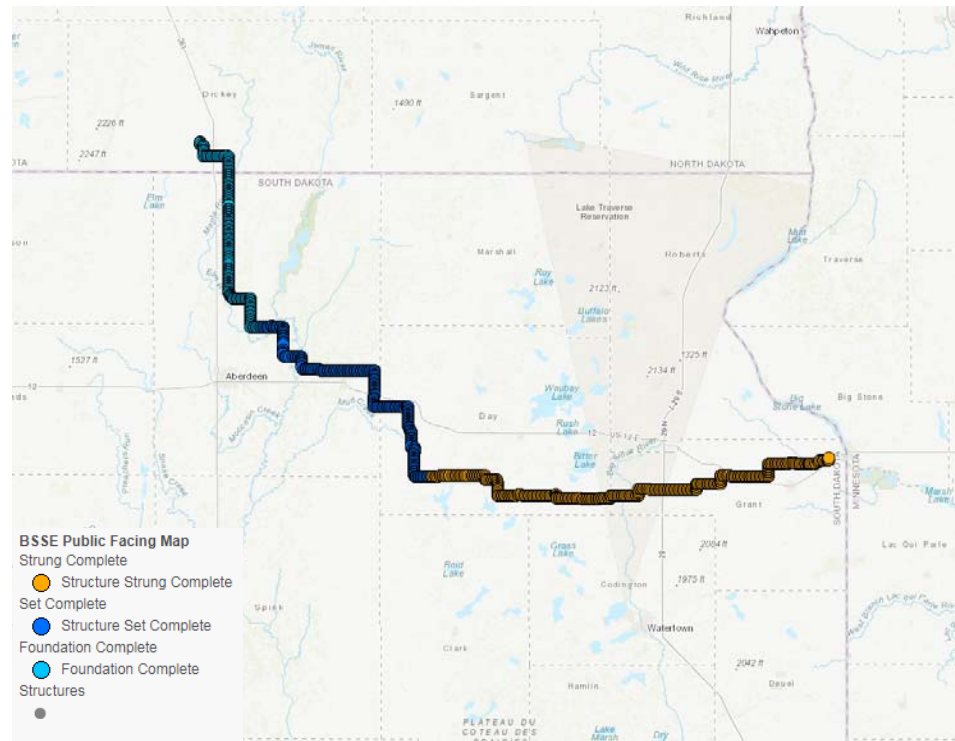
Buyer = Xcel Energy (2021 Commercial Operation Date)



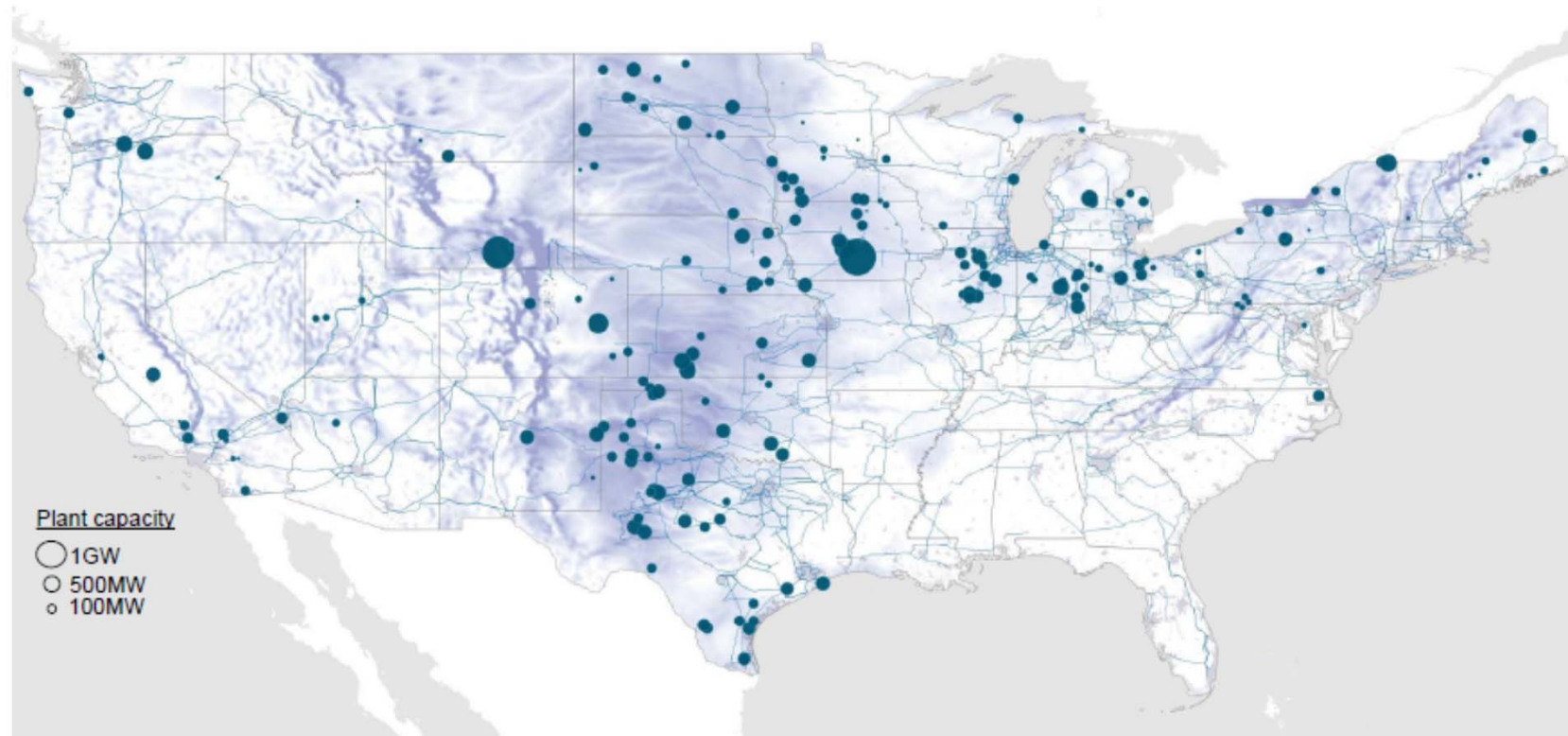
Dakota Range Wind Project Basics

Why Now? Big Stone to Ellendale Line

- **IA:** Signed early 2018
- **Earthwork for POI Substation:** Q3 2018
- **Electric work on POI Substation:** Q2 2019
- **Available Trans:** Q3 2019
- **Commercial Operations**
Date: Late 2020/Early 2021



SD Perfectly Positioned for Wind Opportunities



Source: Bloomberg New Energy Finance, USGS, Bloomberg Terminal MAPS <GO>. Notes: Forecast only includes projects in bottom-up forecast and excludes "buffer" projects. Purple graphs USGS wind resource data, and navy lines show transmission.

Who is Apex Clean Energy?

Apex Clean Energy is a U.S.-focused independent renewable energy company based in Charlottesville, Virginia.

Apex's mission: Accelerate the shift to clean electricity



Acquisition and Development



Financing and Construction



Asset Management

To learn more, visit apexcleanenergy.com.

Apex and the Community

Apex is committed to the responsible development of renewable energy facilities. To us, that means establishing long-lasting relationships and ensuring that our projects benefit both our host landowners and their communities.

“With farming, it’s different year to year. You can do everything right, and Mother Nature can decide differently. Construction is kind of the same way. **With the wind, it’s a steady flow of income coming in**, and that’s what we liked about it.”

—Doug Merz, Landowner
Kay Wind, Oklahoma



“We’re capitalizing on a natural resource. I can diversify my acreage, and **the landowners that live locally spend their dollars back in the community.**”

—Pete Hatfield, Landowner
Hoopeston Wind, Illinois

Xcel Energy to Own Dakota Range Wind Project

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Xcel Energy announces plans for wind farm north of Watertown

By J.T. Fey, Public Opinion News Staff Sep 27, 2017



SIOUX FALLS — Xcel Energy Wednesday morning announced its intention to build a 300-megawatt wind farm, called Dakota Range I and Dakota Range II, 20 miles north of Watertown.

Developed by Apex Clean Energy of Charlottesville, VA, the wind farm will be located on a 40,000-acre site. Xcel said it will be the first publicly announced wind project to advance under the phase down of federal tax credits.

"Even without the full tax credit, the project's cost is low enough to compete with other fuel sources, an investment that is expected to lower customer bills over the project's life," according to Xcel

Energy's press release

The Smart Way To Buy Insurance

- Auto
- Home
- Business
- Life
- Health

STOUDT'S
INSURANCE AGENCY

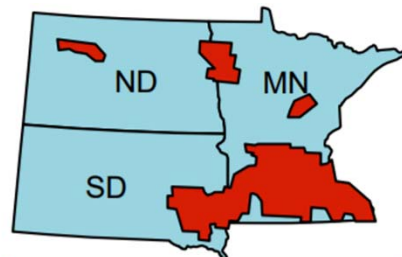
Free No Obligation Quotes 886-9719 or 1-888-326-9719
825 South Maple - Watertown, SD 57201
(Corner of Highway 212 & S. Maple)

SUBMIT YOUR NEWS

We're always interested in hearing about news in our community. Let us know what's going on!

[Go to form](#)

Xcel Service Territory



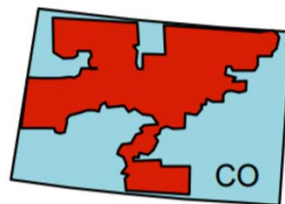
NSPM

2016 Rate Base: \$9.9 billion
2017 Ongoing EPS: \$1.01
2018-2022 Cap Ex: \$7.8 billion



NSPW

2016 Rate Base: \$1.3 billion
2017 Ongoing EPS: \$0.16
2018-2022 Cap Ex: \$1.3 billion



PSCo

2016 Rate Base: \$9.4 billion
2017 Ongoing EPS: \$0.94
2018-2022 Cap Ex: \$6.2 billion



SPS

2016 Rate Base: \$3.4 billion
2017 Ongoing EPS: \$0.30
2018-2022 Cap Ex: \$3.9 billion

A Reliable Energy Source for South Dakota

Xcel and MISO's ability to integrate electricity from a diverse set of generation sources helps them maintain a reliable and stable grid.

- Xcel Energy electric reliability is among the top one-third of U.S. electric utilities.
- Xcel Energy is transitioning its fleet to include more natural gas, wind, and solar energy with a plan that will keep costs affordable.
- Xcel Energy is the nation's leading utility wind provider and is taking advantage of historically low wind prices to install new wind energy that will save money on fuel and other costs over the life of the projects.



Dakota Range Wind Project Benefits

Community Economic Benefits

25-Year Projected Tax Revenue for the Dakota Range Wind Project

Recipient	Annual Tax Revenue (Approximate)	Total Tax Revenue (Approximate)
Codington County	\$80,000	\$2,000,000
Leola Township	\$6,000	\$150,000
Germantown Township	\$30,000	\$700,000
Grant County	\$280,000	\$6,900,000
Lura Township	\$25,000	\$600,000
Mazeppa Township	\$90,000	\$2,300,000
Waverly School District	\$225,000	\$5,600,000
Summit School District	\$280,000	\$7,000,000
South Dakota	\$420,000	\$10,600,000

Benefiting South Dakota Communities

Landowner Lease Payments

- Over its 25-year life, Dakota Range Wind will generate **\$39 million** in lease payments to participating landowners.
 - Prior to construction, project landowners will receive over \$500,000 in development payments.
 - Throughout commercial operations, all participants will receive “**community based**” pay.

Local Spending During Construction

- During construction, about 300 construction workers will be living and shopping in the area, creating a boost for the local economy.
- Several key construction materials will be sourced locally, supporting local suppliers.

Long-term Jobs

- Throughout operation, Dakota Range Wind will employ about 10 full-time operations and maintenance employees, creating approximately **\$17 million** in wages paid to community members.
- The country’s fastest-growing occupation is wind turbine technician, according to the Bureau of Labor Statistics—with numbers expected to more than double over the next decade.*

* Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Wind Turbine Technicians, <https://www.bls.gov/ooh/installation-maintenance-and-repair/wind-turbine-technicians.htm> (visited March 12, 2018).

Community Outreach and Support

Apex Clean Energy is dedicated to being a strong community partner.

Dakota Range has been in regular contact with stakeholders, including:

- Both counties (including their highway superintendents)
- All involved townships
- The Punished Woman's Lake Association
- USFWS
- SD Game & Fish
- SWO
- SHPO
- The Town of South Shore

Dakota Range has an active office in Summit to provide information about the project and answer questions from the community.

Additional community support has included:

- Donation to the addition to the high school in Summit
- Regular contributions to community events (e.g., Fog Days, etc.)
- Donation to fundraising efforts for Summit's Volunteer Fire Department
- Support for Summit High School History Club's trip to Washington, DC
- Contributions to the local Boys & Girls Club
- Dakota Range Community Grant Program (under way)

Serving South Dakota

24 / 7 / 365

- 104 South Dakota jobs
- \$192,000 foundation giving
- \$15.9 million local taxes
- \$3.9 million spending in state
- \$100,000 economic development
- 92,150 customers
- Two wind farms in the works



Clean, Safe, Reliable



Serving a Need in South Dakota

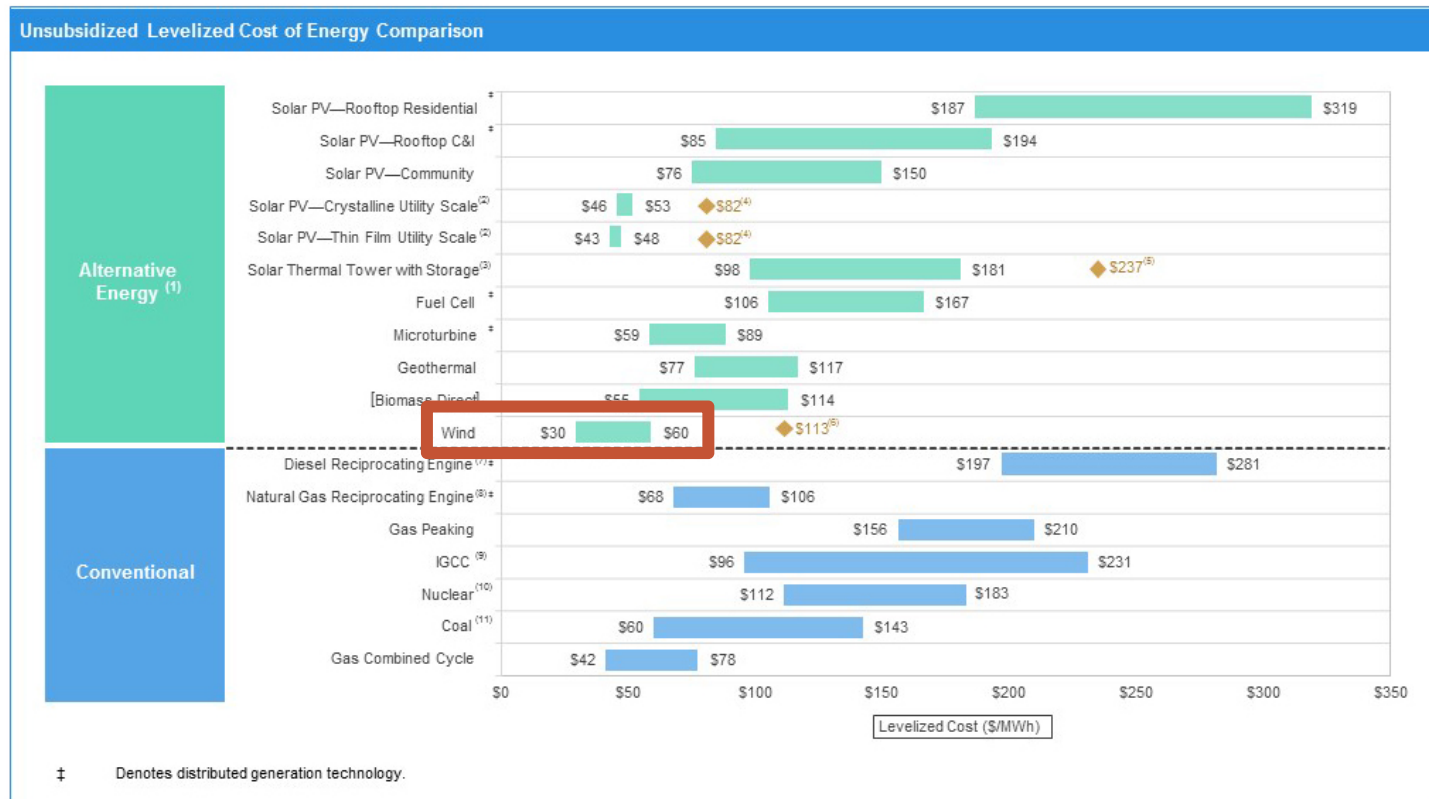
Creating Savings for South Dakota Ratepayers

Dakota Range Wind is expected to save Xcel's South Dakota ratepayers millions over the life of the project.



Wind Power Lowers Energy Prices

Even unsubsidized, wind energy is the cheapest form of energy currently available.*

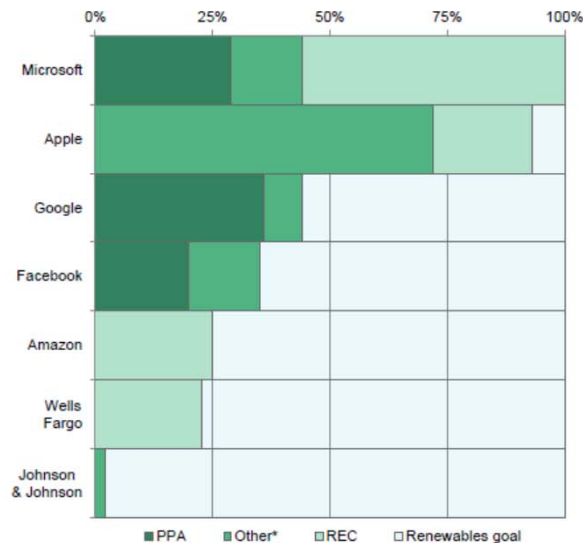


*Lazard's Levelized Cost of Energy Analysis – Version 11.0. 2017.

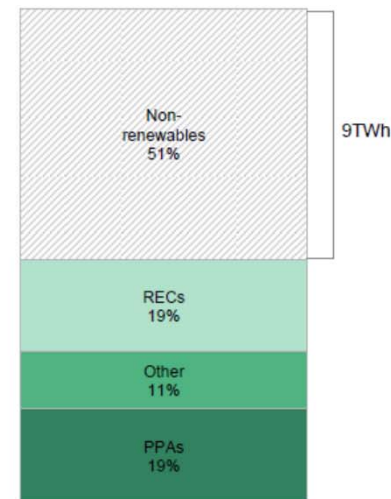
Demand for Renewable Energy Is Growing

The market for renewables is stronger than ever, and South Dakota is poised to take advantage of increasing demand for renewables.*

Global largest companies: renewables targets and estimated progress



Notes: Other* includes renewables through onsite generation, owned projects, green tariffs and grid. Percentages are for most recent period. Above originally published in January 2017. Companies have since made further progress.



Source: Bloomberg New Energy Finance

Trend Reflected in Apex's Recent Partners



- 2014: IKEA purchases Apex's 98 MW Hoopeston Wind facility in Illinois
- 2015: IKEA purchases Apex's 165 MW Cameron Wind facility in Texas
- These facilities offset more than 3x IKEA's U.S. energy demand
- Apex operates both facilities on behalf of IKEA



- 2016: Steelcase, the world's largest furniture manufacturer, signs 12- year PPA with Apex
- The 25 MW PPA offsets 70% of Steelcase's U.S. energy demand and 50% of global demand
- The PPA is with the 147 MW Grant Plains Wind project in Oklahoma



- 2017: Alliant subsidiary Interstate Power and Light purchased Apex's 300 MW Upland Prairie Wind
- Apex completed project development work on Alliant's behalf meeting the utility's rigorous design and siting standards
- Upland Prairie will contribute toward Alliant's goal of having one-third of its energy in Iowa come from wind starting in 2020



- 2016: The U.S. Army enters into a 28-year PPA with Apex to serve Fort Hood in Killeen, Texas
- The 65 MW hybrid agreement combines on-site solar at Fort Hood and off-site wind from the Cotton Plains Wind project
- Army's largest renewable project and first hybrid; will avoid \$168 million in costs over agreement term
- Helps U.S. Army achieve ongoing goal of increasing energy security





Dakota Range Wind Meets All PUC Requirements

PUC Requirements for Permit Consideration

As required, our application shows that Dakota Range Wind will comply with the PUC's siting requirements and will adhere to all applicable laws and rules.

- I. Will not pose a threat of serious injury to the environment nor to the social and economic condition of inhabitants or expected inhabitants in the siting area.
- II. Will not substantially impair the health, safety or welfare of the inhabitants.
- III. Will not unduly interfere with the orderly development of the region, with due consideration given to the views of governing bodies of affected local units of government.

We Follow an Evidence-Based Approach

- Apex follows a rigorous standard, as we conduct our assessments.
- We rely upon qualified/peer-reviewed studies and scientific research in the design of our facilities to ensure compliance with all laws and regulations, and to eliminate or minimize impacts to wildlife, people, and property.
- We encourage interested parties to critically consider information presented in a vague manner, often evidenced by introductions like “studies have shown,” “experts agree,” and “everyone knows.”
- We welcome any questions regarding the scientific veracity of our evidence; we will be happy to provide citations, clearly footnoted in these slides, as desired.

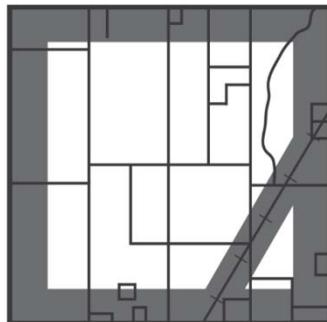
Overcoming Siting and Setback Challenges

A complex range of factors goes into where we can ultimately site turbines. These images demonstrate the many different setbacks we account for when siting—in the end, very little land is actually available for turbines.

ROAD / RAIL SETBACKS

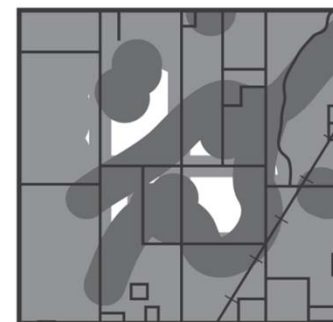
Apex includes a setback around all existing roads and rail lines to ensure that turbines are located an appropriate distance from these features.

In many places in the Midwest, roads follow section lines, which create buffers from the edges of each section as well.



STREAMS & DITCHES

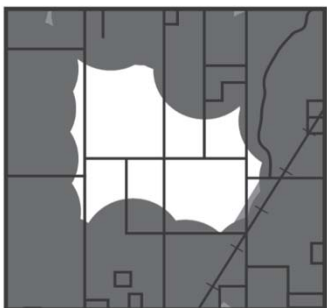
Apex turbines are set back from streams and ditches to prevent adverse impacts to waterways, riparian wildlife, and habitat.



HOUSE SETBACKS

Apex respects an appropriate setback distance from every occupied residence in a project area.

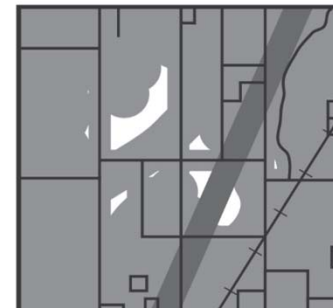
This setback is calculated based on anticipated sound and shadow impacts to ensure that turbines do not adversely affect nearby residents.



COMMUNICATIONS

Cellular devices, televisions, radios, and radar systems send signals through the air from one receptor to another.

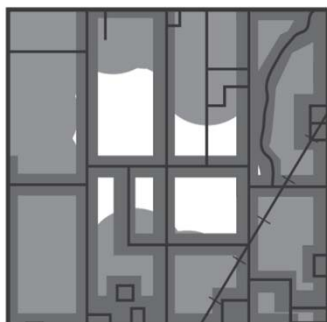
Our analysis of these “beam paths” helps us ensure that turbines do not block or impede these types of signals.



NON-PARTICIPATING PROPERTY LINES

Apex believes it is important to keep turbines a respectful distance from the property lines of those who are not participating in the project.

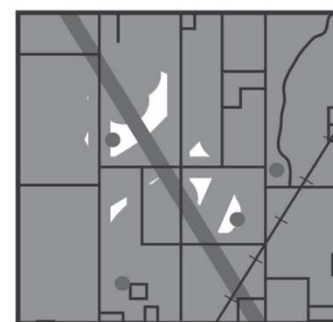
We maintain smaller setbacks from the property lines of those who are participating in the project.



OIL & GAS INFRASTRUCTURE

Wind energy facilities can safely and functionally coexist with oil and gas wells and pipelines.

Apex works closely with landowners, mineral leaseholders, and other energy companies to ensure that both underground and overhead energy resources can be harnessed safely and efficiently.



Compliance with All Applicable Laws and Rules

Codington and Grant County Setbacks:

- **1,000 feet** from existing off-site residences, businesses, churches, and buildings owned and/or maintained by a government entity.
- **500 feet** from onsite or lessor's residence.
- **110% the height** of the wind turbines from the centerline of public roads.
- **110% the height** of the wind turbines from any property line unless a wind easement has been obtained from adjoining property owner.

Voluntary:

Dakota Range Wind has voluntarily agreed to additional setbacks from Punished Woman's Lake.

Environmental Analysis

Apex coordinated with state and federal agencies to accurately assess potential impact (and included supportive reports in our PUC filing).

Apex conducted numerous environmental and cultural studies to greatly minimize impacts to the environment and its residents, including:

- a. Habitat Surveys
- b. 2016 Raptor Nest Survey
- c. 2017 Raptor Nest Survey
- d. Avian Use Survey (2016-2018)
- e. 2016 Grouse Lek Survey
- f. 2017 Grouse Lek Survey
- g. Sound Level Modeling Report
- h. Tribal Consultation
- i. Shadow Flicker Modeling Report
- j. Property Value Effects Studies (wrapping up now)
- k. Decommissioning Plan
- l. Level I Cultural Resources Review
- m. Cultural Resources Monitoring and Management Plan
- n. Architectural Surveys
- o. Level III Cultural Resources Surveys

Meeting Project County's Sound Requirements

Codington and Grant County requirements (See Table 10-1 of the PUC App.):

Noise level shall not exceed 50 dBA average A-weighted sound pressure including constructive interference effects at the property line of existing offsite residences, businesses, and buildings owned and/or maintained by a governmental entity. Therefore, the study listed sensitive receptors were evaluated in this analysis against the 50 dBA limit.

Apex sound studies demonstrate:

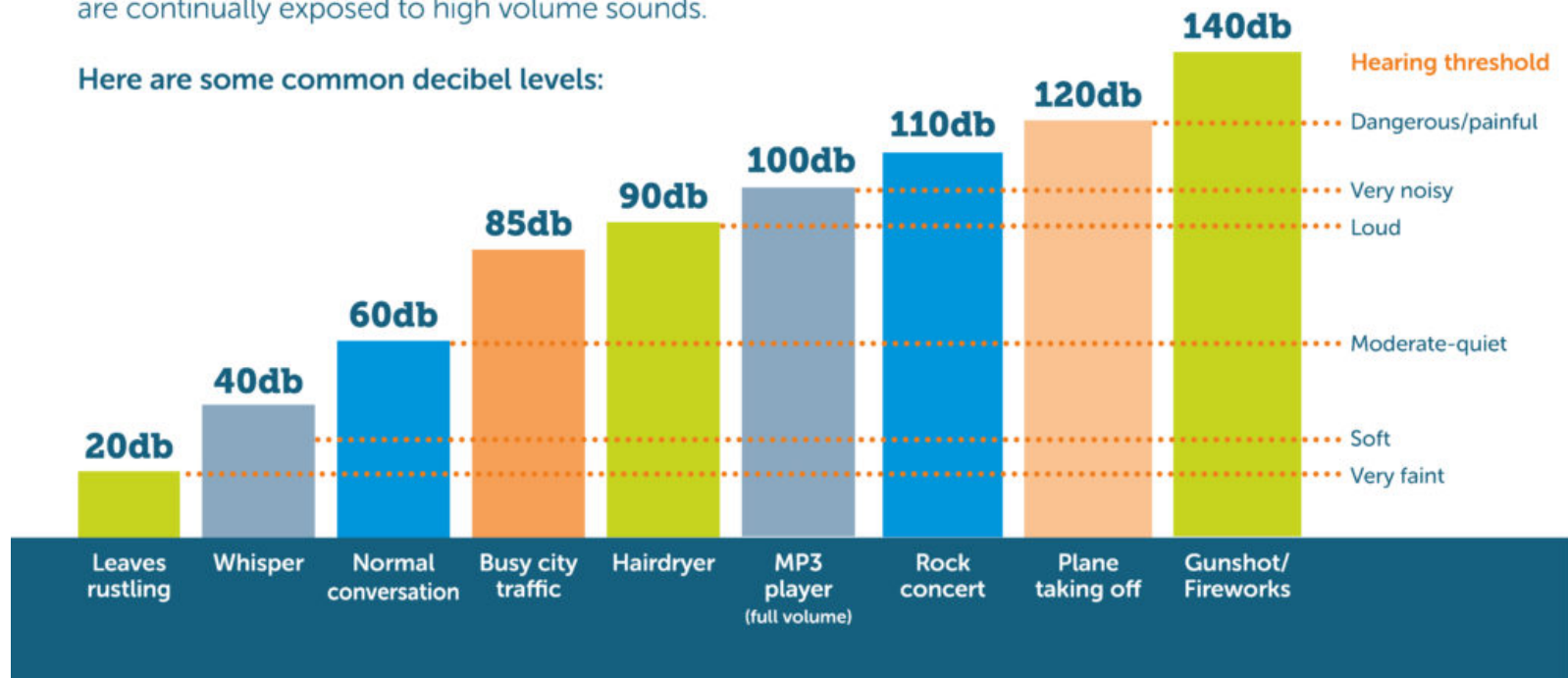
- The sound levels modeled at sensitive receptors in **Codington County** ranged from 17 to 43 dBA.
- Sound levels modeled at sensitive receptors in **Grant County** ranged from 22 to 45 dBA.
- **Project meets/exceeds the sound requirements, within the county regulations.**

Sound: Frames of Reference

How loud is too loud?

Government research suggests the safe exposure limit is **85 decibels** for **eight hours a day**. Your hearing could be at risk of damage if you are continually exposed to high volume sounds.

Here are some common decibel levels:



* Source: Hearing Link, an organization devoted to protecting our hearing; <https://www.hearinglink.org/your-hearing/about-deafness-hearing-loss/protecting-your-hearing/>

Additional Sound Questions

Studies that focus on “the Infrasound Question”:

1. This Canadian study is widely regarded as the most comprehensive analysis:
<https://www.canada.ca/en/health-canada/services/environmental-workplace-health/noise/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html>
2. *Popular Science* article: <https://www.popsci.com/blog-network/unpopular-science/%E2%80%9Cscience%E2%80%9D-wind-turbine-syndrome>
3. Additional informative articles:
<https://skeptoid.com/episodes/4388>
<https://www.quora.com/Is-Dr-Nina-Pierponts-Wind-Turbine-Syndrome-a-real-medical-syndrome-caused-by-wind-turbines>
<http://www.energyandpolicy.org/wind-health-impacts-dismissed-in-court/challenge-of-inexpert-experts/dr-nina-pierpont/>
http://www.mlui.org/mlui/news-views/articles-from-1995-to-2012.html?archive_id=1049%20%2801/2011%29#.WqfosYco6M9

***Please feel free to ask Stephanie for these links after the meeting.**

Minimizing Shadowing Impacts

Apex's Shadowing design goal: No more than 30 hours per year at non-participating occupied structures.

- Apex shadow flicker analysis:
 - Conducted to determine the duration of shadow flicker in the vicinity of the proposed Dakota Range Wind facility within Codington and Grant Counties.
 - Shadow flicker calculated at 189 occupied structures from wind turbines resulting from the operation of the proposed wind turbine layout and alternate wind turbine locations.
 - Modeling results are conservative: Modeling receptors treated as structures with windows on all sides ("glass house" assumption) and surrounding area assumed to be without vegetation or structures ("bare earth"). **Most conservative scientific method for gathering such data.**
- Analysis results:
 - Maximum expected annual duration of flicker at a non-participating receptor: 29 hours, 0 minutes. **Project design goal is met.**

"Large turbines rotate at a rate below that at which the flicker is likely to present a risk." *

*Smedley, Andrew R. D. , Webb, and Wilkins. "Potential of Wind Turbines to Elicit Seizures Under Various Meteorological Conditions." *Epilepsia*, 51(7):1146–1151, 2010

*Harding, Graham, Harding, and Wilkins. "Wind turbines, flicker, and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them." *Epilepsia*, 49(6):1095–1098, 2008.

Wind Turbines and Property Values

The nation's most comprehensive study to date on wind farms and property values* concluded that,

“Regardless of model specification, we find no statistical evidence that home values near turbines were affected in the post-construction or post-announcement/pre-construction periods.”

About the Study

- Researchers analyzed 51,276 home sales near 67 wind farms in 27 counties across 9 U.S. states
- All homes were within 10 miles of wind facilities
- 1,198 sales were within 1 mile of a turbine
- 331 sales were within 1/2 mile of a turbine
- Data was collected before, during and after wind farm construction

A “rural focused” property Value Effects Studies will be submitted to the PUC, coupled with its previous analysis of land values in MN, and it largely mirrors the findings of Berkeley Lab.

* Hoen, Ben, Brown, Jackson, et. al. “A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States.” Ernest Orlando Lawrence Berkeley National Laboratory. 2013.



Dakota Range Wind's Technology

Turbine Model for Dakota Range Wind Project

Dakota Range Wind will utilize the Vestas V136 4.2 MW turbine (82 meter hub height)

- The performance and versatility of the 4 MW platform has been proven with more than 17 GW installed in 35 countries since 2010.
- The 4 MW platform is a low-risk choice. It is based on the proven technologies that underpin more than 62,000 Vestas turbines installed around the world.
- Each turbine is connected to a **Supervisory Control and Data Acquisition (“SCADA”)** system via fiber-optic cable, which allows the turbines to be monitored in real time by the O&M staff.
- The SCADA system also allows the facility to be remotely monitored, thus increasing facility oversight, as well as the performance and reliability of the turbines.
- **The Vestas De-Icing System is fully SCADA integrated and can be triggered automatically or manually, depending on the de-icing strategy.**
- Not only would the local O&M office have full control of the wind turbines, but a 24/7 remote operations facility would also have control of the individual turbines. These two teams coordinate to ensure that the wind turbines operate safely and efficiently.

Vestas V136-4.2

- Rated Power = 4,200 kW
- Hub Height = 105 meters
- Rotor Diameter = 136 meters
- Total Height = 173 meters
- Cut-in Wind Speed = 3 m/s
- Cut-out Wind Speed = 25 m/s
- Maximum RPM = 14 rpm

Dakota Range Wind Project's Met Towers



- Up to five permanent met towers would be installed as part of the project.
- These met towers are used to obtain wind data for performance management once the facility is operational.
- The met towers will be self-supporting with heights not to exceed the hub height of the wind turbines.
- **The met towers will be marked and lighted as specified by the FAA and local/state law. Each met tower will occupy an area of approximately 42 feet by 42 feet (0.3 acre), or less if guy wires are not employed.**

Turbine Technology Continues to Improve

Wind energy projects will require less and less land in the future.

- A project of this size ten years ago would have required approximately 200 turbines. This project will comprise just 72 turbines.
- This facility will generate enough electricity to power more than 130,000 homes.
- The cost of wind energy will continue to fall because of these efficiencies.
- Because future advancements in turbine technology will cause these numbers to shrink even more in years to come, developers in ND are already planning to repower projects with fewer/more efficient turbines.
- Our “community based” compensation model is designed to ensure that communities benefit broadly from facilities, even if fewer turbines are needed. **Landowners generate lease income largely from the amount of acres in the project (vs. the number of turbines they host).**



The Future of Dakota Range Wind

Post-Construction and Safety Commitments

The anticipated life of the project is approximately 25 years, but could be extended through retrofitting, repowering, or other upgrades to the existing components.

- The project will be decommissioned in accordance with all applicable local and State requirements, as well as requirements set forth in the project's easement agreements. **A decommissioning plan for the project is included in PUC application (Appendix P).**
- The construction contractor will provide training, as well as site maps, haul routes, schedules, contact numbers, and other information to local and county emergency management.
- During operations, Dakota Range Wind operator will coordinate with local and county emergency management to protect the public and project facilities in the event of natural, manmade, or other incidents.
- Dakota Range Wind will register each turbine location and the O&M facility with the rural identification/addressing (fire number) and 911 systems.
- Minimum of 1 year of continued bird/bat impact monitoring.

The counties have oversight regarding the operation of this project. If violations against the county or state ordinances occur, the host counties have stated that: operations would likely be curtailed until those issues are corrected.



Conclusion

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THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

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IN THE MATTER OF THE APPLICATION
BY DAKOTA RANGE I, LLC AND
DAKOTA RANGE II, LLC FOR A PERMIT
OF A WIND ENERGY FACILITY IN
GRANT COUNTY AND CODINGTON COUNTY,
SOUTH DAKOTA FOR THE DAKOTA
RANGE WIND PROJECT.

EL18-003

ORIGINAL

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Transcript of Public Input Hearing
March 21, 2018

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BEFORE THE PUBLIC UTILITIES COMMISSION,
KRISTIE FIEGEN, CHAIRMAN
GARY HANSON, VICE CHAIRMAN
CHRIS NELSON, COMMISSIONER

COMMISSION STAFF
Karen Cremer
Jon Thurber
Darren Kearney

APPEARANCES

Mollie Smith,
appearing on behalf of Dakota Range.

Kristen Edwards and Amanda Reiss,
appearing on behalf of Public Utilities Commission
Staff.

Reported By Cheri McComsey Wittler, RPR, CRR
Precision Reporting, 213 South Main, Onida, South Dakota

1 The following transcript of proceedings was
2 held in the above-entitled matter, at the Waverly/South
3 Shore School, at Wavery, South Dakota, on the 21st day of
4 March, 2018, commencing at 5:30 p.m.

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1 CHAIRMAN FIEGEN: Please note that we started on
2 time.

3 We will talk louder. Can you hear me now?
4 That's what I say to my cell phone friends. Can you hear
5 me now?

6 Good evening. I am Kristie Fiegen. I'm the
7 Chairman of the Public Utilities Commission. With me
8 today is fellow Commissioner Gary Hanson and fellow
9 Commissioner Chris Nelson. And we certainly appreciate
10 all of you guys coming out here tonight to give us your
11 thoughts, your comments.

12 We certainly thank Jon Meyer. Is Jon Meyer
13 here? Jon. He is the superintendent of the
14 Waverly/South Shore School and his staff.

15 Jon, I have looked around the gym. There is a
16 2011 State Champion 9B and then I looked -- I went to the
17 back, and I noticed you were established in 2000, which
18 was the year my son was born. He goes to Parker High
19 School. Used to be a B school. This year he was the A
20 school. So we missed the State tournament. Cheri, we'll
21 talk about that later.

22 But I noticed in 2000 you were the Class B State
23 Champions with a record of 25 and 0. So South
24 Shore/Waverly -- or Waverly/South Shore has just a lot of
25 great history, and it's really fun to be in your

1 gymnasium. I'm a sports enthusiast, so always fun to be
2 here.

3 But the purpose of our meeting is not to play
4 basketball, but it is to hold a public input hearing in
5 Docket No. EL18-003, In the Matter of the Application by
6 Dakota Range I, LLC and Dakota Range II, LLC for the
7 Permit of a Wind Energy Facility in Grant and Codington
8 Counties in South Dakota for the Dakota Range Wind
9 Project.

10 An Application was filed with the Public
11 Utilities Commission on January 24, 2018. And in that
12 Application it stated that it is approximately in the
13 area of 44,500 acres, 10 miles northeast of Watertown.
14 The total installed nameplate capacity of this project is
15 approximately 302 megawatts with 72 wind turbines with
16 access roads to the turbines and associated facilities.

17 It also has an underground 34.5 kV line of
18 electrical collector lines. Also has an underground
19 fiberoptic cable for turbines and communications. Also
20 has a collection station, has up to five permanent towers
21 for meteorology. Also has operation and maintenance
22 facilities. And it is expected to be completed in 2021
23 with the estimated cost of \$380 million.

24 The project will be interconnected to a
25 high-voltage transmission grid, and it will be by the

1 Big Stone South to the Ellendale 345 kV transmission
2 line.

3 The copy of the Application -- if you would like
4 to see the copy, of course, there's one up here in front
5 of me. A couple up here. But actually these are the
6 Commission's copy.

7 There's a copy at the county auditors' in
8 Grant and Codington Counties. Also you can access it on
9 our website and that's the puc.sd.gov website. Or you
10 can actually call our office and make sure that -- or
11 stop by our office, and you can look at that.

12 But the purpose of tonight's meeting is for you
13 to provide us information and for us to hear your
14 comments. It's not for the Public Utilities
15 Commissioners to comment. It's for us to come out in the
16 field where the project's at and hear from you.

17 Interested parties have the right to present
18 their views and comments regarding the Application, and
19 we encourage you to do so. No decisions are made tonight
20 or in the immediate future. By law, the parties to this
21 proceeding at this time are Dakota Range and the
22 Commission.

23 Under South Dakota Law each municipality,
24 county, government agency in the area where the facility
25 is proposed to be constructed or any interested person or

1 organization may be granted party status in this
2 proceeding by making written application to the
3 Commission on or before 5:00 p.m. on March 26, 2018.

4 We have applications for the party status form
5 available here for you tonight. And I know our staff
6 will have those. The form is also available on our
7 website. You do not need to become a party of the docket
8 in order for your voice to be heard by the Commission.

9 The reason we're here this evening is to hear
10 your comments, and the PUC will also be accepting
11 comments in writing, by mail, personal delivery, e-mail,
12 right up to the time of our decision on this docket. You
13 only need to apply for party status if you want to
14 participate formally in the case by putting in actual
15 testimony or other factual evidence, conducting
16 discovery, cross-examining witnesses, making legal
17 arguments, et cetera. This preserves your right to
18 appeal to the courts if you do not believe the decision
19 of the Commission is legally correct.

20 We also want you to know that the Commissioners
21 and the staff assigned to this docket thoroughly read all
22 the comments submitted by the public.

23 This is important for you to hear. So this
24 is -- for the permit to be approved, the state law states
25 that Dakota Range must show that the proposed wind energy

1 facility, number one, will comply with all laws and
2 rules; number two, will not pose a threat of serious
3 injury to the environment, nor to the social or economic
4 condition of inhabitants or expected inhabitants in the
5 siting area; number three, will not substantially impair
6 the health, safety, and welfare of the inhabitants; and,
7 number four, will not unduly interfere with the orderly
8 development of that region.

9 Based on those facts, the Commission will decide
10 whether to permit the project should be -- if it should
11 be granted the permit, if it should be denied, or granted
12 upon conditions. The law requires that our decision is
13 made within six months of the Application being filed, so
14 that means our decision will be made no later than
15 mid-July.

16 Our court reporter today is the mother of Nick
17 that won the State Championship in Aberdeen. 18 points.
18 Oh, man. They were all three pointers in that fourth
19 quarter, I think. From Sully Buttes actually. Cheri is
20 our court reporter today.

21 She will want you to speak in the microphone,
22 introduce yourself, spell your name, and speak slowly.
23 Do I have it, Cheri?

24 Also we have five Commission Staff members.
25 Raise your hand. Darren Kearney, Jon Thurber,

1 Amanda Reiss, Kristen Edwards -- Kristen Edwards, and
2 Brittnie Olson. I don't know if Brittnie is here yet.
3 Okay. She's up front.

4 This is the group you can talk to. You can talk
5 to them after the meeting. You can call them at the
6 Public Utilities Commission. You can talk to them at
7 break. But that's the group you can visit with.

8 This front row, the Commissioners and our
9 Commission Attorney Karen Cremer, we are only allowed to
10 talk to you at a public hearing. So it has to be at a
11 public hearing or at our evidentiary hearing, and then
12 you can visit with us. But tonight we will be able to
13 listen to you if you're on the mic.

14 Has everybody signed in? Pretty much? I would
15 say you guys have. You're just not raising your hand;
16 right?

17 Okay. To begin we want to just make sure --
18 just a reminder to mute your cellphones. And then we
19 will start this evening with representatives of Dakota
20 Range, and they'll make a presentation and explain the
21 proposed project.

22 Following that presentation -- and we're going
23 to dim the lights in just a little bit. We will open it
24 up to you, and so that you will actually be able to make
25 comments at that time.

1 Could we have a -- you guys raise your hand if
2 you'd like to make a comment tonight? And, staff, can
3 you kind of look at the number of how many hands there
4 are in the air?

5 So we were originally going to maybe do
6 five minutes. Since there's quite a few of you, we're
7 going to limit that actually to four minutes, unless
8 Commissioner Hanson or Commissioner Nelson disagree. Our
9 goal is to be done around 8:30.

10 Now you need to know that Cheri is going to take
11 your comments -- but actually she's not going to, Cheri.
12 The staff is going to take your comments. Make sure you
13 have your -- if you have written comments and your speech
14 tonight is written out, if you could put your name on
15 them and your address and then when you're done
16 speaking -- and if you don't get to the end of it, we
17 will read that, and we can give it to the staff.

18 Is that how we're doing it? Staff, you're
19 nodding your head; correct?

20 Okay. So we're going to give you four minutes.
21 Also in submitting written comments -- we talked about
22 that tonight. You can also submit written comments. And
23 you're submitting them now. But there's all sorts of
24 guidelines if you want to submit more written comments,
25 and the Public Utilities Commission staff can go through

1 that with you. It's like a maximum of 20 pages that are
2 8 and a half by 11. If for some reason you identify a
3 source, it's kind of like you're back in high school or
4 college, and you have to make sure you identify that
5 source and that content and copyrighting and et cetera.
6 There's no submission of media type of submissions,
7 multimedia or electronic links.

8 So our staff can certainly help you with all of
9 that. So tonight everyone will get four minutes that
10 would like to speak since there are 40 of you. After the
11 presentation we will also have signs up here. So you
12 will see a sign, and the sign is on that side of the
13 table. Jon. Jon has a one-minute sign, and then when
14 you need to be completed --

15 We're going to ask that you don't applaud or
16 boo. I know Waverly is a great community that absolutely
17 respects everybody and I love basketball but we're going
18 to ask that there's no clapping tonight. And if there is
19 a break, just a reminder, you can ask our staff. We'll
20 probably take a little break.

21 Our goal is to be done by 8:30. Most of us are
22 driving back about a three and a half, four-hour drive so
23 that would be into the night.

24 Chris, Gary, what am I missing? What kind of
25 comments?

1 Okay. Dakota Range, I'm going to turn it over
2 to you, and if you could introduce your team, that would
3 be great.

4 MR. MAUERSBERGER: Hello. Can everyone hear me?

5 Okay. My name is Mark Mauersberger. I'm the
6 senior project developer for Dakota Range. This is
7 Mollie Smith. She's our project attorney. And this is
8 Dave Phillips. He's the VP of our environmental group.

9 Shall I go up and give the speech?

10 Okay. Before I begin, I would like to sincerely
11 thank the PUC and all of the folks in attendance for
12 allowing me the opportunity to present this evening.
13 Thank you very much.

14 Okay. Dakota Range Wind Project overview. This
15 first slide outlines some of the project's key elements,
16 which we will discuss in detail this evening. Capacity,
17 302.4 megawatts. Land, 100 percent under easement,
18 approximately 44,500.

19 Up to 72 turbines in Grant and Codington County.
20 Strong wind resource, available transmission, community
21 and landowner support, compatible land use. And the
22 buyer, we signed a deal last September, Xcel Energy, with
23 a 2021 commercial operation date.

24 Dakota Range Wind basics. This is Dakota Range
25 Wind site plan. As you can see, the project is located

1 in both Grant and Codington County and transected -- and
2 is transected east to west by the new transmission line,
3 Big Stone Ellendale.

4 Here's kind of the vision of what the line looks
5 like. Why now? Big Stone to Ellendale. This slide
6 better illustrates the transmission line. The DOT --
7 excuse me. The dot furthest east represents the
8 Big Stone substation. Our footprint is located just
9 southwest of that area.

10 It's important to note this line was conceived
11 as part of the MVP transmission line upgrades and new
12 installations. These lines were built to create better
13 system efficiencies with an additional focus to carry
14 wind energy to the broader marketplace.

15 Why are we in South Dakota? South Dakota
16 perfectly positioned -- is perfectly positioned for wind
17 opportunities. This slide was created by Bloomberg, and
18 it forecasts the wind development in the future. As you
19 can see, the midsection of the country is where all the
20 development will happen in the future.

21 This windy midsection of the country was
22 referred to by my former employer T. Boone Pickens, as --
23 he called it the Saudi Arabia of wind.

24 Who is Apex Clean Energy? Apex Clean Energy is
25 a U.S.-focused independent renewable energy company based

1 in Charlottesville, Virginia. Apex's mission is
2 accelerate the shift to clean energy. We are a
3 U.S.-based developer dealing with a U.S. utility
4 providing needed energy to hard working American
5 customers.

6 Apex is committed to responsible development of
7 renewable energy facilities. To us that means
8 establishing long lasting relationships and ensuring that
9 our projects benefit both host and landowners and their
10 communities.

11 Below are some heartfelt quotes from some of
12 Apex project landowners. As much as we appreciate our
13 friends at Xcel, we could not have developed such a great
14 project without the overwhelming support of our project
15 partners.

16 Xcel Energy to own Dakota Range Wind Project.
17 I'm sure many of you saw this ad -- or this article last
18 September when we signed the deal. Xcel Energy, who will
19 own, operate, and use power generated by Dakota Range
20 Wind Project is a very reputable company.

21 As evidenced by the maps here, Xcel is not only
22 an established utility, they are highly regarded in the
23 industry and one of the nation's largest users and owners
24 of wind energy.

25 Xcel and MISO's ability to integrate electricity

1 from a -- Xcel and MISO's ability to integrate
2 electricity from a diverse set of generation sources
3 helps them maintain a reliable and stable grid. Xcel
4 Energy is transitioning its fleet to include more natural
5 gas, wind, and solar with a plan that keeps costs
6 affordable.

7 Industrywide, the employment of gas peakers and
8 continued practicality of advancing technology, such as
9 battery storage, are quickly addressing the intermittency
10 questions with renewables.

11 Dakota Range Wind benefits. This table shows
12 where the economic benefits will come to each community
13 on a 25-year projected tax revenue. So the left-hand
14 column illustrates all the different townships, counties,
15 and the right-hand column projects the totality over a
16 25-year period.

17 So South Dakota itself based on the nameplate
18 capacity tax will receive income of \$420,000 a year in
19 taxes over the lifetime of the project for 25 years;
20 \$10.6 million. Codington County, \$80,000 a year.
21 \$2 million a year in Grant County where most of this
22 project will be sited. \$280,000 a year. \$6.9 million
23 over the life of the project.

24 Benefiting South Dakota communities. In
25 addition to the aforementioned tax benefits, over its

1 25-year life Dakota Range will generate \$39 million in
2 lease payments to participating landowners.

3 Long-term jobs. Throughout the operation Dakota
4 Range Wind will employ about 10 full-time operations and
5 maintenance employees, creating approximately \$17 million
6 in wages paid to community members. In fact, the
7 country's largest growing occupation is wind turbine
8 technician according to the Bureau of Labor Statistics
9 with numbers expected to more than double over the next
10 decade.

11 Community outreach and support. Apex Clean
12 Energy is dedicated to being a strong community partner.
13 Dakota Range has been a regular contact with
14 stakeholders, including both counties, including their
15 highway superintendents, all involved townships, the
16 Punished Woman Lake Association, U.S. Fish & Wildlife
17 Service, South Dakota Game & Fish, Sisseton-Wahpeton
18 Tribe, SHPO, State Historical, the town of South Shore.

19 Dakota Range also has an active office in Summit
20 to provide information about the project and to answer
21 questions from the community.

22 Additional community support has included --
23 listed below.

24 I'd also like to mention Apex has reached out on
25 multiple occasions to the majority of groups that have

1 been most actively voicing opposition to wind energy. We
2 did not get a single accepted invitation to our various
3 offers to meet and inform these folks.

4 We talked about Apex's active involvement in
5 South Dakota. This slide shows Xcel has been also a
6 valued South Dakota contributor.

7 Serving the need in South Dakota. Creating
8 savings for South Dakota rate payers. Dakota Range Wind
9 is expected to save Xcel's South Dakota rate payers
10 millions over the lifetime of the project. The
11 anti-renewable narrative that wind is not cost-effective
12 simply is not accurate.

13 Wind lowers energy prices. Even unsubsidized,
14 the wind energy is the cheapest form of energy currently
15 available. This is a graph that compares the cost of
16 several different forms of power generation. This Lazard
17 analysis of the levelized cost of energy shows that wind
18 is very cost-effective.

19 Demand for renewable growth -- renewable energy
20 is growing. The market for renewables is stronger than
21 ever, and South Dakota is poised to take advantage of
22 increasing demand for renewables.

23 Below is a graph that shows the largest
24 renewable targets and estimated progress. These are some
25 of the largest companies in the U.S., including

1 Microsoft, Apple, Google, Facebook, et cetera. All of
2 these leading companies are active consumers of
3 renewables to meet their ambitious sustainability goals.

4 This trend has been realized by Apex in their
5 recent nonutility partners. I call them nontraditional
6 renewable energy buyers.

7 The military who fuels the majority of their
8 operation with diesel has been actively seeking to
9 purchase renewables to provide a secure, uninterrupted
10 form of energy for our nation's forces. As you can see,
11 we recently did a transaction with the U.S. Army.

12 Dakota Range meets all PUC requirements. As
13 required by our Application, it shows that South Dakota
14 Range Wind will comply with all PUC siting requirements
15 and will adhere to all applicable laws and rules, will
16 not pose a threat of serious injury to the environment
17 nor social and economic condition of the inhabitants or
18 expected inhabitants of the siting area, will not impair
19 the health, safety, or welfare of the inhabitants, and
20 will not unduly interfere with orderly development of the
21 region, with due consideration given to the views of
22 governing bodies of affected local units of government.

23 Apex follows an evidence-based approach. We
24 follow a rigorous standard as we conduct our assessments.
25 We rely on qualified peer review studies and scientific

1 research in the design of our facilities to ensure
2 compliance with all laws and regulations and to minimize
3 impacts to wildlife, people, and property.

4 We encourage interested parties to critically
5 consider information presented in a vague manner often
6 evidenced by discussions like studies have shown, experts
7 agree, and everyone knows. I like to call these
8 strongman arguments.

9 We also welcome any questions regarding the
10 scientific veracity of our evidence. We'd be happy to
11 provide citations clearly footnoted in these slides. As
12 desired, our door is always open.

13 Overcoming siting and setback challenges. A
14 complex range of factors go into where we can ultimately
15 site these turbines. These images demonstrate for many
16 different setbacks we account for when siting. In the
17 end there is very little land in windy areas that is
18 actually available for turbines.

19 The slide at the top, that's setbacks for rail,
20 followed by housing, nonparticipating property lines,
21 streams, ditches so on. So you can see we're left with
22 very little land to actually place these turbines.

23 Our goal is to deliver a compact, efficient
24 project footprint. Unnecessarily onerous setbacks would
25 actually make these projects more costly and would cause

1 very avoidable project sprawl.

2 We comply with all applicable laws and rules.
3 Below are some of the common county setbacks Apex has
4 either met or exceeded. We also voluntarily agreed to
5 set back from the Punished Woman Lake 2 miles.

6 Environmental analysis. Apex coordinated with
7 state and federal agencies to accurately assess potential
8 impacts and included supportive reports in our PUC file.
9 Apex conducted numerous environmental and cultural
10 studies to greatly minimize impacts to the environment
11 and its residents. Below is a sample of the agencies
12 Apex is actively engaged with.

13 Our VP that leads the environmental group,
14 Dave Phillips, as I mentioned earlier, is here to answer
15 any questions about our due diligence or our methodology.

16 Meeting project sound requirements. Codington
17 and Grant County requirements, see Table 10-1 of the PUC
18 Application. Apex's sound study demonstrates the sound
19 levels modeled at sensitive receptors in Codington County
20 ranged from 17 to 43 dBA. Sound levels modeled at
21 sensitive receptors in Grant County ranged from 22 to
22 45 dBA. This project meets or exceeds the sound
23 requirements within the county regulations.

24 So I mentioned decibels. Obviously, that --
25 dBA, that's decibel levels. So for a frame of reference,

1 how loud is too loud. Below are examples of decibel
2 levels of common generators. Our project sound levels to
3 nearby nonparticipant receptors falls between 40 to 60
4 decibels or below. And that's basically a whisper in
5 normal conversation on this scale.

6 Additional sound questions. Studies that focus
7 on the infrasound question are listed below and their
8 links. The Canadian study is by far regarded as the most
9 comprehensive analysis, which I have noted here.

10 Stephanie, she can raise her hand. She can take
11 your information if you want copies of this link or any
12 of the other footnotes as well.

13 Minimizing shadow impacts. Apex's design goal,
14 no more than 30 hours per year in nonparticipating
15 occupied structures. Apex's shadow flicker analysis
16 conducted to determine the duration of shadow flicker in
17 the vicinity of the proposed Dakota Range Wind facility
18 within Codington and Grant Counties. Shadow flicker
19 calculated at 189 occupied structures from wind turbines
20 resulting in the operation of proposed wind turbine
21 layout and alternative wind turbine locations.

22 Modeling results are conservative. Modeling
23 receptors are treated as structures with windows on all
24 sides, sort of a glass house assumption, and surrounding
25 area assumed to be without vegetation, trees, which is

1 apparently a glass house on bare earth. This is the most
2 conservative scientific method for gathering such data.

3 Our analysis results, which are also on the PUC
4 website, maximum expected annual duration of flicker at
5 nonparticipating receptors is 29 hours, 0 minutes.
6 Project design goal was met. And listed below are two
7 seminal studies that discuss the shadow flicker.

8 Wind turbines and property values. Regardless
9 of model specification, we find no statistical evidence
10 that home values near turbines were affected in the
11 postconstruction or postannouncement preconstruction
12 periods. That's a quote from the Berkeley study.

13 About the study. Researchers analyzed 51,276
14 home sales near 67 wind farms in 27 counties across nine
15 U.S. states. One cannot site a more comprehensive study
16 about this matter. Data was collected before, during,
17 and after wind farm construction. And in addition to
18 this comprehensive study, we'll also be submitting to the
19 PUC a rule-focused property value effect study, which
20 will be submitted, coupled with the previous analysis of
21 land values in Minnesota and largely errors and findings
22 of Berkeley Lab. The footnote is below.

23 In addition to the aforementioned, Codington
24 County Representative actually reached out to their
25 neighboring county's equalization office to discuss

1 property values since Buffalo Ridge Wind Farm was built
2 more than 10 years ago. Brookings County told Codington
3 County that they had just completed such an analysis on
4 243 home sites that were in and around the Buffalo Ridge
5 Wind Farm.

6 Their conclusion? Over the past decade 242 of
7 the 243 homes around this nearby wind farm increased in
8 value by an average of 58 percent. Now I understand
9 project opponents love to cite a flawed real estate study
10 done in Canada. However, I would rely on a South Dakota
11 analysis done on an established wind farm in a nearby
12 county as a better comparable.

13 Additionally, Codington County asked if
14 Brookings County has noticed any increasing health issues
15 in the decade since the project was built. A Brookings
16 County representative told Codington County, no, they had
17 not.

18 Dakota Range Wind technology. The turbine model
19 for Dakota Range Wind Project is the Vestas 4.2-megawatt
20 turbine. The performance and versatility of the
21 4-megawatt platform has been proven. More than
22 17 gigawatts installed in 35 countries since 2010.

23 Each turbine is connected to a supervisory
24 control and data acquisition SCADA system with fiberoptic
25 cable which allows turbines to be monitored in real time

1 by O&M staff. The Vestas de-icing system is also fully
2 SCADA integrated and can be triggered automatically or
3 manually, depending on the de-icing strategy of the
4 operator.

5 Now I included this slide for the edification of
6 the PUC. In the Clark County PUC hearing folks had
7 talked about met towers. And I wanted to include that
8 slide to cover that question as well.

9 Included is a typical picture of one of our met
10 towers. As you can see, these have the interval
11 orange -- FAA orange it's called -- and marker balls as
12 well.

13 There's going to be five permanent met towers as
14 part of this project. Each met tower will occupy an area
15 of approximately 42 feet by 42 feet or 0.3 acre or less
16 if guy-wires are not employed.

17 Turbine technology continues to improve. Wind
18 energy projects will require less and less land in the
19 future. A project of this size 10 years ago would have
20 required approximately 200 turbines. This project will
21 comprise of just 72.

22 The cost of wind energy will continue to fall
23 because of these efficiencies. Because of future
24 advancements in turbine technology will cause these
25 numbers to shrink even more in years to come, developers

1 in North Dakota are already planning to repower projects
2 with fewer, more efficient turbines.

3 Our community-based compensation model is
4 designed to ensure that communities benefit broadly from
5 facilities, even if fewer turbines are needed.
6 Landowners generate lease income largely from the amount
7 of acres they have in the project versus the amount of
8 turbines they host. This avoids what we like to call the
9 winners and losers scenario where only the turbine hosts
10 receive real significant income from the project.

11 The future of South Dakota range wind -- the
12 future of Dakota Range Wind.

13 I hear you, baby. I'm almost done.

14 Postconstruction and safety commitments. The
15 anticipated life of the project is approximately 25 years
16 but could be extended through the retrofitting,
17 repowering, or other upgrades to existing components.
18 The project will be decommissioned in accordance with all
19 applicable local and state requirements, as well as
20 requirements set forth in the easement agreements with
21 our landowners. A decommissioning plan for the project
22 is included in the PUC Application, Appendix P.

23 The construction contractor will provide
24 training as well as site maps, haul routes, schedules,
25 contact numbers, and other information to local emergency

1 contact management. During operations a Dakota Range
2 Wind operator will coordinate with local and county
3 emergency management to protect the project and the
4 project facilities in the event of natural, manmade, or
5 other incidents.

6 Dakota Range will register each turbine location
7 and the O&M, operations and maintenance, facility with
8 the rural identification address and fire number and 911
9 systems. Minimum of one year of continued bird/bat
10 monitoring will also take place.

11 The counties have oversight regarding the
12 operation of this project. If violations against the
13 county or state ordinances occurs, the host counties have
14 stated that operations would likely be curtailed until
15 those issues are corrected. And the Codington County
16 Commissioners were very forceful on this issue as well,
17 and I spoke to them a couple of weeks ago.

18 In conclusion, it's my hope that as we exchange
19 information during our public comment period that we can
20 do so in an orderly, compassionate manner. Whether
21 you're for or against this project, we should submit our
22 comments in a respectful order. You are all neighbors
23 first.

24 Thank you.

25 CHAIRMAN FIEGEN: Thank you. We will now go to

1 the public input comment portion of our meeting tonight.
2 There were 40 people that actually raised their hand.
3 Jon Thurber over here will be timing four minutes.

4 Just a reminder. Speak slowly, state your name,
5 and then spill your -- spell your name for our court
6 reporter, Cheri.

7 Cheri is the one that determines when we go on
8 break. Because as a court reporter you do need a break.
9 So she will let us know when we'll go on break. So,
10 Darren, you have the mic ready to go?

11 And so the first person that would like to start
12 the comments, we're ready for you.

13 MR. STENGEL: I didn't know that I was going to
14 be first. But, Mr. Chairman, members of the South Dakota
15 Public Utilities Commission, my name is Leonard Stengel,
16 and I live in Milbank. I was born and raised --

17 CHAIRMAN FIEGEN: Could you just wait one
18 second. Do you mind spelling your name slowly for our
19 court reporter. And I will give you another 30 seconds
20 to do that. Jon, stop the timer.

21 MR. STENGEL: I'm afraid this is going to roll
22 away on me.

23 The name is Leonard Stengel. L-E-O-N-A-R-D.
24 Stengel, S-T-E-N-G-E-L. I'm a resident of Grant County,
25 born and raised in this area, and I have land which is

1 recorded in the maps here as Riverview Estate, which is
2 the name that I use for my farmland that I own.

3 I first owned land in Farmington Township in
4 1952. Again I bought some land in '57. Later I bought
5 land in the Mazeppa Township in 1958, which is the land
6 under contract with Dakota Range at the present time.

7 We have had pleasant working relations with
8 Dakota Range and find the people in this area very
9 helpful, and they're good neighbors to get along with.
10 And to the best of my knowledge we have had no trouble
11 promoting wind in this area.

12 I was first exposed to the wind farm in 2006.
13 At that time I was 84 years old and looked forward to
14 receiving a little wind power money for my final
15 retirement. I'm still waiting and will be 96 years old
16 at my next birthday.

17 Summit school is building on, and we need help
18 with the township and county roads. We need financial
19 support. We have young people going to college. All
20 this requires money, and we look forward to this help.

21 We have had a lot of wind -- we do have a lot of
22 wind energy to spare, and we encourage the South Dakota
23 Public Utilities Commission to grant the permit for the
24 Dakota Range project.

25 I personally encourage and support the final

1 approval of the project. And my son, who is in with me,
2 is here today to kind of give me a ride and pilot me
3 around, and he'd like to say a word at this time. My son
4 is David Stengel. D-A-V-I-D, David. Still Stengel.

5 CHAIRMAN FIEGEN: Thank you, Leonard. We'll go
6 to number two.

7 MR. DAVID STENGEL: Commissioners, thank you for
8 coming. It's quite a wonderful illustration of the
9 democratic process to be a part of something like this.

10 I would just like to briefly say that as a boy I
11 grew up on these farmlands lifting heavy hay bales and
12 clearing heavy rocks, and my thinking is that if we can
13 learn to farm wind instead of heavy rocks, it has my
14 support.

15 CHAIRMAN FIEGEN: Thank you. And I remember
16 picking up rocks on the farm. That's what he said.

17 Number three.

18 MS. HOLBORN: Thank you. I'm Ruby Holborn,
19 H-O-L-B-O-R-N, from Gary, South Dakota. My husband and I
20 are small acreage owners in Deuel County and belong to
21 the new statewide organization named South Dakotans For
22 Safe Responsible Renewable Energy.

23 It appears the local ordinance for Dakota Range
24 I and II are at odds with the manufacturers's recommended
25 turbine safety zones. Appointed and elected county

1 officials are setting wind ordinances fashioned by the
2 wind developers with little or no consideration regarding
3 our health, safety, and welfare. Dare I mention the
4 negative impacts on residential property values.

5 Big government mandates and production tax
6 credits with the aid of the wind developers have ripped
7 our community to shreds. Many of us have lost our
8 neighbors and friends.

9 On March 10, 2018, my husband visited with
10 Senator John Thune. Senator Thune was unable to offer
11 any solution to this problem, and he did not offer to
12 live in a wind farm. For some reason often the rural
13 nonparticipants have closer turbine settings to their
14 homes than the participants. Consequently many of the
15 landowners are upset with each other.

16 We should never have to pay taxes on property we
17 are unable to use due to the turbine placement on
18 adjacent properties. Quiet enjoyment of one's property
19 should not be taken casually by wind developers through
20 government fiat.

21 When an adjacent landowner has turbines on its
22 property all of its negative effects should remain on its
23 property. This is accomplished by further setbacks.
24 Does this Application unequivocally abide by manufacturer
25 safety zones?

1 Some of our neighbors are concerned about their
2 family's well-being. Often when a turbine is sited too
3 close to children they may become sleep deprived. This
4 can have a negative effect on their cognitive learning
5 skills for the rest of their lives. Does this mean the
6 schools will use the money to hire additional special
7 education teachers?

8 The wind company operates in different places
9 with different people but with the same outcome.
10 Wherever the turbines appear, problems accompany them.
11 This is all for the promise of more money. Since high
12 school I dreamed of living in the neighboring
13 Deuel County. I viewed it as a beautiful, quiet
14 community full of streams, rolling hills, and oak trees.
15 Like areas here near Waverly, it is within one of the two
16 ecoregions of the South Dakota, the Prairie Coteau. I
17 cannot convey with words how much my husband and I have
18 enjoyed living where we live.

19 In 2008 I retired, and my husband and I were
20 blessed to be able to build our retirement home by the
21 landscape we love by Gary, South Dakota. We had owned
22 property in Deuel County for more than 40 years so we
23 knew that this is where we wanted to retire.

24 We both were raised on South Dakota farms. We
25 were blessed to make wonderful friends. It had been

1 paradise in every way, just what retirement should be.
2 But now many of our new like-minded friends are now
3 leaving the county. This exodus began nearly a year ago.

4 They are moving to places unlikely to have wind
5 turbines; Northern Minnesota, full of trees and lakes,
6 and even Harmony, Minnesota, the sinkhole of the U.S.,
7 Hot Springs, South Dakota where there's very little wind
8 and their property is adjoined by the national forest.

9 And, yes, my husband and I, we will be moving to
10 Sioux Falls. This is where the wind developers and the
11 politicians seem to live. We do not know how many
12 hundreds of thousands of dollars it will cost us to
13 extricate ourselves from Deuel County, but we will let
14 you know.

15 People moving out of the community do not bring
16 development to main stream. Few will be enriched while
17 many taxpayers and rate payers will be impoverished.
18 This renewable wind energy project is marketed and
19 mandated only for economic development and the promise of
20 more money.

21 This Application should be denied until health
22 professionals educated on the adverse health effects
23 caused by the industrial wind turbines are included in
24 our wind energy ordinances and permitting processes.

25 My husband and I and others like us are forced

1 to either live among the turbines with no consideration
2 regarding our health, safety, and welfare or leave,
3 paradise destroyed.

4 CHAIRMAN FIEGEN: Thank you, Ruby.
5 Number 4. Thank you.

6 MR. HOLBORN: My name George Holborn from
7 Gary, South Dakota. H-O-L-B-O-R-N. Sorry.

8 Wind developers' paid experts have claimed for
9 years what you can't hear can't hurt you. The wind
10 industry has known this for more than 35 years.
11 Dr. Neal Kelly found people complained as far as
12 1.8 miles away from the nearest turbine about
13 sleeplessness, headaches, and nausea.

14 Those kind of miseries were linked to a
15 2.0-megawatt turbine in this application. I'm told the
16 wind developer here is proposing turbines as large as
17 4.2. There are no 4.2 turbines operating in South Dakota
18 or Minnesota.

19 What I'm about to tell you is new. As far as I
20 know, at least to me, it's less than a year old. There's
21 some work done by Steven Cooper, and he has taken
22 Dr. Kelly's study a step further. He found dBA does not
23 work. It is correlated well with wind speed, Cooper
24 says, but not with noise from the turbine. This is so
25 important. It was not until we tried the complaint, says

1 Cooper, versus the infrasound that the sensation came out
2 as a major impact. We tried plotting the greatest level
3 of sensation. That is, when the residents actually left
4 their properties or wanted to leave and found matters of
5 disturbance related to power output.

6 I understand someone suggested installing fewer
7 larger turbines and feathering or repowering. Cooper's
8 work seems to indicate that may not be a good idea. You
9 would be using nonparticipants as test subjects without
10 their knowledge. And this is really crucial, as Cooper
11 continues. What we have found is we can present the
12 inaudible wind turbine noise and get a reaction while we
13 can provide inaudible road traffic noise or wind noise at
14 similar levels and not get any reaction.

15 For the people who are adversely affected by
16 wind turbines to the extent that it affects their daily
17 lives, in extreme cases causes them to abandon their
18 homes, it is clearly a problem.

19 So Cooper has identified and can reproduce the
20 industrial wind turbine's signature. This next quote is
21 even more important. "It appears the residents report a
22 greater sleep disturbance over time, and more people have
23 had to abandon their homes." Because of Cooper's
24 research, medical studies are now available to confirm
25 the actual impact on people that live among the turbines.

1 Until those studies are completed, the precautionary
2 principles should be applied, that being a moratorium.
3 Do no harm. People need to come before profits.

4 For example, at a county commission meeting in
5 Clear Lake, South Dakota a wind developer representative
6 talked on and on about 30 hours of flicker. Finally one
7 of the commissioners asked him if it's such a small
8 amount, why don't you turn the turbines off? After a
9 brief pause, the wind developer replied, That would
10 affect the profitability of the project.

11 What about the profitability and the adverse
12 health effects of the people who are forced to live among
13 the turbines?

14 Cooper concludes with seven questions needed to
15 be answered by the regulatory authorities in relation to
16 the criteria that those authorities have issued to permit
17 wind turbines to operate in proximity to residential
18 receivers.

19 I'll read three of them. The most common
20 complaint from residents relates to sleep disturbance.
21 Please provide the studies of wind farm noise that
22 identifies the noise that gives rise to sleep
23 disturbance. Number two, please provide studies of wind
24 farm noise that identify the noise level that will not
25 give rise to sleep disturbance. In light of the above,

1 please identify who would be liable in a damage claim to
2 the consequences of adverse impacts.

3 Sorry.

4 CHAIRMAN FIEGEN: Thank you, George.

5 MS. REDLIN: Hi. My name is Diane Redlin. I
6 live in South Shore. I've lived in the area for most of
7 my life.

8 And before I go on, who are the people we can
9 talk to and who are the people we can't?

10 CHAIRMAN FIEGEN: The four of us in front. So
11 your three Commissioners. And Karen is the Commission
12 attorney so she advises the three of us separately, and
13 so you can't talk to our Commission attorney.

14 That table in the back, you can talk to them
15 during the meetings. Right now you can talk to all of us
16 because it's a public meeting.

17 MS. REDLIN: Okay. You know, I just wanted to
18 know. R-E-D-L-I-N, D-I-A-N-E. R-E-D-L-I-N.

19 I want to thank you for letting people at least
20 come so you know what our concerns are, and I hope you
21 take them into consideration. That was a great
22 presentation.

23 I don't know if there were other things that
24 weren't true, but I do know that you stated that the
25 City of South Shore and the Punished Woman Lake

1 Association are supporting the project. No. That was
2 never voted on. You sent a letter up that was written by
3 Dakota Range, as if it were written by the president of
4 our lake association for him to sign, and we had a
5 meeting and, no, we did not sign it.

6 We have a beautiful lake with eagles and wood
7 ducks and geese and ducks that migrate, and we don't
8 want -- I mean, for myself and I know that the lake
9 association, nor the city has not said anything or voted
10 that they are in support of it.

11 So that's all I'm wanting to say.

12 CHAIRMAN FIEGEN: Thank you, Diane.

13 MR. GAPP: Hello. My name is Tim Gapp, G-A-P-P.
14 I am a resident of Summit, South Dakota and a landowner
15 in Grant County, South Dakota.

16 Wind development has been a goal of many of the
17 landowners in the Farmington Township and in our area for
18 over a decade. We've always known we've got a great wind
19 resource here, but we've lacked the infrastructure to be
20 able to transport it out.

21 With the development of Otter Tail Big Stone
22 Ellendale power line we now have that ability and can
23 finally get to the point where we can get the electrical
24 power to the demand.

25 The wind development can provide several

1 benefits in our area. First of all, it provides
2 renewable energy with no emissions. That's an important
3 part in my book. Provide an annual income source for
4 landowners at a time when additional income can be
5 essential to the survival of local farmers. And with the
6 low farm prices we are seeing right now, any kind of
7 additional income would be very beneficial.

8 We do have people out here trying to make a
9 living and trying to make things work, as well as people
10 who are retiring and enjoying the aesthetics of the
11 area.

12 The income the landowners receive is a
13 community-based model. Now that community-based model
14 will provide income to all of the landowners who are
15 signed up within the wind farm footprint. So it's not
16 again just a handful of folks. It goes to a larger share
17 of the folks who are landowners in the area.

18 It also provides additional tax revenues for
19 local governments. Mentioned that there's projects in
20 schools. There's townships and counties in these rural
21 areas that sure could use that. It also provides
22 construction jobs and some permanent jobs in our area as
23 well.

24 All of these benefits are critical to the
25 survival of our small towns and our rural way of life in

1 South Dakota, which seems to be continuing to
2 disappearing.

3 Dakota Range Wind has sponsored many community
4 events in my community and donated to community projects
5 in other communities as well. Some of the projects have
6 been the Summit daycare facility, the Summit school gym,
7 and the volunteer fire department.

8 I feel Dakota Range has demonstrated that they
9 intend to be good neighbors and they've proved it to us
10 and hopefully can be good neighbors which will continue
11 into the future as well.

12 So I personally strongly support approval from
13 the PUC, and I thank you very much for your time.

14 CHAIRMAN FIEGEN: Thank you.

15 MR. SOREN: Thank you. My name is Wayne Soren,
16 S-O-R-E-N, and I'm the vice president of the South Dakota
17 Farmers Union.

18 Members of the committee, thank you for the
19 opportunity to express our positions for the Dakota Range
20 Wind farm. South Dakota Farmers Union works to promote
21 the interests of farmers, ranchers, and their families.
22 We work hard to advance the sound and beneficial
23 agricultural policies. The South Dakota Farmers Union
24 has policy that supports the development of wind energy,
25 and we support landowners' rights to develop their

1 property.

2 Agriculture has been the backbone of the rural
3 communities so when landowners, farmers, ranchers do
4 well, so do their communities. Wind farms provide a
5 unique opportunity to use our natural resources to bring
6 opportunity and stability to farmers and ranchers and
7 landowners, rural governments, and communities where they
8 live and do their business.

9 America's the greatest country in the world and
10 agricultural community has been that backbone of this
11 country throughout its history. We honor that history by
12 fighting every single day for farmers and ranchers and
13 their rural way of life.

14 South Dakota Farmers Union was a major
15 contributor in the development of the White Lake Wind
16 farm near Plankinton, South Dakota. This project, along
17 with South Dakota businesses that supplied goods and
18 services to the wind industry, support nearly 2,000
19 good-paying jobs in our state.

20 Better yet, there are numerous wind power
21 projects being planned across our state, and if built,
22 these wind farms will attract billions of dollars of new
23 private investment, millions of dollars of new revenue
24 for farmers in rural communities, and thousands of new
25 jobs, many of which will be trained right here in

1 South Dakota at Mitchell Vo-Tech.

2 Today I'm proud to say that South Dakota is one
3 of only two states where the wind power provides over
4 30 percent of in-state power generation. That's power
5 that the whole region can count on. The growth of wind
6 power in our state and region did not happen overnight or
7 without careful planning and advanced -- and advancements
8 in technology.

9 Wind works well with South Dakota's other major
10 power resources, such as hydroelectric, coal-fired,
11 natural gas-powered plants, adding to our fuel diversity
12 and reducing our reliance on imports.

13 Beyond keeping electricity prices stable, wind
14 power can also benefit the families, communities who host
15 the projects on their land. Wind farms now pay
16 approximately \$5 million each year in lease payments,
17 creating a new drought resistant revenue stream that can
18 help family farmers and ranchers withstand market
19 fluctuations in crop prices.

20 Renewable power is provided -- it's worked
21 throughout the Great Plains of South Dakota is committed
22 to keeping the state open for more wind development.
23 Renewable wind energy sector is one of the fastest
24 growing in the nation, and renewable energy will continue
25 to play a critical role in creating new jobs and the

1 growth of our state economy.

2 As wind power has grown to nearly one-third of
3 our energy production, our grid is reliable as ever. And
4 with this experience in mind I and the South Dakota
5 Farmers Union will continue to support the expansion of
6 renewable energy in South Dakota.

7 Now I've heard some of the objections to wind
8 farms, and I want to respond to a couple of them. I have
9 served on the South Dakota Wind Partners Board of
10 Directors --

11 CHAIRMAN FIEGEN: Excuse me. I'm sorry. If you
12 can hand your comments in, we will read the rest of them.

13 Thank you.

14 MR. SOREN: I surely will. Thank you.

15 MR. LYNCH: Thank you.

16 Hi. My name is Patrick Lynch, that's
17 P-A-T-R-I-C-K, L-Y-N-C-H, and I live just a few miles
18 north of Waverly.

19 So I guess communities in general are built to
20 support the people living in and around them, and people
21 in turn support the community. People is the key word
22 here because only with them do you have a healthy and
23 thriving community.

24 In the beginning it was the small crop and dairy
25 farms that provided the people in our communities. But

1 as the industry industrialized or you were forced to go
2 larger to compete and new machinery came out and we were
3 able to do more with less people, that shrank the farming
4 community and in turn that shrank your communities
5 because there's less people out in the area to support
6 those small town communities.

7 And I feel like lately we have a great
8 opportunity to change that. Now with high speed internet
9 you can work from home for many, many companies. I work
10 for a company, Daktronics, in Brookings that offered many
11 of its employees the opportunity to work from home. And
12 that's the main reason that spurred me and wife's search
13 to look for a property and move back out into the
14 country. Because we had that opportunity.

15 And we ended up buying the property out here.
16 And since we've done that we talked to each other and we
17 have a lot of friends and other people we know that would
18 like to move out into the country now that that
19 opportunity is out there. Like it just didn't exist
20 10 years ago where you didn't have the opportunity to
21 work from anywhere.

22 Literally now in today's environment you can
23 work from anywhere. You could work for a company in
24 California, and you can work right from South Dakota.

25 And the key is that you need people to build

1 communities. And in the real estate industry they do
2 something called a comparable. It's where you take a
3 piece of land, and you take a house. And then now take
4 that same exact house and that same exact piece of land
5 and now put a wind tower next to it that adheres to your
6 50 dBA rule and your 1,000-foot setback, right, and you
7 put the same price tag on those two houses; right?

8 And you ask the person to choose Where are you
9 going to live? Are you going to live in this house with
10 the wind tower even though it adheres to all of these
11 rules, or are you going to live in this other property
12 without the wind power? And most likely you are going to
13 choose to live in the other property without that wind
14 tower.

15 That's the main way that property values are
16 affected. It's just not wind towers. It's any large
17 object. It's called an obless [sic] I think the
18 realtor -- realty. So you could have high power lines,
19 anything like that that affects how desirable a property
20 is.

21 So I think it's going to in the end hurt these
22 small communities like South Shore and Waverly because
23 people like me that are moving back out into the country
24 that can live and work anywhere because of the high speed
25 internet connection, we're going to look and we're going

1 to compare and we're just simply going to decide not to
2 move into areas with things that we don't see as
3 desirable in them. And, most likely, everybody else that
4 has the option to live anywhere is not going to move into
5 an industrial wind farm.

6 So in the end I think you're going to end up
7 with less people in your communities, and you're going to
8 end up hurting these small communities.

9 CHAIRMAN FIEGEN: Thank you.

10 MR. LYNCH: Thank you.

11 MS. LINDGREN: My name is Linda Lindgren.
12 That's L-I-N-D-G-R-E-N. And I live with my husband on
13 our farm 3 and a half miles south of South Shore.

14 He has lived on this farm all of his life. I,
15 on the other hand, am new to the area as I moved here in
16 2013. I am daily amazed by the natural beauty all around
17 us, the wild turkeys, deer, and pheasants, and the geese
18 flying overhead, rolling hills and open skies and
19 pastures and fields going on seemingly forever.

20 Yesterday I saw a bald eagle between South Shore
21 and our home. The wild turkeys seen at times do come
22 around daily in our area. We soon might need a turkey
23 crossing sign on the road in front of our house.

24 Wildlife is so beautiful and essential to our
25 fragile ecosystem, so important, in fact, that there is a

1 law against killing bald eagles. Do any of you know what
2 the penalty for killing a bald eagle is? I will tell
3 you.

4 If a nondeveloper kills a bald eagle, the fine
5 is up to \$250,000. And the person can face up to
6 two years imprisonment. A story in the Washington Times
7 reports that, bald and golden eagles may be legally
8 killed or injured in the thousands by high speed turbines
9 reaching 170 miles per hour. Under new regulations
10 released by the Obama administration, the rules which
11 affect individual wind energy companies that plan to
12 operate the technology for up to 30 years allows up to
13 4,200 of the birds to perish. The U.S. population of
14 bald eagles stands at roughly 143,000 while the Fish and
15 Wildlife Service puts the number of golden eagles at
16 40,000. 4,200 endangered bird deaths per company is
17 bigger than it sounds. There are nearly a dozen such
18 companies, which means for 10 a whopping 42,000 bald and
19 golden eagles are permitted to be killed by wind
20 developers. The 4,200 limit is vague. Wind developers
21 can break up their corporations into smaller ones.

22 I am amazed at all the money people spend to
23 travel to our area to go hunting and fishing. It is
24 something they enjoy, and it is a good way to share the
25 beauty of our area, and the money that comes in helps

1 support the beauty without changing it. Money is spent
2 on hotel rooms, meals, equipment, and travel.

3 Wind towers will greatly affect the draw that
4 our beautiful state has to offer. Less animals to hunt
5 because of the damage to the ecosystem and less beauty
6 with the wind towers higher than the Statue of Liberty
7 marring the beautiful and natural landscape.

8 Wind power is not green. I always thought that
9 wind power was green. After all, wind is free and
10 natural. In fact, when you study the effects of wind
11 towers and what goes into them, you will see it is just
12 the opposite.

13 You need a good wind, of course, for wind power.
14 You also need petroleum and natural gas and coal. It
15 takes tons of coal to make the steel for these giant
16 towers, petroleum for the blades. To keep everything
17 inside the tower working smoothly, you need lubrication,
18 which means oil. Making these towers requires tons of
19 rare earth minerals, which are mined in China. Obtaining
20 these minerals creates major damage to the --

21 CHAIRMAN FIEGEN: Thank you. Oh, I had you at
22 4:12. So you have another 10 seconds. I rudely
23 interrupted you. I'm sorry.

24 MS. LINDGREN: How is using tons of fossil
25 fuels, rare earth minerals, and oil to make and maintain

1 these huge towers going green? They harm the
2 environment, people's health, and the ecosystem. Please
3 do the research and don't be fooled.

4 CHAIRMAN FIEGEN: Thank you, Linda. I'll work
5 on my timer a little bit better this time.

6 All right. Go ahead.

7 MS. LAU: Hello, everyone and good evening. My
8 name is Alexis Lau. A-L-E-X-I-S, L-A-U.

9 My family has land in the Dakota Range Wind
10 Project, and my dad works for Apex Clean Energy so seeing
11 this project take place would be my dad's dream. He grew
12 up in Summit, South Dakota and is a vital part of the
13 community and serves on the Summit Volunteer Fire
14 Department.

15 Apex has supported the local community and
16 school at Summit with a donation to their Wellness Center
17 as well as a donation to the Summit School History Club.
18 This made it possible for the students to go to
19 Washington, D.C.

20 As a freshman at Northern State University, I'm
21 concerned about the future for our youth. Most recently
22 there have been groups that come from out of town trying
23 to shut down this project. Some of these people may not
24 be around for another 25 years, but I will be. I may be
25 raising a family and would want to really see this

1 project take place and be built of how great it would be
2 for my family's financial future. The economic impact on
3 the United States is about \$20 billion.

4 Compared to conventional energy, wind energy has
5 very little negative impact on the environment itself.
6 Wind energy is very safe and healthy. The environment as
7 well doesn't create any direct carbon emissions. Wind
8 energy will not create any global warming so it could
9 also benefit with our future generations. The turbines
10 also take up very little space over the land. In recent
11 years wind energy compared to conventional energy has
12 been significantly cheaper pricewise too.

13 This energy project could create many more job
14 opportunities available for many people as well. The
15 United States has a vast domestic resource and highly
16 skilled workforce and can complete -- and can compete
17 globally in a clean energy economy.

18 Dakota Range Wind will put much needed tax money
19 into our local communities and schools. I want to see
20 this project be built. Don't let others who have nothing
21 at stake tell us what we should or shouldn't be doing
22 with our land.

23 I would like to ask the Commission to approve
24 the permission -- the permit for the Dakota Range Wind
25 Project.

1 Thank you.

2 CHAIRMAN FIEGEN: Thank you.

3 MR. DOLEN: I'm Jamie Dolen. I am from
4 South Shore. J-A-M-I-E D-O-L-E-N. I represent the town
5 of South Shore, and I also am the president of the lake
6 association of Punished Woman's Lake.

7 In the proposed Application it did state that it
8 was a voluntary act of 2 miles. I have some
9 disagreements with that. It's too long to go into, but
10 what I would like to ask is that the town of South Shore
11 and the Punished Woman Lake Association propose that it
12 would be a mandatory, instead of voluntary, 3 miles of
13 the water's edge and the town boundaries.

14 Our concerns for that reason are because of the
15 aesthetic beauty of the land. South Shore is basically
16 in a bowl all around the hills. And so for a long ways
17 you're going to see them.

18 The possible noise concerns, the possible growth
19 of the town. Our school is growing like crazy along with
20 everything to go with it.

21 Protection of the wildlife. We have GF&P lands
22 all around us, state lands, federal lands, and we hope
23 to -- and that would help protect that.

24 When the landowners signed up for their contract
25 close to the town of South Shore and Punished Woman Lake

1 no landowners came to the town or the lake association
2 and asked our thoughts or concerns.

3 As a representative of the town of South Shore
4 and the Punished Woman's Lake, we are asking politely for
5 the mandatory -- wording of mandatory of 3 miles from
6 town boundaries and water's edge. We feel that there is
7 more than enough land to be used for wind towers between
8 going west from South Shore to Florence. Maybe the
9 wind's not the greatest, but I'm pretty sure it's windy
10 all the way across. We do not feel by asking for 3 miles
11 there would be no impact in their ability to establish a
12 wind farm.

13 Thank you for your time.

14 CHAIRMAN FIEGEN: Jamie, could you tell me --
15 you said you were a representative of South Shore. Is
16 that official capacity?

17 MR. DOLEN: Yes. I am on the town council of
18 South Shore.

19 CHAIRMAN FIEGEN: Thank you. Appreciate that.
20 So that's for the record. Thank you.

21 MR. NEWCOMB: Jim Newcomb, N-E-W-C-O-M-B. And
22 I'm a developer. We have another project close by here.
23 It's called Summit Wind.

24 And particularly of note I want to say that I
25 started working wind in this area in 2006, so I've been

1 around here and around the people and around the concerns
2 and doing my research.

3 And I decided I should do some research about
4 one particular issue. It's called infrasound. And it's
5 about the sound that can be very upsetting to people and
6 just what is this sound? Where does it come from, and
7 what -- how serious is it? Are we dealing with feelings,
8 or are we dealing with facts?

9 So I can understand the fear of health issues.
10 It's tough enough just getting old, let alone having
11 another added risk to keep us awake at night. There's
12 been a long discussion on noise from wind turbines
13 affecting our health. It matches up with concerns we've
14 had with microwaves and transmission lines.

15 You recall that where microwaves were going to
16 be a big issue. A lot of concern, a lot of risk, a lot
17 of unknowns. Pretty soon they became accepted and found
18 to be safe. And similar with transmission. So it's easy
19 to attribute a fear of poor health to chances
20 occurring -- changes occurring around us.

21 Stress is involved. Fear is involved. It's
22 like the first time I operated a combine. There was a
23 lot of stress and fear when I took ahold of the controls.
24 I had some encouragement. And I was assured that I could
25 be successful and I was but I based it on somebody else's

1 work, not on my fears.

2 And so the first research I did was on the site
3 that was mentioned here earlier and in the Grant County
4 Review about wecaresouthdakota.org/research. There's a
5 library there, and the research suggested -- is suggested
6 by this anti-wind group, which was successful in
7 deterring wind development in Lincoln County.

8 And Lincoln County, in my perception -- I grew
9 up near Sioux Falls. And now it is a very heavily
10 populated and a higher base location than it is here. I
11 perused some of this library. There is some good
12 information, and there's some clearly out of date. It's
13 incomplete, and it's irrelevant. Some of it is in this
14 library.

15 So here's another source that I think is much
16 better, and I've got -- I've got these sources on my
17 paper here, and I've given staff a copy of my pages. So
18 from the Atlantic -- or I'm sorry. Yeah. From the
19 atlantic.com science archive, one of the researchers,
20 Nina Pierpont, P-I-E-R-P-O-N-T, Nina Pierpont, has
21 changed her conclusion about infrasound and based it on
22 facts and not feelings. She said there was -- the focus
23 was too much on symptoms rather than causes.

24 Another fellow by the name of Jeff Levanthall,
25 L-E-V-A-N-T-H-A-L-L, he's a senior UK acoustician, gave

1 us an example. He said, The proportion of sleep
2 disturbance which people attribute to wind turbines is
3 not very different from the proportion of sleep
4 disturbance reported in general, about 30 percent. So a
5 lot of people waking up during the night --

6 CHAIRMAN FIEGEN: Jim, we've actually went four
7 minutes. But I didn't catch where you were from, for the
8 record.

9 MR NEWCOMB: Okay. I'm from Red Feather Lakes,
10 Colorado. And I work here -- I've been working here
11 since 2006.

12 CHAIRMAN FIEGEN: So your residence, for the
13 record for Cheri, is -- I'm sorry -- Colorado? Red
14 Feather Lakes, Colorado.

15 Thank you. Appreciate it.

16 All right. Thank you.

17 Sir, your four minutes is up.

18 MR. NEWCOMB: Okay.

19 CHAIRMAN FIEGEN: In fact, we're over. Thank
20 you.

21 MR. JOHNSON: All right. I'm Levi Johnson,
22 L-E-V-I J-O-H-N-S-O-N. I'm currently enrolled at Lake
23 Area Tech where I'm in the energy operations program, and
24 I'm going to be reading this letter on behalf of Kenneth
25 Kittelson, who's currently in Arizona.

1 "Dear Public Utilities Commission: Thank you
2 for the opportunity to express my opinions of the Dakota
3 Range Wind Project. I have lived in Codington County for
4 over 30 years, and I am excited for the economic impact
5 this project will have on our community.

6 "The project will benefit not only the
7 landowners participating in this project but also all
8 citizens of Grant and Codington Counties and will help
9 the overall health of the state by reducing pollutants
10 and carbon dioxide emissions in the air.

11 "I ask the Commission to vote in favor of the
12 project and put the interests of the citizens and future
13 generations first in this decision.

14 "Dakota Range Wind will bring in tens of
15 thousands of dollars, which our community can use to
16 improve our schools and infrastructure and give citizens
17 some much needed tax relief. I know many of the farmers
18 in this community have struggled over the last few years.
19 This will give them a continuous and predictable stream
20 of income.

21 "The project will also allow the county to not
22 raise taxes in the near future because of the payments
23 the county will receive from the project. As a result of
24 the tax payments from this wind project, it will allow
25 the county to hold the line on property taxes.

1 "The developer of Dakota Range Wind, Apex Clean
2 Energy, is a reputable organization, and the Dakota Range
3 Wind team has proven to be competent and transparent in
4 their years of working with the community members. From
5 researching their previous projects, it is clear that
6 quality, safety, and integrity are core principles of the
7 organization.

8 "I ask the Commission to vote for a brighter
9 future for South Dakota and to vote in favor of Dakota
10 Range Wind. Thank you. Kenneth L. Kittelson, president
11 of the Broken K Ranch, Incorporated from Henry,
12 South Dakota."

13 (Discussion off the record.)

14 CHAIRMAN FIEGEN: So we'll take two more, and
15 then we're going to take a break.

16 MR. MEYER: Hi. My name is Vince Meyer,
17 M-E-Y-E-R. I'm from Grant County. I'm asking you to
18 deny the Dakota Range Application because the turbines
19 will affect the health and safety of my community.

20 On Tuesday of this week the Grant County
21 Commissioners were asked to sign a letter of support for
22 the Dakota Range project. They refused. In addition,
23 they are considering a resolution for safer setbacks
24 because the industrial wind turbines may not fit with our
25 county zoning ordinances.

1 Here are a few of the issues:

2 "Whereas, Grant County Compiled Zoning Ordinance
3 dated 1-25-2018, Section 103 are adopted for the
4 promotion of the public health, safety, morals, or
5 general welfare.

6 "Whereas, Grant County Compiled Zoning Ordinance
7 1-25-2018, Section 1211.101 WES, protects the health,
8 safety, and welfare of Grant County citizens.

9 "Ordinance 2004-1 REV-204-1G. Whereas,
10 industrial turbines near where people live, work, and
11 enjoy recreation is a human health hazard. October 14,
12 2014, the Brown County Wisconsin Board of Health declared
13 the Shirley Wind Farm a human health hazard. Pierpont,
14 M.D., Ph.D., 2010, Wind Turbine Syndrome. Chapman, Facts
15 About The Industrial Turbine Noise.

16 "Whereas, Grant County Compiled Zoning Ordinance
17 dated 1-25-2018 does not address flicker, strobe light
18 sensation, vibercosis [sic], infrasound, stray voltage,
19 and the effects on human and livestock health.

20 "Whereas, Grant County Compiled Zoning Ordinance
21 dated 1-25-2018, Section 1101.01, defines the purpose of
22 an agricultural district. This district is established
23 to maintain and promote farming and related activities
24 within an environment which is generally free of other
25 land use activities.

1 "Whereas, Grant County Compiled Zoning Ordinance
2 dated 1-25-2018, Section 1300 CAFO. Intent. A supply of
3 healthy livestock, poultry, other animals essential to
4 the well-being of county citizens and the State of
5 South Dakota.

6 "Whereas, the Grant County Compiled Zoning
7 Ordinance dated 1-25-2018, Section 1211.03, WES states
8 precautions to protect livestock during all phases of the
9 project's life but wind towers cause issues with
10 livestock.

11 "2010, Testimony to the Public Service
12 Commission. Our 1978 White Paper Engineering and Service
13 Center, U.S. Airforce, Fish & Wildlife, and the U.S.
14 Department of Interior. Young 2010 testimony, Wind
15 Siting Rules Public Service Commission.

16 "Whereas, the industrial wind turbine landowner
17 contracts are confidential and may be in direct conflict
18 with Grant County compiled zoning ordinances. And the
19 assignment and sublease clause in industrial wind turbine
20 contracts could put the greater community at risk.

21 "Be it therefor resolved to uphold Grant County
22 Compiled Zoning Ordinance dated 1-25-2018, Grant County
23 establishes a requirement for best practices, aircraft
24 lighting and taxiing system, and an industrial wind
25 turbine 2-mile setback from a nonparticipating owner of

1 property line allowing for a waiver. Please deny this
2 permit."

3 Yesterday I was loading a load of hay. This
4 gentleman came from Wisconsin, and we was talking about
5 wind turbines. He said he just came from Colorado and
6 somewhere he parked out there for the night, and he said
7 he couldn't believe it. There was a wind turbine about a
8 quarter of a mile away, and he said his truck was
9 continually rocking all night because of that turbine.
10 He says whatever you can do, stop this thing before it
11 gets started.

12 Thank you.

13 CHAIRMAN FIEGEN: Thank you. One more, and then
14 we'll go on break.

15 MR. JENSEN: Good evening. My name is
16 Kurt Jensen, K-U-R-T J-E-N-S-E-N. I am a resident of
17 Summit, South Dakota. I'm the superintendent of the
18 Summit School District. I am here speaking this evening
19 on behalf of the Dakota Range Wind Project in our area.

20 Many in my area have been supportive of wind
21 development for over the past 10 years. Concerning
22 school finance, if passed and if completed, this wind
23 farm could greatly benefit our school. This passage
24 could significantly alleviate our current opt-out status,
25 which sadly is a normal complication in numerous smaller

1 districts.

2 For a sparsely populated geographic location and
3 prominent winds, this is a unique opportunity which could
4 financially affect not just our school but create
5 additional tax revenue for the county and townships as
6 well.

7 Lastly, I would like to mention that Apex,
8 Dakota Range Wind have been active components to our
9 community and school. We thank them for that. They have
10 built a reputable rapport in our community, and through
11 their good will they have proven to be highly valued
12 members of our area.

13 Thank you for your time and consideration.

14 CHAIRMAN FIEGEN: Thank you. 10 minutes.
15 Welcome back at 7:11. 7:11.

16 (A short recess is taken.)

17 CHAIRMAN FIEGEN: We are coming back to order.
18 If you can be so courteous, the line that I interrupted,
19 there were some people in front. You guys know who you
20 are. I could not see the line. There were probably five
21 or six in line that were in order, and if you guys could
22 come back according to that line when I said there would
23 be two more, I would so much appreciate that.

24 Cheri, are you ready?

25 Okay. Here we go.

1 MR. PIKE: Can you hear me now? My name is
2 Richard Pike from Summit, South Dakota. R-I-C-H-A-R-D
3 P-I-K-E. I've lived in the Summit area since 1968 when I
4 moved up here from Sioux Falls. I come up here to get
5 clean air, and I got it.

6 I also got the Interstate. Nobody's mentioned
7 the Interstate noise. I wonder why. I might talk about
8 it a little more later.

9 But I am a landowner on the Dakota Range Wind
10 Project. I have been on a project of some kind since
11 19 -- well, 10 years. I became acquainted with Jim
12 Newcomb over there who introduced to me to it because he
13 said you live in the Coteau Hills where we have plenty of
14 wind. I am sure everybody knows that who lives up in
15 that area because we do have plenty of wind. And so why
16 not use it?

17 It's plain stupid to think that the wind is
18 destructive to our health. It is not. In fact, it
19 cleans the air up if we have wind.

20 We have a great relationship with Apex and trust
21 them to do what is right. And so far I've understood
22 that they're doing a great job.

23 There are groups of people that have come to our
24 area who do not live here to testify against it. I don't
25 think they got any business doing that. Because I live

1 here, and I'm not going to move away. I've been here
2 about 40 years plus. You get to the point I'm not
3 moving.

4 And so I want to tell you some people are
5 concerned of their property rights going down. Well,
6 when the Interstate came through my property rights
7 didn't go down but up. Values, I should say. And so
8 when I sleep at night sometimes when the wind blows from
9 the west -- and I only live about three-fourths of a mile
10 from the Interstate. I sleep real well because I'm used
11 to it.

12 Now why can't we get used to these wind turbines
13 in the same aspect? And I know that some areas have been
14 shown where they're going to have turbines. My turbine
15 on my farm -- I'll have two, I understand -- are going to
16 be quite a ways away from my area so I don't believe I'll
17 hear them. If it does, I'll turn my hearing aid off.

18 People complain about the noise of the turbines.
19 You know, my son went down south here a while back to
20 interview -- or to see what the turbines did down in
21 White. And he stood right underneath, and he hardly
22 heard a noise. And that was many years ago. Our
23 turbines have changed in construction. And they run
24 quiet, as I understand.

25 We want this project to help our townships, our

1 schools, and our landowners to grow, to pay our fair
2 share. I would like the Commissioners -- is that what I
3 call you?

4 CHAIRMAN FIEGEN: Yes. But if you could -- we
5 need to stop. And then if you have any extra minutes,
6 then you can --

7 MR. PIKE: Oh, I didn't know I talked too long.

8 CHAIRMAN FIEGEN: Thank you. Thank you,
9 Richard. Appreciate it.

10 MR. PIKE: Yeah. You're welcome.

11 MS. LAU: Hello. My name is Wanda Lau,
12 W-A-N-D-A L-A-U, and I support the Dakota Range Wind Farm
13 Project. I don't have statistics and numbers, but what I
14 have is a personal testimony on what this project has
15 already done for my family and community.

16 My husband and I owned a trucking business in
17 this community for over 20 years, and the recession came
18 and things got really tough for us. We had a lot of
19 financial struggles. There were times I wondered how I'd
20 pay bills, put food on the table, or even buy things such
21 as school supplies or things for the kids, not to mention
22 the bigger things like house insurance, health insurance,
23 and taxes.

24 Then we ended up closing our business and I
25 really wasn't sure what we were going to do and then my

1 husband got offered a job with Apex Clean Energy and the
2 Dakota Range Wind Project. It was a good paying job and
3 since then it's turned our finances around, and I'm able
4 to pay my bills and also give to charities such as
5 Salvation Army and Orphan's Promise and others.

6 And also we were able to give to the Summit
7 History Club so they could go to Washington, D.C., and I
8 was very proud to be able to do that. I know for a fact
9 that Apex also supports our community. They have also
10 given to the Summit History Club and the Summit School
11 for their gym, which is beautiful, and the Boys and Girls
12 Club of Watertown to name a few.

13 Which is another personal note. My kids have
14 attended the Boys and Girls Club in Watertown while I
15 work, and I don't know what I would do without a place
16 like that.

17 And there is just a few things that Apex has
18 done without a project completed. What more could they
19 do in the future?

20 Just what if this finished project does exactly
21 what it says it will, bring in revenue and good paying
22 jobs to our community? And what about produce
23 electricity? How important is electricity?

24 We lost power at work the other day, and
25 everybody said, oh, we don't have power. We can't work.

1 We might as well go home. Like the old saying, don't put
2 all of our eggs in one basket. So what's wrong with
3 having more than one source of electricity?

4 And South Dakota has something to offer. It's
5 called wind. I hear statistics all the time about
6 South Dakota being ranked at the bottom of the list in
7 areas such as tax revenues and wages and et cetera.
8 Minnesota has embraced clean energy, including wind farms
9 that are up and operating. North Dakota is on board too.
10 Do we just sit back and do nothing? How will you ever
11 succeed if you don't even try?

12 This community wants to grow. I've heard it.
13 I've seen it over and over. We want to attract people to
14 our area. To me here's an opportunity for that. Why
15 not?

16 I love living in South Dakota and this
17 community. These are my grassroots. I've been here my
18 whole life. I would love to see my children grow up and
19 stay here in South Dakota. I have a daughter attending
20 NSU for elementary education. I would love to see her be
21 able to get a teaching job in this area.

22 My youngest son says he wants to be a farmer. I
23 would love to have all my kids stay here, but we need to
24 have a good reason for them to stay. I've seen too many
25 friends and family leave here.

1 This group of people involved in the Dakota
2 Range Wind has worked very hard on this project so far.
3 I've seen it myself. They have become like family to us.
4 If the landowners signed up their land for this, it must
5 be what they approve of too. So who am I to tell them
6 what they can or can't do with their land? If they
7 receive a benefit out of it themselves, it benefits all
8 of us as well.

9 Even before my husband was in the industry we
10 would drive through the country through areas with wind
11 turbines, and everybody in the car would stop and look
12 and say, wow, look at those. They're beautiful and
13 amazing. And I must not be the only one that thinks this
14 because I've seen pictures of wind farms on calendars,
15 brochures, and other advertising literature.

16 Thank you.

17 CHAIRMAN FIEGEN: Thank you.

18 MR. HAVERLY: Good evening, Commissioners. My
19 name is Jeff Haverly, J-E-F-F H-A-V-E-R-L-Y, and I
20 represent the Governor's Office of Economic Development.
21 Tonight I'd like to share the following statement on
22 behalf of the Governor's Office of Economic Development,
23 which would urge your favorable consideration of the
24 benefits that wind energy projects such as this one have
25 for South Dakota.

1 GOED sees tremendous opportunity for our state
2 through investments in wind energy. South Dakota's wind
3 resource continues to attract attention at a national
4 level. And my office regularly receives inquiries about
5 possible projects here in South Dakota.

6 Each of those projects represents economic
7 development potential through capital investment in our
8 state, as well as good paying jobs in many of our rural
9 areas.

10 Apex Clean Energy is an excellent example of the
11 kind of project we support at GOED. And we have been
12 working with them for some time to ensure South Dakota
13 remains a top choice for their planned investment.

14 The specific project subject of today's
15 proceedings, the planned Dakota Range Wind Project, would
16 encompass approximately 300 megawatts of generation in
17 the state. This capacity would be brought to you by over
18 a \$400 million investment in South Dakota and generate
19 considerable economic impact to the area through tax
20 revenue, as well as job creation.

21 At GOED we believe the future of energy
22 production in South Dakota is here, and it's real. It's
23 obvious that renewable energy provides secure, domestic,
24 and sustainable source of energy for our state and our
25 nation, be it solar or wind. We see tremendous economic

1 development opportunities from these types of projects.

2 On average more than 25 percent of
3 South Dakota's power generation comes from wind power.
4 As a matter of fact, South Dakota currently has over
5 980 megawatts of wind power capacity and produces enough
6 energy to power more than 260,000 homes.

7 But this is what excites us even more. In
8 South Dakota we have the potential to produce more than
9 3 million gigawatts of hours of energy on an annual
10 basis, and, according to the PUC, if South Dakota had the
11 ability to harness the entirety of that wind energy
12 potential, we could provide power for almost the entire
13 United States.

14 While we don't currently have that wind
15 harnessed, South Dakota does rank in the top five states
16 for wind energy potential. We believe our wide open
17 spaces and high quality wind resources can provide much
18 more wind power for the citizens of our state as well as
19 those in parts of the country that do not enjoy
20 South Dakota's ample wind resource.

21 In the past decade South Dakota has seen
22 tremendous job creation and capital investment in
23 renewable energy. Wind power has contributed more than
24 2 billion in capital investment and directly created more
25 than 500 jobs.

1 We recognize there is an important local
2 discussion that must take place concerning any project
3 and, therefore, we do not take a position on siting
4 projects such as these. However, my office does see
5 clear benefits to expand wind power production in our
6 state and is quite pleased to offer our support for
7 expansion of wind energy in South Dakota.

8 I would urge your favorable consideration of the
9 project. And thank you for your attention.

10 CHAIRMAN FIEGEN: Thank you.

11 Next. Right over here.

12 MR. FLOREY: Dear PUC Commissioners, Madam
13 Chairman, my name is Michael Florey, M-I-C-H-A-E-L,
14 F-L-O-R-E-Y. I was born and raised on a farm north of
15 Clark, South Dakota. I have been farming for 30 plus
16 years, and I am here in support of renewable fuels, which
17 wind is part of, and the economic value for local
18 landowners, for the county, and for the state for many
19 years to come.

20 My farm is located within a half a mile of a
21 wind turbine from the Oak Tree Wind Farm, which I do not
22 receive any payment from. So let me tell you about my
23 experiences.

24 Some people say wind towers drive away wildlife.
25 My experience is that I have geese and pheasants on my

1 land as much now as before wind towers. Deer are very
2 plentiful and are often seen bedded down near the towers.

3 As far as noise, they do make some, but half the
4 time the wind is blowing in the opposite direction, and a
5 lot of the time the wind is calm at night so no noise is
6 made. Tower or no wind tower, wind by itself makes
7 noise.

8 Another concern is ruining the roads and
9 increased traffic on the roads. I farm on a township
10 road, and my road is no worse off than before towers.
11 Except for a couple of weeks during construction, there
12 is no more traffic than normal.

13 Another concern is health problems. After
14 four years of living next to this tower I can say I have
15 no health problems. I have no trouble sleeping. I have
16 no headaches. So I -- I disagree with that. Also my
17 cows and sheep are not affected at all by the wind
18 towers.

19 Some people don't like the blinking lights. I
20 can stand in my yard and look at blinking lights on a TV
21 tower a few miles away, and I'm thankful for TV. I can
22 look in the opposite direction and see the blinking
23 lights on a wind tower, and I'm thank you for
24 electricity. I can get in my car and drive a few miles,
25 and I can see a blinking light on a communications tower.

1 I'm thankful for cellphones. I can drive a few miles in
2 the opposite direction and see blinking lights on a GPS
3 tower. I am thankful for GPS for farming, for direction.
4 All these blinking lights mean progress is occurring.

5 There are 11 towers within 4 miles of my farm
6 and I can stand in my yard and I can only see one because
7 of the trees, the lay of the land. So site is not a
8 problem either.

9 So with this being said, I support the wind
10 project because of the economic value for the community
11 and the state, and I ask for your approval of this wind
12 project.

13 Thank you for your time. Michael and Linda
14 Florey and family.

15 Thank you.

16 CHAIRMAN FIEGEN: Thank you, Michael. And if
17 you have comments that you have -- I don't know if
18 they're written out or not. You can certainly turn them
19 in.

20 Go ahead.

21 MR. HOMAN: Neal Homan, N-E-A-L H-O-M-A-N, and I
22 have ground signed up with the wind project. And when
23 they first came to me they were respectful. They didn't
24 just drive up on the yard. They came in -- called me,
25 made an appointment, and they treated me good. My

1 questions that I had for them they answered straight and
2 direct. And I got along really good with them ever
3 since.

4 And whenever they need to see me or want to see
5 me they call first. So they're respectful of my time,
6 and I'm respectful of theirs.

7 And I believe that this will be a good project
8 for the area. I have a cattle farm/ranch and produce a
9 cow/calf operation and four years ago a cow/calf
10 operation, I sold calves for the highest price I ever
11 have in my life. Now this year they're getting close to
12 the bottom of what I've ever sold for. So the economic
13 part of it is, yes, that would be nice to have a little
14 bit of income that I could rely on at a certain stage.

15 And as far as, you know, the wildlife is
16 concerned, yes, I don't like to see any animals get
17 killed or dead. But how many deer, raccoons, skunks get
18 killed on the highways by cars going on? Are we supposed
19 to stop driving cars?

20 And when the power goes out, who's the first to
21 call? Everybody calls. Get the power back on. Well, if
22 something happens somewhere, you've got to have a
23 different source of power, you can get it from different
24 places, and it's nice to know that you can probably get
25 one that's close by.

1 So I thank you for your time, and I hope you
2 pass this project.

3 CHAIRMAN FIEGEN: Thank you, Neal.

4 MR. CAPP: My name is Ronald Capp, R-O-N-A-L-D
5 C-A-P-P. Born and raised in Grant County. Right now my
6 wife and I own property along I-29 that my
7 great-grandfather homesteaded. I have been on the
8 township board and realize the responsibilities and the
9 need for revenue to support our townships. So my wife
10 and I strongly support the development of wind.

11 Thank you for your time.

12 CHAIRMAN FIEGEN: Thank you.

13 I remember those calls during snow storms during
14 those township times when you have to get the snowplow
15 out there, and everybody wants it first.

16 Go ahead.

17 MR. MEYER: My name is Jon Meyer, J-O-N
18 M-E-Y-E-R.

19 Just a point of clarification on the potential
20 financial impacts with regards to school districts that
21 were included in the presentation. The potential
22 revenues for school districts as presented would actually
23 require a very significant change in the current funding
24 formula for school districts in the State of South
25 Dakota.

1 The way the funding formula is currently written
2 any new wind projects or any other projects that generate
3 other revenues for the first five years of the project
4 there is a significant financial benefit for the school
5 districts. Over the second five years that revenue is
6 slowly sunsetted at a decrease of 20 percent each year.
7 So at the end of year 10, beginning year 11, 100 percent
8 of the revenues generated by those projects are credited
9 as local revenues and result in a dollar-for-dollar
10 decrease in state funding that's offered to school
11 districts.

12 So under current legislation the revenues that
13 we would see would have to be decreased by at least
14 \$3.4 million from your presentation. I think that's a
15 very important point of information that the general
16 public needs to know. And, again, in order to receive
17 the dollars that you're quoting us, we would have to see
18 a very significant change in current legislation.

19 Thank you.

20 CHAIRMAN FIEGEN: Thank you, Mr. Meyer. And I
21 think you saw all three Commissioners write a note when
22 that was up there because we would have asked that at the
23 evidentiary hearing.

24 But thank you for bringing that up to the public
25 because that's not our point to do today but I certainly

1 appreciate you doing that.

2 MS. MOGEN: Good evening. I'm Kylee Mogen,
3 K-Y-L-E-E M-O-G-E-N. I'm concerned about my future and
4 the health impacts of these wind turbines for my
5 generation. I'm going to read a short story from a
6 South Dakotan by David Janes.

7 "While the thousand-foot setbacks was probably
8 used, it makes no difference. The shadows from the
9 turbine blades hit our house from all directions every
10 day, and even with the limited available light at night
11 you are still able to see shadows moving across the
12 house. It is especially disturbing during any outdoor
13 activities. Sometimes it is absolutely shocking and
14 makes you think something is creeping up behind you. The
15 flashing red lights are almost as distracting as the
16 blade shadows. There's never a peaceful night of
17 solitude.

18 "We installed blinds and draperies and are still
19 getting that light sweep through and around the windows.
20 The noise is even worse. We are never left in silence
21 when the turbines are active. When there is moisture in
22 the air it can sound like the roar of a jet plane engine.
23 We invested over 500,000 in our home, but we had to live
24 with headaches caused by the constant flashing and noise.
25 We even bought a camper for the sole purpose of getting

1 away to a peaceful location for a month or more at a
2 time. Unfortunately, my wife Linda passed away last
3 year. The peace and solitude we expected have been
4 completely taken from us."

5 I have a sister with epilepsy, and because of
6 these turbines having flashing lights and strobe lights
7 during two times a day for 15 minutes, that can trigger a
8 seizure. I plan to go into the medical field, and I
9 don't want to see patients coming in with effects from
10 these turbines. So I'm trying to make a change now.

11 Please take this into consideration, and thank
12 you so much for your time.

13 CHAIRMAN FIEGEN: I didn't hear where you were
14 from. I'm sorry. Could you come back to the mic. And
15 just make sure when you state your name and spell it if
16 you could tell us where you're from, that would be great.

17 MS. MOGEN: From Twin Brooks.

18 MS. KAAZ: Hi. My name is Teresa Kaaz, and I
19 live at South Shore out in the country. I'm holding in
20 my hand a map showing where my property is located. It
21 is within the site. And also it's all four sides of me
22 are signed leaseholders.

23 At this time I'm going to ask you to think very
24 deeply about requesting that this permit right now be
25 denied for the following reasons. And I apologize

1 because I think I'm shorter than the microphone.

2 Okay. The things that we will receive from
3 wind, as we are nonparticipating landowners -- which
4 means we don't be factored into any aspect other than the
5 things that we are going to receive -- we'll receive
6 shadow flicker, moving shadows, which is voluntary given
7 to us no more than 30 hours a year.

8 It's hard to measure as we have to gather the
9 information for a year to see if the promise has been
10 upheld, then do another year study to make sure it is not
11 in compliance. When that study is done if there is a
12 problem, I'm sure it will be taken care of as soon as
13 possible; correct?

14 We will receive sound measure at 50 decibels at
15 our property line. At least it's not measured from my
16 house. Only time will tell if there will be a problem.
17 Probably right at bedtime. But, again, I'm sure it will
18 be taken care of.

19 Infrasound. That's not even covered in the
20 Permit Application at this time so we won't talk about
21 that.

22 We will receive new visual effects. We are
23 going to be able to enjoy our new landscape viewing an
24 astonishing 360 sight line from our property of the
25 485-foot spinning industrial privately owned utility

1 turbines.

2 Economics. Dan and I will watch our real estate
3 value quickly dwindle away as more towers come through
4 all the surrounding counties, including Codrington County.
5 I am sure when we sell our property at a fair market
6 value when we are ready to retire it will go at a good
7 price. Anyone would love living amongst 485-foot
8 industrial turbines; right?

9 Lastly, I will cover the safety of the
10 inhabitants. There is nothing like living within the
11 safety zone of a wind turbine. What could possibly
12 happen? I will be thinking of that as the wind employees
13 will be asked to stay 1,640 feet or so away from the
14 turbine in case of a break, failure, or a fire or until
15 it can be shut off or even an ice throw because we never
16 have ice around here. Will we be safe?

17 In closing, it is my understanding that the
18 Applicant's responsibility is to prove that it does not
19 or will not impair the health, safety, or welfare of the
20 inhabitants or will pose a threat to the economic
21 conditions of the inhabitants or expected inhabitants
22 within the siting area. This cannot happen at the
23 current setbacks in this Application.

24 For those reasons I'm requesting that this
25 permit be denied. Remember the decision -- this decision

1 will only affect everyone in both Codington Counties and
2 Grant Counties, but also the effect will last for
3 50 years.

4 Thank you for your consideration.

5 CHAIRMAN FIEGEN: Thank you. Could you spell
6 your name.

7 MS. KAAZ: T-E-R-E-S-A K-A-A-Z.

8 CHAIRMAN FIEGEN: I'm glad I asked for that
9 spelling.

10 Go ahead.

11 MR. FALK: Hi. My name is Wade Falk, W-A-D-E
12 F-A-L-K. I live in the suburbs of Stockholm,
13 South Dakota. And my family farms from Twin Brooks,
14 Stockholm, South Shore, and right to the corner of
15 Day County.

16 In my -- just kind of the point that if anybody
17 should care, I do. My kids are the fifth generation
18 living in Grant County, living where we do. There will
19 be a power line put right over -- pretty much over the
20 top of my house. And yet I'm for it because I wouldn't
21 want to stand in the way of progress. I wouldn't want to
22 stand in the way of something that's better for everyone.

23 I'm very thankful for the timing of this because
24 I think 20 years ago it might not have made any sense.
25 10 years ago maybe. I'm thankful that Apex is doing it,

1 not someone else. I'm thankful that they have -- in
2 their presentation before and all the meetings they've
3 had before have answered all the questions you could
4 possibly make, my own included. Poor David had the
5 misfortune of me having his phone number, so no one has
6 quizzed him more than I have probably.

7 The reason I should care is that my family has
8 lived and worked here in my -- in my travels just today I
9 have driven pretty much from one end of the county to the
10 other and back and back visit -- you know, driving
11 through South Shore four times, Waverly once, and
12 Stockholm twice. Nobody enjoys this area -- well, I
13 enjoy it as much as anyone else, I should say.

14 What I had written down is I'm sure in this
15 rural community I don't need -- I don't have to tell
16 anyone here that the farm and ag economy isn't where it
17 needs to be. The wind farm would bring much needed
18 income to our landowners, the tax base, and you know how
19 our economy works, will trickle down to Main Street and
20 beyond. Thank God for good timing.

21 Dakota Range Wind will help everyone in the
22 country just when we need it most if things don't turn
23 around soon. Lord willing, the ag economy should turn
24 around. The added income would only help the community
25 prosper. I hope this decision to let them come in will

1 be as simple to you as it is to the landowners who have
2 signed on. The community -- this county, this country
3 needs it. We want it, and we're thankful it should be
4 coming soon.

5 I would like to request the Commission to
6 approve the permit for Dakota Range Wind.

7 Thanks.

8 CHAIRMAN FIEGEN: Thank you.

9 And you're going to have to speak in the mic.
10 And if somebody can help.

11 MS. MOYER: I'm Alice Moyer, A-L-I-C-E
12 M-O-Y-E-R. I'm a landowner in the Dakota Range Wind
13 Project. Our family has been farming this land for the
14 past few generations.

15 The wind always blows in South Dakota so we
16 might as well use it to make energy. Wind energy is not
17 a new technology. It used to be used in our area for
18 grinding corn, grain, pumping water, and why not creating
19 electricity now?

20 This 75 plus years ago wind technology is still
21 being used today, and we want this project in our
22 community. It also will help create jobs, benefit the
23 local townships, schools, the tax revenue that it will
24 produce. I would like to request that the Commission
25 approve the permit for Dakota Range Wind.

1 Thank you.

2 CHAIRMAN FIEGEN: Thank you, Alice.

3 Go ahead.

4 MR. SCHLAGEL: Terry Schlagel. Commissioner
5 Fiegen -- S-C-H-L-A-G-E-L.

6 Commissioner Fiegen, you reporter, I've got a
7 bone to pick with you. I'm from Clark Willow Lake.

8 CHAIRMAN FIEGEN: I have a bone to pick with you
9 because my son that plays for Parker had to go up to A
10 and you guys got to come down to B, and Parker was at the
11 State Bs last year so we can talk afterwards.

12 MR. SCHLAGEL: We'll swap it off then.

13 CHAIRMAN FIEGEN: He's a senior next year so I
14 hope he gets to go to the State As next year.
15 Congratulations to Clark. It was fun to watch your team.

16 MR. SCHLAGEL: We have 11 towers just north of
17 Clark 3 to 5 miles. The first one is 3 miles north. The
18 furthest one is 5 miles north.

19 On the way up here this afternoon I drove
20 3 miles north. There's two towers, one approximately
21 1,000 -- or excuse me. Two towers on either side of the
22 road, about a thousand feet off. I believe that's what
23 Clark's was at the time they put the towers in.

24 I shut my pickup off. I listened. I never
25 heard anything. Maybe I'm -- realize I'm getting a

1 little long in the tooth, but like the gentleman's saying
2 that it rocked his truck a half a mile or a quarter mile
3 away, jeez, maybe he should put some new shocks or
4 springs on it, you know.

5 Golly. As far as the noise, there's grain
6 dryers in the town of Clark that make more noise than
7 what you could hear when I was parked alongside the
8 towers -- or between them, I should say.

9 Shoot. There's a lot of us husbands probably
10 got home late at night our wives made more noise than
11 what those towers made and, I mean, I'm serious about
12 that.

13 CHAIRMAN FIEGEN: Just kidding. Go ahead.

14 MR. SCHLAGEL: As far as Oak Tree Farms, they
15 run a game lodge. There's a lot of people from Minnesota
16 and Texas and Missouri, several states, fly in there to
17 hunt pheasants and fish and wildlife and whatever. Trust
18 me. There's just as many dead deer on that oil road
19 going north of Clark as there is some of the roads where
20 there isn't wind towers. There are deer around.

21 One thing that's -- thing that maybe been
22 brought up, this is a \$380 million project from what I
23 understand. I opened up our paper in Clark just last
24 week. They're opting out again in our school system.

25 Gee whiz, folks. It brings money into town. It

1 will put people back in job -- maybe it's going to bring
2 some jobs. It will help the economy. I would certainly
3 think so. It can't help but help the economy, I wouldn't
4 think.

5 Just like the little town I'm from is Raymond.
6 First we lost our school. Then we lost our -- our bar
7 burnt down. Then we lost our grocery store. Then our
8 implement dealership. You cannot -- you cannot spend a
9 dime in Raymond, South Dakota unless you stick it in the
10 pop machine. I mean, it's -- we've just got to have
11 economic development and try to -- try to help the
12 countryside.

13 And I realize change is difficult. Gee whiz,
14 you know. It's -- I imagine when the REA lines and the
15 telephone lines come in some farmers were again' that
16 because they didn't want to mow around them and put the
17 road ditches up. Just as people said, it's sure been
18 handy to use phones and electricity over the years.

19 I guess with that, I'll close. And one thing
20 about the wind farm, you farmers and ranchers are
21 guaranteed a steady income. You're not dealing with \$3
22 corn, 4, \$5 wheat, 8, \$9 beans. You've got some money to
23 put in the bank at the end of the year.

24 Thank you very much.

25 CHAIRMAN FIEGEN: Thank you.

1 Go ahead.

2 MS. MOGEN: Hi. Kristi Mogen, K-R-I-S-T-I
3 M-O-G-E-N. I'm from Twin Brooks. That one's going to be
4 a tough one to follow. But, you know what, if you're
5 living with it, it's not a 10-minute snapshot in time.
6 Okay? I've lived with industry.

7 My family and I fled from one home already
8 because of industry companies using us as guinea pigs,
9 destroying our health, land, livestock, and wealth. We
10 have dealt with multinational companies and their
11 accidents. There's not -- they're so big that not even
12 the State will be able to enforce the rules, let alone
13 communities' local ordinances.

14 I question the wind participants, if they
15 understand what they have signed or the risks they've put
16 their community in with these confidential contracts. If
17 everything's so great, why all the confidentiality
18 clauses? And why not offer a property value protection
19 clause or contracts with nonparticipating neighbors?

20 When the contracting landowners are planning to
21 retire on this income only to find out that the plans for
22 the project have changed, there will not be a turbine on
23 their property now. They'll be living under their
24 neighbors' 500-foot health killing monstrosity for the
25 rest of their lives. If the industry turbines go in, you

1 will lose your property value and now can't afford to
2 sell and move away. And I know because I've been there.
3 Property value, use, and enjoyment is diminished.

4 The study by Martin Hertzman [phonetic] and
5 Kari Tuttle [phonetic] in 2011 states, Values in the wind
6 shadowed properties within 1 to 3 miles of an industrial
7 wind turbine have a negative impact from 15 to
8 31 percent. In Kurt Kursack's [phonetic] 2009 Wind
9 Turbine Impact Study if the property had an industrial
10 turbine, the value decreases by 65 percent.

11 In yesterday's Grant County newspaper ad by
12 Jim Newcomb it urges you to consider the view of
13 95 percent of the people living near wind turbines. He
14 didn't say whether they were under confidentiality
15 agreements and can't say anything. So, please, don't
16 sign away your constitutional rights.

17 Are there state laws that void the contract if
18 the project hasn't started in a certain amount of time?
19 Has the board looked at those and submitted easements and
20 see if they've become voided because of state law?

21 Were these guys sold a bill of goods just so an
22 out-of-state company could get a cheap fence-to-fence
23 easement with a right to assign a lease or an easement to
24 a multinational company? Who is the number one buyer of
25 those easements? Will you receive any payment when those

1 easements are resold or have any say in who or what can
2 be done on your land? Who will hold the liability?

3 With the reassignment did the industry -- did
4 the industrial wind turbine company relieve itself of all
5 of its liability? As per taped industry testimony at the
6 Codington County Planning and Zoning hearing March 12,
7 the industry representative said decommissioning costs
8 were 170,000 per turbine. That does not match the
9 submitted Application for the PUC.

10 PUC, are there any bad actors soliciting
11 investments with no accountability in association with
12 this industrial wind turbine contracts or applications?
13 I've dealt with industry before, energy industry.
14 They're acting the same. For your health, your safety,
15 your wealth --

16 CHAIRMAN FIEGEN: Kristi, if you do have
17 comments, if you could turn them in, that would be great.

18 MS. MOGEN: Okay. Thanks.

19 CHAIRMAN FIEGEN: Thank you.

20 MS. COYLE: Hi. My name is Sarina Coyle, and
21 that's S-A-R-I-N-A C-O-Y-L-E, and I am here on behalf of
22 Andrew Van Kuren, the Campbell County Economic
23 Development Coordinator. And that is V-A-N-K-U-R-E-N.

24 "Campbell County has been experiencing the
25 benefits of wind development experience since 2015, and

1 the Campbell County Economic Development Corporation
2 supports and continues development of the wind energy in
3 South Dakota.

4 "The Campbell County wind farms is a 95
5 milliwatt facility considering 55, 1.7 milliwatt
6 turbines. Personally I have lived in various regions
7 throughout the United States. Each region usually makes
8 the best use of their natural resources.

9 "South Dakota has the opportunity to wisely use
10 wind as a natural resource and profit from it. We hope
11 the Commission recognizes the impact wind facilities on
12 local economics and in the South Dakota future and will
13 vote to approve the permit for Dakota Range Wind.

14 "Each year our county sees over \$250,000 in tax
15 revenue from our project. Considering our population is
16 less than 1,500 people, this is -- this has provided huge
17 financial assistance in maintaining and improving our
18 community.

19 "During the development and constitution of the
20 project Campbell County's businesses hosted hundreds of
21 construction workers, developers, and engineers.
22 Construction alone requires over 100 workers that lived,
23 ate, worshipped, and shopped in the area over
24 nine months. The economic boost was felt by many local
25 businesses and churches.

1 "We hope the Public Commission recognizes the
2 huge positive impact wind facilities of our community --
3 and can continue to have on the future of South Dakota.

4 "We encourage the Commissions to acknowledge the
5 opportunities like Dakota Range Wind provided for rural
6 communities like ours by approving the permit of Dakota
7 Range Wind."

8 Thank you.

9 MR. COYLE: I am Sean Coyle. That's S-E-A-N
10 C-O-Y-L-E. I'm from Miller, and I'm a student at LATI
11 pursuing a degree in energy technology. I chose a career
12 in energy operations because it is a rapidly growing
13 industry, and I wanted a long-term career where my skills
14 would be in high demand.

15 The technical skills for a job as a wind turbine
16 tech or in wind farm operations can be learned in just
17 two years at one of the numerous tech colleges in
18 South Dakota.

19 Our community is extremely lucky to have LATI in
20 the area. Lake Area Technology Institute has outstanding
21 programs in energy operations and energy technology in
22 Watertown. These programs are helping ensure the energy
23 industry has the well-trained employees it needs and has
24 given South Dakotans an opportunity for great high-paying
25 careers. The program at LATI has over a 98 percent job

1 placement rate and has been named at the top technical
2 schools in the country.

3 I'm extremely fortunate to be on track in
4 completing my degree debt free thanks to the Build Dakota
5 Scholarship Fund. South Dakota scholarship requires that
6 technical college graduates stay in South Dakota and
7 complete two years of work before leaving South Dakota.

8 Myself and dozens of others on the South Dakota
9 scholarship program are -- years of our careers and major
10 financial investment because of the optimistic outlook of
11 wind energy in our state.

12 Last fall South Dakota Governor Dennis Daugaard
13 wrote that wind power has contributed over more than
14 2 billion in capital investments to our state for the
15 construction and maintenance of the 14 wind projects now
16 in operation. These wind farms have also brought nearly
17 2,000 good paying jobs to South Dakota.

18 An analyst of South Dakota wind development by
19 the Environmental Law and Policy Center found that a
20 250-megawatt project in South Dakota would create about
21 500 direct construction jobs, job years, and an
22 additional 500 indirect in induced job years. This
23 includes the service and retail industries, which support
24 the project, construction workers, such as coffee shops
25 and motels.

1 During its operation years a 250-megawatt
2 project will employ as many as 23 wind technicians to
3 maintain turbines, 44 jobs of suppliers, an additional
4 55 indirect induced jobs.

5 As Mark mentioned, the country's fastest growing
6 occupation is wind turbine technician. According to the
7 Bureau of Labor Statistics, with numbers expected to more
8 than double over the next decade, the wind industry is
9 one of the top three fastest growing occupations,
10 according to the Bureau of Labor Statistics.

11 The way we live and communicate has changed
12 completely in just a few decades. New technology has
13 taken over many careers with South Dakota Scholarship and
14 great technical colleges. South Dakota is preparing for
15 the future by arming young people with the skills
16 necessary to meet the new demands of industry.

17 Wind and solar jobs are the fastest growing job
18 segments in the country. These projects can keep young
19 people at the home in South Dakota who otherwise would
20 have to move away to find employment. I've seen many
21 friend leave the state to pursue other careers and
22 opportunities because there was no options for a good
23 career near home.

24 Young people across the country are excited for
25 clean energy. Most of the supporters here tonight look

1 to be near or over retirement age.

2 CHAIRMAN FIEGEN: Thank you, Sean. If you could
3 give your comments to our staff.

4 Thank you.

5 MR. HUBNER: My name is Gregg Hubner, that's
6 G-R-E-G-G H-U-B-N-E-R, and I'm from Avon, South Dakota.
7 I am the president of the South Dakotans For Safe And
8 Responsible Renewable Energy. Our group represents about
9 20 counties now that advocate for safe and responsible
10 renewable energy in our state.

11 It occurred to me this winter and after three
12 trips to Pierre that I got to the party about 10 years
13 late. In 2008 the wind industry was busy writing their
14 own laws in Pierre, including the draft model ordinance,
15 the codified laws. In several areas of the state,
16 including mine, wind developers were signing up land
17 easements 8 to 10 years ago.

18 Developers were doing all their work, waiting
19 for the production tax credit to be reinstated, which was
20 in January of 2013. Now they are really working to get
21 their projects approved before the so-called production
22 tax credit phases out.

23 Tonight I will address the issue of setbacks and
24 how it will affect the health, safety of the residents.
25 Every developer promotes short setbacks from a residence

1 or a property line. The other night in Turner County
2 they were promoting a 500-foot setback for a 600-foot
3 tower. Short setbacks increase the developer's profits.

4 In 2008 the wind industry decided that setbacks
5 would be 1.1 times the tower height because if the wind
6 or a tornado blew the tower over, there would still be a
7 10 percent cushion before it hits your home. That was
8 the only perceived threat from a wind turbine in 2008.

9 Now we have turbines that are 600-foot tall
10 instead of 300-foot tall, and they still want the same
11 setback. But now the genie is out of the bottle. The
12 Shirley Wind Farm in Wisconsin has been designated the
13 human health hazard since 2014 and remains one until this
14 day.

15 It took almost five decades until they finally
16 got the tobacco industry to pay \$206 billion in a lawsuit
17 proving that tobacco caused cancer. It took about
18 50 years to prove that asbestos insulation in houses
19 caused cancer. How about agent orange? How many years
20 did the government cover that up?

21 In each example the manufacturers, the
22 government, the American Medical Association, they all
23 lied about any potential danger of their product for
24 financial gain. People all over the world are now waking
25 up to the fact that there are health hazards with wind

1 turbines.

2 So the problem with the project, with this
3 project and the same project in the state, is setbacks.
4 All the arguments are about setbacks. The lawsuits are
5 about setbacks. The setbacks are too short to protect
6 the health and safety of the resident.

7 I'm giving you a whole list of resources. Some
8 are peer reviewed and some just factual data. Health
9 problems are real. Ice throw is real. Infrasound is
10 real, and shadow flicker is real. We don't want our
11 grandkids to start smoking or be exposed to Roundup, and
12 we would never buy a house with asbestos insulation. So,
13 likewise, we don't want to raise our families within
14 2 miles of a wind turbine.

15 I ask you to deny this project because the
16 setbacks are unsafe.

17 CHAIRMAN FIEGEN: Thank you. Go ahead.

18 MS. HUBNER: Good evening, Commissioners. I'm
19 Marsha Hubner from Avon, South Dakota. That's
20 M-A-R-S-H-A H-U-B-N-E-R. I live 10 miles from the
21 Beethoven wind project.

22 I would like you to think about wind energy as a
23 whole. Wind energy companies don't build wind projects
24 unless they are paid to by the taxpayer. Then they force
25 utility companies to buy their electricity through

1 government policy, and included in the lease that people
2 sign is a confidentiality clause prohibiting them from
3 speaking about any ill effects.

4 And then when the nonparticipants start to
5 complain about those ill effects they pay them with a
6 good neighbor agreement to keep their mouth shut. And
7 the people who do not want to be a part of this game
8 aren't allowed a proper setback that would make it
9 possible for them to live under or among the turbines.
10 So it's really quite a deal as a whole.

11 And this is not the first meeting where you have
12 witnessed passionate opposition. Once again, a stable
13 and friendly part of our state has turned into a split
14 community that will last for generations. Obviously,
15 there are negative effects on a community.

16 And there's a growing number of people
17 testifying that they have had to move away from their
18 homes because of the shadow flicker, audible sound, and
19 infrasound of the wind turbines.

20 We are talking about homes. You don't pack up
21 and move away for made-up reasons or take wind energy
22 industries to court with your own money to shut them down
23 because of the effects. But that is what people are
24 doing. The health effects are real.

25 Where is development when people refuse to build

1 new houses or move into an area covered with wind
2 turbines? The thousands of acres of land that is leased
3 to foreign or multinational corporations of big wind
4 includes not just the area, the roads, the transmission
5 lines, the concrete the turbines are on, but every acre
6 pertaining to the lease, fence line to fence line.

7 That ends other development for that landowner
8 for 50 years or more. Electricity prices go up, and
9 property values go down. Is that not a threat to the
10 economic condition of inhabitants?

11 The PUC has the authority to permit wind
12 industries with the criteria of measuring their effects
13 on the community's welfare, social, environmental health,
14 safety, and development. I hope that is your main
15 concern.

16 Because what I have witnessed with wind
17 development is that county commissioners and zoning
18 boards and it seems our state's government's first
19 priority is making the wind project possible.

20 How did it happen that the foreign corporations
21 owning these wind projects have taken priority over our
22 state citizens? That is wrong, and it's very
23 short-sighted.

24 I wonder how many times I have heard they're
25 just against wind energy, as if that negates anything I

1 have to say. I may see wind energy as it is done today
2 anyway as a colossal waste of taxpayer money and a land
3 grab, but that's not why I am here.

4 I want what we all should want, setbacks that
5 are safe and that protect the health and property rights
6 of those who made their home here first. If that keeps
7 the wind project from a few more turbines than they want,
8 then so be it. What do we owe corporations in France,
9 Canada, Germany, Italy, Spain?

10 Our first priority must be the safety and
11 well-being of the citizens of South Dakota. Because of
12 that, I ask you to please deny this Application.

13 Thank you.

14 CHAIRMAN FIEGEN: Thank you. And if you could
15 turn those comments in.

16 Thank you.

17 MS. SOHOLT: Beth, B-E-T-H, Soholt, S-O-H-O-L-T.
18 So good evening, Madam Chair and Commissioners and staff.
19 My name is Beth Soholt, and I am the executive director
20 of Wind On The Wires, a regional renewable advocacy
21 organization based in St. Paul, Minnesota and working
22 across a nine-state footprint, including here in
23 South Dakota.

24 Our members, both nonprofit and for-profit, work
25 on and support the development of wind and solar projects

1 in South Dakota and across the Midwest.

2 We've worked for a long time in South Dakota,
3 and we've worked since 2001 to foster the development of
4 wind power and new transmission lines to bring wind power
5 to market. As with any crop, if more wind is
6 producing -- can be consumed in the local area, the wind
7 must be transported to market where it can be used.

8 WOWA's worked side by side with electric utility
9 companies and others to integrate new renewable energy
10 into the regional grid.

11 I want to briefly address three issues this
12 evening. Number one, the shift to renewable energy that
13 is taking place across the United States; two, the demand
14 for renewable energy and the benefits wind farm
15 development brings to local communities and the state;
16 and, three, a few words about decommissioning.

17 First the shift to renewable energy. The Apex
18 Dakota Range Wind Farm is part of an exciting shift to
19 renewable energy that is taking place across the
20 United States. As reported by the American Wind Energy
21 Association, over 7,000 megawatts of wind power was
22 completed in 2017, representing \$11 billion of private
23 investment in rural communities and states.

24 Building new wind farms keeps American factory
25 and construction workers employed while bringing new

1 revenue to landowners and farm communities. The trend is
2 projected to continue this year and beyond since there
3 are many wind farms under construction or in advanced
4 stages of development in the Midwest.

5 Utilities are adding renewable energy,
6 particularly wind power, to their generation portfolios
7 for many reasons, but chief among them is that wind is an
8 economical choice.

9 The Apex Dakota Ridge Wind Farm will be part of
10 Xcel Energy's generation portfolio to help Xcel achieve
11 their stated goal of 85 percent carbon-free resources by
12 2030, and the resource will also serve South Dakotans.

13 Second, I want to talk about the demand for
14 renewable energy and the benefits to communities in the
15 state. The State of South Dakota and local communities
16 are poised to be able to take -- to provide a product
17 that many companies and electric utilities want.

18 Many companies have renewable energy or
19 sustainability goals and are looking for wind projects to
20 meet their needs. The wind resource in South Dakota and
21 neighboring states is one of the best in the country, and
22 with new transmission lines such as CapX2020 and the MISO
23 multivalued projects, South Dakota finally has some
24 additional outlet for its wind.

25 So what's in it for the state and local

1 communities? Landowner payments, local spending, such as
2 at hotels, restaurants, gasoline, taxes to the state, job
3 creation during construction and afterwards, and the wind
4 developer being part of the community into the future.
5 That's just a partial list of state benefits -- state and
6 local benefits that accrue for wind farm development.

7 Finally, a word about decommissioning a wind
8 farm. Decommissioning has been a topic that's often
9 brought up as folks have concerns about what would happen
10 to a wind farm if it ever ceases to operate. Apex has
11 filed a lengthy decommissioning plan in its Permit
12 Application.

13 CHAIRMAN FIEGEN: Thank you. If you could
14 submit those comments, that would be helpful.

15 MS. SOHOLT: Thank you.

16 MR. DUMMANN: Howdy. My name is Paul Dummann,
17 P-A-U-L D-U-M-M-A-N-N. I am a lifetime farmer in Grant
18 County. I've also sat on the Commission, Grant County
19 Commission, for 20 years. Thank you very much for the
20 opportunity to speak to you today, and thank you for
21 serving on the Commission. As being a Commissioner
22 myself in a small county, I know it's not all roses.

23 And, anyway, I'm here today to speak about this
24 wind farm. And if you look at the footprint of the wind
25 farm and the farmers that are involved in it, it looks to

1 me like the overwhelming majority of the landowners are
2 signed up in the wind farm, and they support it. And I
3 think as landowners, the people that own that land should
4 have certain rights. If they want to proceed with a wind
5 farm, a wind farm in their area, I think they should have
6 that right to do that.

7 As Terry Schlagel said, the small towns around
8 South Dakota are drying up. It isn't easy out in the
9 country. The farmers right now are having a hard time
10 and the wind -- the wind farms are harmless as far as the
11 environment is concerned and they bring a lot of money
12 into the economy, through the economy. They help the
13 schools, the counties, and the state.

14 I honestly have to say I sympathize with the
15 people that are against the wind farms. I have some very
16 good friends that own land that don't approve of wind
17 farms, and it's -- it's not easy to be on a commission
18 and you've got to make a decision one way or the other.
19 You have to go with the majority and you have to go with
20 your gut feeling and I believe that the wind farm should
21 be supported.

22 So thank you very much for your time.

23 CHAIRMAN FIEGEN: Paul, I'm going back to my
24 legislative years, years ago. Just asking, are you
25 testifying -- or giving comments on behalf of all the

1 Commissioners or --

2 MR. DUMMANN: No, I'm not. And I want to make
3 that very clear. I'm only speaking as an individual. I
4 am a Commissioner. I am not speaking for the Grant
5 County Commission.

6 CHAIRMAN FIEGEN: Thank you. You know we always
7 ask that question as legislators.

8 MR. DUMMANN: Yeah. And I wanted to say that,
9 and I forgot so I'm glad you reminded me. But I will say
10 in 20 years sitting on a Commission we have had one
11 meeting where we have had a group of people that opposed
12 the wind farms out of the 20 years and we've had, I don't
13 know, four, five, six wind farms come in and make
14 proposals to the Commission and we have had very little
15 opposition.

16 But I will say, you know, the opposition that we
17 have had have been some of my best friends, and it's not
18 easy to say I do support the wind farm. I think it's
19 good for the county and I think it's good for the
20 landowners and I think the landowners got that right if
21 they want to have wind towers, that they should have
22 them.

23 CHAIRMAN FIEGEN: Thank you. Thank you for
24 clarifying. Appreciate that.

25 MR. DUMMANN: Thank you, ma'am.

1 MR. HACKER: Hello. I am Kalin Hacker,
2 K-A-L-I-N H-A-C-K-E-R, and I'm a Lake Area Tech student
3 speaking on behalf of Joshua Clayton, J-O-S-H-A-U
4 C-L-A-Y-T-O-N.

5 "As a South Dakota resident and Grant County
6 landowner, I'm writing in strong support of the Dakota
7 Range Wind projects. The wind's potential to blow is one
8 constant which all South Dakotans are aware. Once
9 harnessed wind, provides a renewable source of energy
10 with no emissions and economic benefits to farmers,
11 landowners, and the local economy.

12 "Expanding wind power capacity in the state by
13 approving the Dakota Range Wind Permit Application and
14 project is a step towards continuing South Dakota's
15 tradition of harnessing renewable power sources. From
16 homestead windmills to hydroelectric power plants,
17 South Dakota has focused on harnessing the available
18 resources.

19 "South Dakota ranked number four as a state with
20 the greatest potential for wind energy by the
21 American Wind Energy Association. Yet we are ranked
22 19th for installed capacity. We can and should do more
23 to gain the benefits of wind production.

24 "Direct and immediate economic benefits will be
25 received by the farmers and landowners in the wind farm

1 permit area. New jobs will be created to manufacture,
2 construct, and maintain the wind project that benefits
3 the local economy and tax revenue for local governments
4 that will support schools, residents, towns in Codington
5 and Grant Counties.

6 "In addition to the economic benefits, there are
7 also environmental benefits of the wind production. Wind
8 energy is a renewable source with no emissions. Coal and
9 gas-fired -- powered plants consume water and emit carbon
10 dioxide.

11 "To supply South Dakota's wind energy with coal
12 or gas energy in the 2016 power companies should -- would
13 have consumed an estimated 236 million gallons of water
14 and emitted 466,000 metric tons of carbon dioxide.
15 Thanks to South Dakota's growing wind energy sector, that
16 waste and pollution will not occur.

17 "I believe the Dakota Ridge Wind I and II
18 projects will greatly benefit the local community and
19 state, which is why I strongly support the project."

20 Thank you.

21 CHAIRMAN FIEGEN: Thank you, Kalin. All right.
22 Next.

23 MR. LAU: My name is Dylan Lau, D-Y-L-A-N L-A-U.
24 I live in Watertown and attend Summit High School.

25 Hi. I'm Dylan. I'd like to start off real

1 smooth by saying that wind energy is definitely cleaner.
2 It's better than nuclear power plants because they
3 produce toxic byproducts and coal-fired plants because
4 they can slowly destroy our ozone layer.

5 We got wind going on here in South Dakota, which
6 is really useful if you have the right equipment to
7 harness it. And I can't see how people can dislike it
8 when it can add so much to the community and the people
9 around.

10 Say there's a person -- you might know them.
11 They're driving down in the country, and they see a bunch
12 of oil rigs. The thought might cross their mind, hey,
13 oil rigs. That's oil. That's good for my car.

14 They might drive down a different country path
15 and see a bunch of wind turbines, and they'll think to
16 themselves, wow, why would those ugly towers be in my
17 country?

18 I disagree with them, and I think that if you
19 take a more positive outlook, you might think, hey,
20 that's nothing but a big old field of flowers. Large,
21 very powerful flowers.

22 Here's a good example that I thought of of how
23 useful these towers are to certain farmers. Let's say
24 you have a set number of acres and you have a certain
25 amount of money per acre. All right. Now let's mix it

1 up. Throw a tower on half an acre of land. It's just
2 taking up half.

3 Now this tower gives you thousands of dollars of
4 extra income every year while only taking up half an
5 acre, which would make hundreds by itself, if even. What
6 else can you plant once and harvest for 30 plus years
7 with no input other than half an acre of land?

8 Another thing is that Apex is good for the
9 community. It brings people together. The employees
10 there are easy to talk to about the project and easy to
11 get along with. Tomorrow if you wanted, you could go
12 down there and talk to them about the wind project, and
13 they will answer any of your questions.

14 It's also good for people in the community who
15 sell things. It slowly trickles money down from the
16 farmers who buy something from a store owner who then can
17 keep the money in circulation.

18 If you're against this project, take a moment to
19 think about it. Think about wind towers in South Dakota.
20 Now stop for a second. Has life really changed for you
21 if they're up? Maybe your taxes are lowered. Maybe your
22 air is cleaner. And your electricity may be lower as
23 well.

24 I can't control the people and I can't control
25 the people's opinions but I can waiver them.

1 To finish off, I'm going to end with another
2 example of how useful the extra income is for farmers.
3 Let's say you're a farmer for the wind project and you
4 just bought a new set of tires for your pickup truck.
5 She's a beaut, isn't she?

6 Let's say you drove on those tires a couple
7 years now. They're pretty worn, but you don't have the
8 extra money to spend on tires so you'll have to wait it
9 out for another year.

10 Now let's go to the future where you have that
11 extra income from a tower on your land. So you've had
12 this same truck, and you're ready for new tires. Now you
13 have a chance to buy tires, and you don't have to risk
14 something happening to them or you on the same tires.

15 I would like to request that the Commission
16 approve the permit for Dakota Range Wind.

17 CHAIRMAN FIEGEN: Thank you.

18 MR. WOHLLEBER: Hi. My name is Arlyn Wohlleber.
19 That's A-R-L-Y-N W-O-H-L-L-E-B-E-R. And if I'm a little
20 nervous, I haven't had this many people on my backside
21 since the school board was up there, and those people
22 really don't want me to coach any longer.

23 I'm also the trustee and the executive for
24 Violet D. Wohlleber Estate, and I'm here in that capacity
25 tonight. So some of the words I'm going to tell you was

1 the wisdom of talking to an 86 year old lady at a kitchen
2 table.

3 First of all, I also hold licenses, health and
4 life, Series 63 and Series 66. So I knew when the
5 gentleman came out, made an appointment, and sat at that
6 table everything was above board. So I feel a little bit
7 betrayed when I read in a paper that my mom was
8 hoodwinked or that she didn't know what she was doing.
9 She very well knew what she was doing.

10 She watched the Otter Tail line go through on
11 the south side of our property, and she was for that
12 because she recognized that that progress was good for
13 all the people in South Dakota.

14 What would she have said if she would have heard
15 some people from way down in Avon come here to speak?
16 She might have said where were they when you were riding
17 that hayrack throwing 1,000 bales a day and we were
18 struggling to keep everybody on the farm? How did we get
19 through the 18 and 20 percent interest rates?

20 I watched her cry the day she paid the last
21 mortgage payment on the farm in 1981. She wished for
22 this farm to stay in our family. The revenue off of that
23 will help us to secure that.

24 We have about 400 acres of pasture so I was
25 somewhat concerned when I heard that it might be

1 affecting livestock. So I have a cousin who raises
2 purebred cattle out in McPherson County. They have had
3 wind generation on their ranch for 10 years. This is not
4 a small purebred operation. They run 1,000 cows.

5 I asked him, Does it scare the cattle? He goes,
6 No. In the afternoons if it gets hot, they sit under the
7 shade of the wind turbines. I go, What about wildlife?
8 He said No. What about this report that they come in and
9 raise havoc with the roads? He goes, You know what?
10 It's been the greatest thing for us because we got better
11 access to our pastures. It's cut down on time. We can
12 get better minerals and creep to the calves.

13 For me this would help and lessen the burden of
14 what property taxes are right now. I don't want to talk
15 about property tax issues.

16 One last issue on the livestock. I asked him
17 about fertility. He said their fertility rate runs about
18 2.5, which is actually 50 percent less than the state
19 average. So there's no change on that.

20 I thank you for your time, and I'd ask that you
21 approve the permit for the Dakota Range Wind.

22 CHAIRMAN FIEGEN: Thank you.

23 MS. HANSEN: Hello. My name is Alexis Hansen,
24 and that's A-L-E-X-I-S H-A-N-S-E-N, and I'm from
25 Clear Lake, South Dakota.

1 So wind power, however, is more than just these
2 big wind turbines because wind power is one of our oldest
3 sources of power. It was first used for things like
4 boats and grinding grains and pumping water. And we can
5 still use it to do all those things, but it can be used
6 on a much larger scale now as well.

7 And a report by the DOE's National Renewable
8 Energy Lab said by 2050 renewables could contribute to
9 80 percent to electricity, much of that energy being made
10 by wind power.

11 And allow me to enlighten you on some of what I
12 have discovered. Wind power has many advantages,
13 including the obvious ones that we've heard over and over
14 again, saying that it's clean, renewable, and relatively
15 cheap. So let me expand a little on those.

16 Clean. Wind energy doesn't require us to burn
17 through those nonrenewable resources such as coal. And
18 that causes greenhouse gases and pollution. All it takes
19 to create this energy is obviously wind. The kinetic
20 energy of wind is used to make the mechanical power, and
21 then the generators take that and convert that power into
22 electricity so we can all use it.

23 And wind is renewable. As much as wind can be a
24 pain sometimes, we won't go outside and it will just run
25 out one day. Especially not here in South Dakota. Other

1 ways of energy, such as fossil fuel burning, uses
2 resources that can run out one day, though.

3 Wind energy plants create many jobs as well.
4 The U.S. wind sector employed more than 100,000 workers
5 in 2016, and a wind turbine technician is one of the
6 fastest growing American jobs of this decade. According
7 to the Wind Vision Report, wind has the potential to
8 support more than 600,000 jobs in manufacturing,
9 installation, maintenance, and supporting services by
10 2050.

11 Now any idea, however, has to have a catch;
12 correct? So let me tell you about some of the
13 disadvantages but also argue them.

14 The first disadvantage is that they say that to
15 set up wind turbines and plants is outrageously
16 expensive. Now a typical wind turbine costs roughly 3 to
17 \$4 million to set up. And I know that sounds like a lot
18 of money, but to set up a coal-fired power plant costs
19 well over \$2 billion, and that's a lot more money. And
20 we have to remember to run wind turbines costs next to
21 nothing.

22 Now I want you to think of looking out your
23 window to see these windmills, which people say is going
24 to be something so terrible. But for me in my future I
25 would rather look out my window and see some wind turbine

1 than to see so much pollution that it's hard to see.

2 And I have people in my school, which I go to
3 Great Plains Lutheran High School in Watertown, and
4 they're from China, and they say that it's absolutely
5 amazing to be in South Dakota where you're actually able
6 to see the stars at night. And I wouldn't want that to
7 change for them.

8 Now I want to conclude with the fact that I
9 would like you -- I would like to request the Commission
10 to approve the permit for the Dakota Range Wind.

11 Thank you.

12 CHAIRMAN FIEGEN: Thank you. Now you're going
13 to see how Commissioners deal with -- we have to talk in
14 front of you because this is an open docket.

15 How many people -- I can't see the line. How
16 many people are in line? There's six people in line.
17 Are there any others that would like to comment?

18 Six, seven, eight, nine, 10, 11. 11.

19 So now the Commissioners are going to have a
20 discussion. So, Commissioners, what I'm thinking is
21 asking for new information.

22 Commissioner Hanson and Commissioner Nelson, if
23 there is a letter from somebody that is not present, I
24 would ask that you state that information, the name, and
25 then we will read that letter as Commissioners. And it

1 will be available on the website; right, staff? Or
2 you'll scan that in so everybody can read.

3 Do we want to limit any time here, or how would
4 you like to do it?

5 COMMISSIONER HANSON: I like the idea of what
6 you're saying. Everybody gets an opportunity to talk.
7 They just introduce the information, and if they have
8 something new, that's great.

9 CHAIRMAN FIEGEN: If you heard my fellow
10 Commissioner speak, at a public hearing they suggested
11 that what we do is to do new information. You get an
12 opportunity to talk. You still have your four minutes.

13 And then if you have a letter that is on behalf
14 of somebody else, if you can just state that information
15 and submit it, we'll read it.

16 So we'll continue.

17 MR. GOOCH: Thank you. My name is Les Gooch --

18 MS. FIEGEN: And, court reporter, you let me
19 know, Cheri, if you need a minute or two.

20 MR. GOOCH: G-O-O-C-H. First name L-E-S.

21 I am a third generation landowner within the
22 boundaries of the Dakota Range Wind Project. I grew up
23 in South Shore and Milbank but have not resided within
24 the county since I inherited the land. I currently live
25 in Sioux Falls. As a resident outsider I am unable to

1 vote on local or county issues, but I'm here now because
2 I want to let you know how I feel about this project.

3 Wind is totally free, readily available, and
4 never -- in never ending supply. With wind energy there
5 is a clean source of power, a renewable source which is
6 cost-effective, and in this case with the utility company
7 contracted to purchase the power generated.

8 As a landowner I have the opportunity to gain
9 more profitability from the land while minimally
10 modifying the available cropland for production. This is
11 something that will be around for a very long time to
12 come. It's not polluting anything, it isn't causing any
13 damage to anything, and it isn't hurting anyone. And
14 they are under contract to return the land to normal when
15 it ceases operation.

16 Grant County is like many rural counties here in
17 the Midwest. The population is shrinking while the cost
18 of schools and government continues to rise dramatically.
19 Since time began, this land has been for one purpose:
20 Agriculture.

21 I believe for the first time ever we have the
22 opportunity to enhance the production of the land through
23 energy, profiting the landowner, the schools, and the
24 government through a boost in taxation as well as the
25 involved utility companies through the sale of affordable

1 energy.

2 This will also impact in a positive way during
3 construction through jobs and benefit the local
4 businesses through those involved spending their pay
5 locally during construction.

6 There is always concern with what this will do
7 to a neighborhood. If you aren't familiar with this
8 area, please drive around. It's very sparsely populated
9 land we are talking about. And many of those living in
10 the affected area are actually signed on in agreement
11 with the project.

12 While I know this is merely my own opinion, I
13 think these turbines are very interesting to see. I love
14 driving through this area, seeing across the landscape
15 for many miles with the ag land at different stages
16 throughout the year. A few abandoned homes and farms
17 still struggling to stay standing and not a single person
18 in sight.

19 But I also worry about what will become as the
20 population continues to decline and there is no sign of
21 new progress for the future. This project presents that
22 future progress, and it does it in a positive way for
23 generations to come.

24 I would like to request that the Commission
25 approve the permit for Dakota Range Wind.

1 Thank you.

2 CHAIRMAN FIEGEN: Thank you. Appreciate that.
3 And you're our first one that had to go by the new
4 guidelines.

5 Just a reminder if you could try to give new
6 information. I know you wrote your stuff so it's a
7 little bit hard, and we'll give you grace.

8 But thank you so much.

9 Go ahead.

10 MS. PIES: My name is Brook Pies, B-R-O-O-K
11 P-I-E-S. I grew up in this community, and I hope to stay
12 here in the area after I graduate.

13 I'm not going to tell you that I know everything
14 because I don't, but I'm going to tell you what I do know
15 and how they've affected me and how they hopefully will
16 in the future.

17 As some of the past residents have mentioned,
18 this last summer they donated a lot of money towards our
19 Washington, D.C. trip, and it enabled me and five other
20 students to go there.

21 While we were there we were able to not only
22 participate in our national competition, but we also had
23 extra funds to go visit our national monuments and some
24 of the Smithsonian. And we also took a trip to the
25 Capitol building. We met with Mike Rounds, John Thune,

1 Kristie Noem, and we toured there. Without the money
2 donated from Apex Clean Energy, we would not have been
3 able to use the fullest potential that that trip gave us.

4 And they not only told us that they would
5 happily give us the money to help us out, but they told
6 us that if we ever needed help with things in the future,
7 that they would be more than willing to.

8 And now I go to school in Summit. And I'm more
9 for the arts. I don't do sports much, so I'm just going
10 to focus on that. We don't exactly have the highest
11 funds for our arts programs, as well as we have the
12 history club which took us to D.C.

13 The history club funds all the supplies and the
14 props that we need to compete to make it to the national
15 level. They pay also for historical trips that we take
16 and for re-enactors to come and to just enhance our
17 education.

18 Our drama department, we also struggle a little
19 bit. We did get a new light this year. It's the only
20 thing that we really have. And we are actually kind of
21 deprived if you compare us to other schools because when
22 we go to competitions we're not exactly prepared because
23 we don't know how to use the technology that they have.

24 And with the extra money that would be coming
25 into our school due to these wind turbines we would be

1 able to do funding that would help with our oral interp.
2 library. We could update it. And we could get the
3 technology that we need with our plays, and we can do
4 more with the history club.

5 As long as I can remember, I've been told to set
6 myself up for success and to set the next person up for
7 success. And that's exactly what I want to do. The Apex
8 Clean Energy will affect not only me, but my children as
9 well. And not only do I want to set up my children, I
10 want to see us as a community to set up the next
11 generation for success.

12 All in all, I would like to recommend the
13 Commission to approve this Dakota Wind Project for our
14 community so we cannot only create but be a part of
15 something that is bigger than just us because it's a
16 possibility for our community to thrive again.

17 Thank you.

18 CHAIRMAN FIEGEN: Thank you, Brook.

19 MS. BRINK: Sara Brink, S-A-R-A B-R-I-N-K, and
20 I'm from Codington County.

21 I'm just going to give you a couple blurbs real
22 quick. I'm a mom of a special needs child. I've just
23 drove my son down to Sioux Falls two weeks ago for a
24 medical appointment. It was night. He literally turned
25 around in his car seat to fixate on the wind turbines

1 along the Interstate.

2 So many children with autism do not have the
3 communication skills to effectively communicate their
4 needs. Thus, the constant wind turbine noise, coupled
5 with communication defects, could result in a significant
6 increase in aggressive behaviors among children with
7 autism.

8 Aggressive behaviors could also increase in
9 individuals with ADD and ADHD. And I say "could" because
10 no parent in their right mind would want their children
11 to be used as guinea pigs to find out if that is what is
12 actually going to happen. It is not fair to put our
13 children in these situations.

14 As us as adults, I don't want to live near one.
15 I think everybody has the right to put one on their
16 property, but I don't want one 1,000 feet from my
17 property line. I would like my kids to be able to go
18 outside and enjoy things and enjoy the outdoors, which is
19 why I moved out here.

20 One other point would be sensory sensitivity.
21 And this does not just apply to children with autism or
22 Asperger's or ADD or ADHD. This one specifically speaks
23 to children or people with Asperger Syndrome are
24 sensitive or even hypersensitive to certain sounds or
25 sensory stimuli, such as noise, smell, and light.

1 This could lead to a feeling of being overloaded
2 and often results in an angry outburst. This means they
3 live in fear of unexpected sensory stimuli in order to
4 avoid angry outbursts or anxiety. Would you ever want to
5 put somebody in the position where they are fearful to go
6 to their homes or fearful to leave their homes because
7 they don't understand what's going on?

8 One in every I think it's 160 children right now
9 are being diagnosed with autism. Imagine the children in
10 your communities right now who attend your schools and
11 who attend programs in your schools and how this is going
12 to affect them.

13 Thank you.

14 CHAIRMAN FIEGEN: Thank you. This is off the
15 record right now.

16 (Discussion off the record.)

17 CHAIRMAN FIEGEN: Go ahead with the spelling of
18 your name.

19 MR. BAUER: Okay. My name is Anthony Bauer.
20 It's A-N-T-H-O-N-Y, B-A-U-E-R. I live in South Shore or
21 the country around South Shore and I go to Summit High
22 School and I'm going to live right where the windmills
23 are and I feel that's kind of an important thing because
24 I want to move on and live here a long time because I
25 feel like this is one of the best places I've ever been.

1 I've also gone to Washington. You go to other
2 places and you see all of these trees and it's just not
3 beautiful like South Dakota and this place. You can see
4 for miles and miles and I feel like that's a great thing
5 about this place and I don't want to like lose that sight
6 because of windmills.

7 I was also a little bit concerned because my
8 family likes to go and do like -- have campfires and, you
9 know, have fireworks on the Fourth of July and stuff, and
10 I feel like if there's a bunch of windmills, those
11 blinking lights might distract you from looking at the
12 stars or something. If there's a bunch of blinking
13 lights, it might make it just lose that great part about
14 it.

15 And that's -- and the fireworks thing, and I
16 don't -- I believe that if you're doing fireworks or
17 something, it would look kind of bad just having like a
18 big burst of fireworks and having a bunch of blinking
19 lights behind it.

20 But yeah. I don't have much other than that.

21 CHAIRMAN FIEGEN: Thank you, Anthony. We
22 certainly appreciate that. You're off the record again.

23 (Discussion off the record.)

24 MS. MILLER: I am Carol Miller, C-A-R-O-L
25 M-I-L-L-E-R, from Bowman County, and I live near a wind

1 farm in Rhame, North Dakota.

2 Apex Clean Energy is developing another wind
3 farm in our area, and I am here today to address what my
4 experience has been living close to the footprint of a
5 wind farm.

6 The wind farm in Rhame went in operation about
7 eight years ago. The construction period is -- for this
8 project lasted about nine months, and everything worked
9 seamless. From my personal experience with Apex and from
10 people that I have talked to, they will show the same
11 respect in ensuring that our roads and personal property
12 are back in better shape than they were before the
13 construction.

14 This evening I am here -- hear numerous citizens
15 voicing concerns about negative impacts of the turbines.
16 From my firsthand experience living on an area of over a
17 dozen turbines in front of my front door, I have not
18 experienced any health issues from the turbines, and the
19 distance from my home ensures that we are not impacted by
20 them.

21 With the ag industry suffering over the past few
22 years, the wind industry is a fresh new income that will
23 greatly affect us for the better of years to come.

24 Many people are concerned about the impact to
25 the view of the turbines. The red lights bring a very

1 minimum disturbance to our property. The impact of our
2 view is minimal, just as the power lines when they went
3 in. It is -- it was a simple adjustment.

4 Our community has not seen any decline in
5 property values from the wind farm. The tax revenue from
6 the wind turbines actually add value to many properties
7 in the area. The idea of the wind turbines will hurt
8 property value is not true. From my and my neighbor's
9 firsthand experience near a wind farm, I would like to
10 request that the Commission approve the permit for the
11 Dakota Range Wind. Thank you.

12 MR. BORGHEIINCK: My name is Wayne Borgheiinck,
13 W-A-Y-N-E B-O-R-G-H-E-I-I-N-C-K.

14 (Discussion off the record.)

15 CHAIRMAN FIEGEN: That's off the record; right?

16 MR. BORGHEIINCK: Back to business.

17 What I'm hearing tonight is people on both
18 sides. Myself, I live just two blocks away here in
19 Waverly. That's my home. It's a small piece of land, a
20 little corner. That is my home.

21 I've been homeless in my life. I hear people
22 talk about what it's like to not be able to live
23 someplace because of something. I know what it is to
24 lose a home and not have any place else to go. If
25 something happened where I was not able to live there

1 anymore --

2 Because I have trouble too. I'm a disabled
3 veteran. You bring in certain sounds, it drives -- the
4 people with posttraumatic stress -- and I'm sure there's
5 some in this room -- could tell you this.

6 Now I had three semesters of economics at Lake
7 Area Tech with an instructor named Al Reader. If I
8 didn't get anything out of it, I learned that economics
9 is not just about money. When you do an economics
10 assessment study they forget the human aspects.

11 The economics is life. That's what I learned
12 from three semesters. So that people's lives that are
13 affected by this is also part of your economic study.
14 You can't separate the money from that.

15 Wind energy is important. It's good. I lived
16 with it on Buffalo Ridge in Minnesota. It can be good,
17 but it can be a nuisance. So the problem comes is how do
18 we make this work?

19 My little piece of land is not 1,000 acres. If
20 I have 10,000 acres and you want to put 10 towers out
21 there, go do it. But I do not have a right -- I have a
22 right to do that on my land. This is a rule of real
23 estate. By the way, I also used to be in real estate.

24 The rule of real estate is I can do anything
25 with my land as long as it does not interfere with the

1 guy next to me that also has a right to live on his land.
2 I believe it might even -- I can't say for certain, but
3 it may even be in the Constitution that every man has a
4 right to live on his own land in his own -- in serenity.

5 But if the guy next door has something that's
6 interfering with my peace and quiet -- and serenity -- by
7 the way, I did 22 years of military service all total,
8 and I believe I earned the right to say this. Okay.

9 If you got 10,000 acres, you got 1,000 acres,
10 you got 100 acres, you can put your tower out there and
11 you don't interfere with me, you have every right to do
12 it. But when you start interfering with my -- when I
13 hear these people talk about how it might interfere with
14 their life, when that interferes with my life, that's my
15 home. It's a little tiny piece of land in Waverly.
16 That's my home. I have no other place to go. You drive
17 me out, I have no other place to go. I'll be homeless
18 again.

19 So what I ask the Commission to do is take
20 another look at this before issuing the permit. I'm not
21 going to say don't issue it, but before issuing the
22 permit maybe modify it, make stipulations that other
23 people have talked about, change the rules to make sure
24 that the setbacks are far enough back so that if the man
25 who wants to use his land for wind towers, can benefit

1 from it, but also do not interfere with the people who
2 live in a small town like Waverly that this is our home.
3 This is --

4 This is my family. This is my family. It ain't
5 just a home. It's a family. So I would like you people
6 to consider all of these other families who have asked
7 you to consider their frustrations with the wind towers.

8 Even though the other people may not mind those
9 wind towers -- for example, the lady with the child with
10 a health issue, veterans who have posttraumatic stress.
11 I have Legion magazines, DAV magazines. I have all kinds
12 of good stuff. You need literature, I can take you down
13 to Sioux Falls, introduce you to people.

14 CHAIRMAN FIEGEN: Okay. We're off the record
15 now. Thank you.

16 (Discussion off the record.)

17 MR. BUNDE: My name is Larin Bunde, L-A-R-I-N
18 B-U-N-D-E, and I own and live on land leased to the
19 Dakota Range Wind Project.

20 It's been my observation that most people want
21 clean energy. Everybody wants cheaper energy. I think
22 this project is projected to do both and will do both.
23 Europeans have been doing it for decades.

24 I found Apex Energy and Dakota Range Wind and
25 their staff to be respectful, and they addressed all of

1 our concerns to our satisfaction. And I certainly
2 respect the opposition's very valid concerns. And I
3 believe they would be good corporate citizens and respond
4 like they did to us to our satisfaction, and so I would
5 like to see the project approved.

6 Thank you.

7 MR. TYLER: Tim Tyler, T-I-M T-Y-L-E-R,
8 Big Stone City.

9 Okay. I'm a resident of Grant County. I've
10 lived in Grant County I think about 46 years. I own land
11 there. And I'm here to ask that you deny this permit
12 under the responsibility that the permittee has to show
13 that it will not substantially impair the health, safety,
14 or welfare of inhabitants.

15 I'll speed this up more than -- just because of
16 the time. But blink, blink, blink, blink, blink, blink,
17 blink, blink, blink, blink, blink, blink, blink, blink,
18 blink. That would be five rotations of the rotor.

19 When I did this to my wife I did it in the speed
20 that it should have been. She really got irritated at
21 eight. She didn't know what I was doing, and I really
22 wanted to get your attention.

23 Just the blink -- the fact -- I'm a morning
24 person, and that's my understanding is when it's probably
25 the worst. I love being outside in the morning. And,

1 well, imagine your 3 year old pushing a chair up to the
2 light switch, even broad daylight, and just start on and
3 off, on and off with that light. That's what this is
4 going to be. And that cannot be healthy. It would put
5 me over the edge.

6 So there's so many other health benefits, but I
7 just wanted to hit on this one item. So I would
8 appreciate your consideration in denying the permit for
9 this reason and all the other reasons.

10 Thank you.

11 MS. TYLER: Yes. I did just about smack him on
12 the way after about the tenth blink.

13 I'm Kathy Tyler, K-A-T-H-Y T-Y-L-E-R, Big Stone
14 City, South Dakota, and I'm here --

15 (Discussion off the record.)

16 MS. TYLER: First of all, I want to thank you
17 for your time for traveling to our side of the state. I
18 know that at least one of you is pretty close to home
19 now, and I want you to imagine these beautiful hills
20 covered with 3- to 500-foot wind towers and what a view
21 that is not.

22 Before I go any further, I will confess that
23 about 10 years ago I as my dad's power of attorney signed
24 a contract with a wind tower firm. After talking and
25 listening to many people and both sides this past month

1 or so, I am so happy that they did not build in my
2 beautiful Coteau Hills. Money cannot buy the vistas that
3 we have or our health.

4 And the rest of my presentation was on health,
5 but I'm just going to give that information to your
6 people over there.

7 And as I was listening to the decommissioning
8 thing, a long time ago when they were talking about the
9 Big Stone II Project and the wind people came in and that
10 sort of thing and one of the things that I talked about
11 at that time is what happens to those wind towers after
12 25 or 30 years? And that hadn't been brought up before.
13 So I just did a little bit of research while I was
14 sitting there since you said I had to switch topics.

15 Okay. Decommissioning a wind tower. According
16 to this article, it's about \$200,000. They try to tear
17 them down and they try to recycle as much as they can.
18 But the blades themselves are a high-tech wonder of
19 composite material, which most experts agree cannot be
20 separated into its component materials and is, thus,
21 worthless for recycling.

22 The blades are composite. Those are not
23 recyclable. They can't be sold. The landfills are going
24 to be filled with blades in a matter of no time.

25 Thank you for your time today.

1 CHAIRMAN FIEGEN: Thank you, Ms. Tyler.

2 MR. FARRELL: Hello. My name is Matt O'Farrell,
3 M-A-T-T O-F-A-R-R-E-L-L. I'm a resident of Marvin,
4 South Dakota.

5 Many people say farmers and ranchers make a lot
6 of money. Some probably do, but I would argue that many
7 struggle financially. One of the biggest financial
8 struggles they face is property taxes.

9 With the latest property tax increase for Summit
10 school, my parents are paying over 30 percent of their
11 income from their land on just the property taxes. I
12 don't know of any other business that pays 30 percent of
13 their income on property taxes.

14 I'm not here to complain about the property
15 taxes, but I think it's important for people to know the
16 amount of taxes agricultural landowners like my parents
17 pay is substantially more than a nonlandowner with the
18 same income. Most of those taxes go to our school so
19 agricultural landowners are beneficial to the success of
20 our children.

21 I understand people's concerns and ask them to
22 be considerate to the landowner that is struggling and
23 wants to try and supplement some of their income by
24 having wind power on the property.

25 I've seen -- as seen tonight, there are some who

1 are not in favor of wind development and adamantly reject
2 new energy development for a variety -- for a variety of
3 reasons. Some of those opponents are from We Care
4 South Dakota. We Care stands for Wind Energy Concerns
5 About Rural Environment. As their name suggests, it is a
6 group.

7 If this group was concerned about wind energy
8 development, it would seem they'd be willing to have
9 productive discussions with wind developers about the
10 issues.

11 And to save time, I'm just going to turn that
12 in. If you guys would read it over about the concerns
13 and the misconceptions and the false advertising. They
14 said this meeting was in Waverly, Minnesota. It's just
15 full of miscommunication, misinformation.

16 Something else that I would say is Apex has been
17 more than willing to talk to anybody that I know of. For
18 the Dakota Range Wind Project they've been transparent
19 about the process, gained the trust of the community
20 members. The landowners who are signed up deserve clear
21 information, an honest company to work with, and they're
22 lucky to have found Apex.

23 I ask the Commission to approve Dakota Range
24 Wind.

25 MR. OWEN: My name is Kelly Owen. I ranch and

1 farm and own land. K-E-L-L-Y O-W-E-N. I ranch and farm
2 and own land in both Codington and Grant County.

3 For sake of time, I'll skip a few things here.

4 My family has ranched and farmed in Grant County
5 for five generations, and I hope my children have the
6 opportunity to do it.

7 In 2012 I built a house on the same place where
8 my great-grandfather built his house. If I knew that I
9 was going to be surrounded by these wind towers at that
10 time, I would not have built that house.

11 I don't think tonight we've really touched on
12 how big these turbines are. According to the Vestas
13 brochure, the state-of-the-art industrial wind turbines
14 currently proposed can be .25 kilometers or 820 feet at
15 the tip height for a 4.2-megawatt turbine, which is
16 larger than a Jumbo 747 jet.

17 The acceptable industry-recommended safety zone
18 is 500 meters or 1,640 feet in each direction of the
19 turbine. This makes a 193.4-acre industrial zone that
20 has limited and decreased agricultural use.

21 As a landowner, I'm not going to tell anybody
22 else what to do with their land, but when it starts
23 affecting me and my family, then I have to say something.
24 I cannot wrap my head around why we have a 1,000-foot
25 setback when in their own brochure their safety zone is

1 1,640 feet.

2 I'm not saying that we are against wind energy
3 or any economic development in the state. But, again, we
4 need to take another look at these setbacks. A lot of
5 these setbacks were made and voted on when the wind
6 towers were 300 feet tall. We're looking at
7 540-feet-plus wind towers, and the setbacks have not
8 reflected the change.

9 In closing, I would ask you deny the Dakota
10 Range Application because the facility will cause a
11 threat of serious injury to the environment or social or
12 economic condition of the inhabitants or expected
13 inhabitants.

14 Thank you.

15 MR. REIMCHE: Christian Reimche,
16 C-H-R-I-S-T-I-A-N R-E-I-M-C-H-E. I'm an aerial
17 applicator with Buffalo Ridge Air Spray.

18 And we're all for landowners' rights, but we
19 want you guys to know that we want to be able to help you
20 guys manage your land as much as possible by controlling
21 the pest, but it's going to be tough sometimes with the
22 generators out there, the power lines, where we just
23 can't do it. And just -- we guys -- we want you guys to
24 know that.

25 And another thing is it's really neat to look

1 at the infrared pictures of a crop yield around wind
2 generators. There is a loss around it. You can see
3 it in the infrared pictures. Just letting you guys
4 know.

5 CHAIRMAN FIEGEN: Okay. I think you were
6 number 50.

7 You know, I want to thank everybody for coming.
8 All Commissioners were taking notes. We were listening.
9 And what's helpful about tonight is it gives us ideas on
10 how to ask questions or what to look into during our
11 evidentiary hearing.

12 So we will be, as three Commissioners, at an
13 evidentiary hearing in the future, and we'll get to ask
14 questions and people will be under oath. So the facts
15 will be presented. We will make sure the facts are
16 presented.

17 You can make comments to the PUC up to the time
18 we make the decision. If you feel like you would legally
19 like to be part of the party status, make sure you
20 understand what it means and work with our staff.

21 Fellow Commissioners?

22 Vice Chairman Gary Hanson, do you have anything
23 else?

24 (Discussion off the record.)

25 CHAIRMAN FIEGEN: Go ahead.

1 COMMISSIONER HANSON: I'd just like to say thank
2 you very much. You were all extremely civil and
3 presented in a very professional fashion, and we
4 sincerely appreciate your comments.

5 And as Chairperson Fiegen said, this helps us
6 from the standpoint of we've been through this process
7 before, obviously on a number of other dockets. However,
8 some of you presented some completely new information,
9 and we appreciate that. We'll bring that, as she said,
10 to the evidentiary hearing.

11 And it's very important for you to understand
12 the process that we go through now in which it's similar
13 to a court process where evidence is presented, and there
14 is a process where the attorneys ask questions. And if
15 you are represented by an attorney -- now a lot of times
16 we might have 40 different parties represented by one
17 attorney.

18 If that's the case, then you have to work
19 through your attorney. As an Intervenor with party
20 status, you have the legal responsibilities. And so a
21 lot of people get an attorney because that's important.

22 However, don't be communicating information back
23 and forth unless you do it through your attorney, if you
24 have one.

25 Thank you.

1 CHAIRMAN FIEGEN: Back and forth to the
2 Commission?

3 COMMISSIONER HANSON: Yes. Back and forth with
4 the Commission. And --

5 Well, I'll leave it at that.

6 Thank you, Madam Chairman.

7 COMMISSIONER NELSON: Obviously, there are
8 deeply held and divided opinions on this subject, and I
9 just want to say two things.

10 First of all, thank you for bothering to come
11 out tonight and share your thoughts with us. And I would
12 echo Commissioner Hanson, my great appreciation for you
13 being able to do that very respectfully and carefully,
14 and we appreciate that.

15 Thank you.

16 CHAIRMAN FIEGEN: A reminder. We do have two
17 staff attorneys. They will represent -- could you guys
18 raise your hand. You can ask them questions of the
19 process, if you have legal questions of the process.

20 And then Jon and Darren are the analysts that
21 will be also helping present, so you can ask them
22 questions.

23 Thank you again for coming. We so appreciate
24 it. It was fun for me to be in a high school gym. And
25 drive safely home.

1 Happy Easter.
2 (The hearing is concluded at 9:10 p.m.)
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1 STATE OF SOUTH DAKOTA)

2 :SS

CERTIFICATE

3 COUNTY OF SULLY)

4

5 I, CHERI MCCOMSEY WITTLER, a Registered
6 Professional Reporter, Certified Realtime Reporter and
7 Notary Public in and for the State of South Dakota:

8 DO HEREBY CERTIFY that as the duly-appointed
9 shorthand reporter, I took in shorthand the proceedings
10 had in the above-entitled matter on the 21st day of
11 March, 2018, and that the attached is a true and correct
12 transcription of the proceedings so taken.

13 Dated at Onida, South Dakota this 20th day of
14 April, 2018.

15

16

17

18 /s/ Cheri McComsey Wittler
Cheri McComsey Wittler,
19 Notary Public and
Registered Professional Reporter
20 Certified Realtime Reporter

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001111

EL18-003 - In the Matter of the Application by Dakota Range I, LLC and Dakota Range II, LLC
for a Permit of a Wind Energy Facility in Grant County and Codington County, South Dakota,
for the Dakota Range Wind Project

Public input hearing on the Application on March 21, 2018, at
5:30 p.m., CDT, at Waverly-South Shore School Gymnasium,
319 Mary Place, Waverly, S.D.

Kelly Owen

Stocking, M SD 8 1267

Hi I'm Kelly Owen from the Grant and Codington Hills, there
are 6 proposed turbines. I am asking you to deny the Dakota
Range application because the facility will cause a threat of
serious injury to the environment or social or economic
condition of the inhabitants or expected inhabitants.

According to the Vestas Brochure, the state of the art Industrial
Wind Turbines currently proposed can be .25 kilometer or
820.21 feet tip height, 4.2 MW, are larger than a Jumbo 747 jet;
and the industry recommended acceptable risk safety zone of
500 meters (1,640 feet) in each direction. This makes a 193.4-
acre industrial zone that has limited and decreased agricultural
use. (Jonathan Rogers, Nathan Slegers
and Mark Costello 2011- *A method for defining wind turbine
setback standards* Johan Meyers and Charles Meneveau 2011-
*Optimal turbine spacing in fully developed wind-farm boundary
layers*)

Talk about how the turbine increases risk management,
insurance, who is liable, who pays

Talk about how your farming activities (sprayers) will change
and the serious economic impacts.

Then ask to deny again

My name is Richard Pike

Summit, South Dakota 57266

I am a landowner in the Dakota Range Wind Project. We have wanted wind development in this area for over 10 years. We have a great relationship with the team from Apex and trust them to do this right.

moved to Summit in 1968 at a price of \$80 an acre - now it's \$1000 an acre being sold for 1000 plus
There have been groups from out of the area trying to stop this and other projects. I don't want any group to decide what I can do with my own land.

People are concerned about their property values going down and from what I have learned the complete opposite is true. Property values actually go up.

wind energy is safe & healthy

People complain about the noise from the turbines. My son stood right under a turbine and said he could hardly hear anything.

now we have access lines to get power out
We want this project to help the townships, schools, and landowners.

interstate noise has not affect my land value
the income the landowner will receive provided will help me in my support of my farm

I would like to ask the commission to approve the permit for Dakota Range Wind.

Corey Amdahl,

Summit, SD 57266

My name is Corey Amdahl.

I am a landowner in the Dakota Range Wind Project. I have had a good working relationship with the guys from Apex over the last few years. I trust their team and they have been easy to work with.

We don't want these groups from areas like ~~Sidney Falls~~ ^{Avon} and out of state coming to our community trying to stir up trouble and shut down something that we have wanted for a while. We want this project in our community.

I would like to request that the commission approve the permit for Dakota Range Wind.

001114

I am Carol Miller and I live near a wind farm in Rhame, ND. Apex Clean Energy is developing another wind farm in our area and I am here today to address what my experience has been living close to the footprint of a wind farm.

The wind farm in Rhame went in to operation about 8 years ago. The construction period for this project lasted about nine months and everything worked seamless. From my personal experience with Apex and from people that I have talked to, they will show the same respect to ensure that our roads and personal property are in better shape than they were before the construction.

This evening I have heard numerous citizens voice concerns about negative impacts of the turbines. From my firsthand experience, living with over a dozen turbines in sight of my front door, I have not experienced any health issues from the turbines and the distance from our homes ensures that we are not impacted by them.

With the Ag industry suffering over the past few years, the wind industry is a fresh new income that will greatly affect us for the better for years to come.

Many people are concerned about the impact to the view from the turbines, the red lights bring a very minimal disturbance to our property. The impact of our view is minimal, just as when power lines went in, it was a simple adjustment.

Our community has not seen a decline in property values from the wind farm. The tax revenue from the wind turbines actually adds value to many properties in the area. The idea that the turbines will hurt property values is just not true, from mine and my neighbors' firsthand experience near a wind farm.

I would like to request that the commission approve the permit for Dakota Range Wind.

Coral Miller



Bauman, ND
58623

Hello everyone! My name is Alexis Hanson.

What is the first thing you think of when you hear me say wind power? Many of you are probably picturing the big wind towers, that's typical. Wind power however is more than just the big towers. Wind power is one of the oldest sources of power, first used for boats, grinding grains, and pumping water. Now wind can still be used to do all those things, and it is but it is also used on larger scale now as well. A report by the DOE's National Renewable Energy Lab said that by 2050 renewables could contribute to 80% of American electricity. Much of that energy being made by wind power.

Now, if you're like me at first, you're skeptical on if wind power is actually the right decision. Allow me to enlighten you on what I have discovered. Wind Power has many advantages, including the obvious ones that we have heard over and over, it's clean, renewable, and is relatively cheap. So, let's expand on those. Clean, wind energy doesn't require us to burn through natural gases and nonrenewable resources that cause greenhouse gasses and pollution. All it takes to create this energy is obviously, wind! The kinetic energy of wind is used to create mechanical power. The generators then convert that power into electricity so that we can all use it!

Renewable, wind is a renewable resource. As much as wind can be a pain sometimes, it won't run out one day. Other ways of energy, such as fossil fuel burning, use resources that CAN someday run out. Imagine if all our energy relied on a nonrenewable resource and then one day it all ran out?

These Fossil fuels help to transition into the advantage of Wind power being relatively cheap. The U.S currently depends on fossil fuels that are imported into our country. Strains on the supply of fossil fuels are likely to increase the cost of these resources and leave the U.S economy exposed to international market (VOL-A-TIL-ITY)**volatility**. With wind power we wouldn't have to rely on these other country's resources for our power because our power would come from our wind! Yes, we would have to pay to set up the towers and energy centers but after their installation the cost to maintain them is next to nothing. Wind energy is one of the lowest priced energy sources available today, costing between 2 and 6 cents per kilowatt-hour. This is also good because the cost of wind energy does not change like the prices of fossil fuels. Wind energy also is enabling U.S. industry

growth. Wind has an annual economic impact of about \$20 billion on the U.S. economy.

Wind energy plants also creates jobs. The U.S wind sector employed more than 100,000 workers in 2016, and a wind turbine technician is one of the fastest growing American jobs of the decade. According to the Wind Vision Report, wind has the potential to support more than 600,000 jobs in manufacturing, installation, maintenance, and supporting services by 2050.

Now, any amazing idea must have a catch, correct? You may think I'm crazy but now I'm going to tell you some disadvantages, but I'm also going to argue them. The first disadvantage is that the set up of wind turbines and plants is outrageously expensive. Now a typical wind turbine cost roughly \$3-4 million to be installed. I know what you're all thinking, that's a LOT of money! BUT! To build a coal-fired power plant costs well over \$2 billion! That's a lot MORE money! We need to remember that after a turbine is built then it is next to nothing to run. Once a coal plant is built then you need to continue to pay to run it and gather coal.

I'm going to combine the next few because I feel like they can be. A few disadvantages are view interruptions, noise, and wildlife dangers. First, worrying about the view. I'm sure that some people don't want to look out their window and see windmills all over, but maybe some people do. Why do I say that? Because I'd rather see a windmill than having so much smog that I can't see anything. Seeing the windmills is a constant reminder that we are saving our planet, our home. I am puzzled on how seeing smog and pollution sounds more appealing than a windmill. Noise is the next disadvantage. Noise however should be the least of our problems, in my opinion. Windmills do make noise, yes but I think the advantages overcome this disadvantage. Wildlife dangers. Don't get me wrong, me arguing this does not mean I'm an animal hater, in fact I am an extreme animal person, I'm a zookeeper for Pete's sake. However, the number of annual bird fatalities, around 20,000, is tiny compared to transmission lines or even other animals! Today, even the Audubon Society supports wind power, recognizing that global warming causes a far greater threat long-term to all animal populations, not just birds and bats. The National Audubon Society protects birds and their habitats, so if they are supportive of wind energy despite

this disadvantage I think this shows the real **HERE** And I'm sure that the occasional bird that runs into a windmill won't cause them to go extinct. This I'm pretty sure is called natural selection.

I would like to request the commission to approve the permit for Dakota Range Wind.

Submitted by: Dylan Lau

Watertown SD



Hello, my name is Dylan Lau. Well to start off, wind energy is a cleaner energy. It's much better than nuclear plants and, because coal plants destroy our ozone layer. We got this wind thing going on and I don't see how people who are far from the project be complaining about it. Have you ever seen a Wind Farm? It's quite a sight to behold. I think of it as one of man's great accomplishments.

If you saw a bunch of oil rigs around, you'd think "hey that's good for my car." If you saw a bunch of wind towers around. You'd might think "what are those doing around here?" When you should be thinking "Hey, those are supplying my everyday electricity use." These people from other areas think what are these wind towers doing here? They're noisy and they take up a bunch of space. People say they look ugly, but if you look in a more optimistic way, you'll see a field of flowers, very large powerful flowers!

Another point of yours, is the shadow flicker. Well, to me, complaining about the shadows of something is like seeing your own shadow and thinking "Aaah! What's that? My shadow?! No. Not happening, I'm calling the police. We're taking out the sun because I don't tolerate shadows!

Here's an example of how useful these towers are to farmers:

Let's say you have a set number of acres that you make a certain amount of money per acre. Add a Wind Turbine to that and you get thousands of dollars more in income added to that land and all the land you lost was half an acre, which doesn't make too much profit per year by itself anyways. What else can you plant once and harvest for 30 years with no input other than a half-acre of land.

Another thing is that Apex is good for the community. It brings people together. The employees there talk to people about the project and are easily approachable. Tomorrow if you wanted, you could go to the summit location and talk with them and learn everything you need to know easily and for free. Also, they're putting money in pockets of the local farmers and our community. In fact, they will be bringing in hundreds of thousands of dollars into my school here in Summit.

With you naysayers

I can't control the people and I can't control people's opinions, but I can waver them.

If you are against this project. Take a moment and think about it. Think about Wind towers in South Dakota. Now, stop for a second, how much has life really changed for you? Maybe your taxes have lowered, and your air is cleaner. And your electricity has lowered because of the wind turbines that you were so against.

It's also good for the community that sell things. Hopefully, they are profiting from the influx of income from this wind farm because people can spend more money on their products which creates taxes.

To finish off, I'm going to end with another example of how useful this extra income is to the farmers:

Let's say you're a farmer before the wind project, and you just bought new tires for your pickup truck, she's a Bute, isn't she? Let's say you drove on those tires for a couple years now. Well, your tires are pretty worn out and you say to yourself "I should get some new tires for ol' veronica my truck cause these ones are starting to wear out quite a bit. (probably from all that drag racing and drifting I've been doing with her)" After you look into it a little bit, you decide you can't get tires this year because you got to keep food on the table. "oh well," you say "Hopefully these can last another year" so you wait another year and get your tires. Well, let's fast-forward into the future when you have a few wind turbines on your land brining in thousands of dollars extra income, once again, you need some new tires, and because of all this extra money, you can afford it. But maybe you'll get one of those fancy new trucks, ol' veronica is getting pretty worn... Oh yes! I'm going to use this extra cash and I'm going to get me a Chevy!

I would like to request that the commission approve the permit for Dakota Range Wind.

Dylan Lau



Watertown SD

LES GOOCH

SIoux FALLS, SD 57110

My name is Les Gooch

I am a third generation land owner within the boundaries of the Dakota Range Wind project. I grew up in South Shore and Milbank but have not resided within the county since I inherited the land. I currently live in Sioux Falls. As a resident outsider, I am unable to vote on local or county issues, but I'm here now because I want to let you know how I feel about this project.

Wind is a totally free, readily available, and in never ending supply. With wind energy there is a Clean Source of Power, a Renewable Source, which is Cost Effective and in this case with a utility company contracted to purchase the power generated. As a land owner, I have the opportunity to gain more profitability from the land while minimally modifying the available crop land for production.

This is something that will be around for a very long time to come. It's not polluting anything, it isn't causing any damage to anything, and it isn't hurting anyone, and they are under contract to return the land to normal when it ceases operation. Grant County is like many rural counties here in the Midwest, the population is shrinking, while the costs of schools and government continue to rise dramatically. Since time began, this land has had one purpose, agriculture. I believe for the first time ever we have the opportunity to enhance the production of the land through energy, profiting the land owner, the schools and government through a boost in taxation, as well as the involved utility companies through the sale of affordable energy. This will also impact in a positive way during construction through jobs, and benefit the local businesses through those involved spending their pay locally during construction.

There is always concern with what this will do to a neighborhood. If you aren't familiar with the area, please take a drive around. This is very sparsely populated land we are talking about, and many of those living in the affected area are actually signed on in agreement with the project. While I know this is merely my own opinion, I think these turbines are very interesting to see. I love driving the area, seeing across the landscape for many miles, with the ag land at different stages throughout the year, a few abandon houses and farm building struggling to stay standing and not a person in sight. But I also worry about what will become as the population continues to decline, and there is no sign of new progress for the future. This project presents that future progress, and it does it in a positive way for generations to come.

I would like to request that the commission approve the permit for Dakota Range Wind.

My name is Alice Moyer

Water town, SD

I am a landowner in the Dakota Range Wind project. Our family has been farming this land for the past few generations. The wind always blows in South Dakota, so we might as well harness the energy from it.

Wind energy is not a new technology. It used to be used in our area for grinding corn/grain, pumping water (and creating electricity). We used to have batteries in the basement to capture the generated electricity and store it for when the wind wasn't blowing.

75 years ago wind

~~Coal & its local~~
↓

This 75-year-old technology is still being used today and we want this project in our community!

It will also help create jobs, benefit the local townships & schools with tax revenue.

I would like to request that the commission approve the permit for Dakota Range Wind.

I'm Sean Coyle, I'm from ____ and am a student at LATI pursuing a degree in ____.

I chose a career in wind energy operations because it is a rapidly growing industry and I wanted a long-term career where my skills would be in high demand. The technical skills for a job as a wind turbine tech or in wind farm operations can be learned in just two years at one of numerous Technical Colleges in South Dakota.

Our community is extremely to have LATI in the area! Lake Area Technical Institute has outstanding programs in Energy Operations and Energy Technology in Watertown. These programs are helping ensure the energy industry has the well-trained employees it needs and is giving South Dakotans an opportunity for great, high-paying careers. The program at LATI has over a 98% job placement rate and has been named the top technical schools in the country.

I'm extremely fortunate to be on track to completing my degree (*debt free*) thanks to, South Dakota Works, a scholarship fund.

SD Works Scholarship requires that technical college graduates stay in South Dakota and complete two years of work before leaving South Dakota. **Additional info on scholarship?** Myself and dozens of others on the SD Works Scholarship program, are betting years of our careers and a major financial investment because the optimistic outlook of wind energy in our state.

Last fall South Dakota Governor Dennis Daugaard wrote that, "Wind power has contributed more than \$2 billion in capital investments to our state for the construction and maintenance of the 14 wind projects now in operation." These wind farms have also brought nearly 2,000 good-paying jobs to South Dakota.

An analysis of South Dakota wind development by the Environmental Law & Policy Center found that a 250 MW project in South Dakota, "would create about

500 direct construction job-years and an additional 500 indirect and induced job-years.” This includes the service and retail industries which support the project, construction workers, such as coffee shops and motels. During its operating years, “a 250 MW project will employ as many as 23 wind technicians to maintain the turbines, 44 jobs with suppliers and an additional 55 indirect and induced jobs.”

As [REDACTED] mentioned, the country's fastest-growing occupation is wind turbine technician, according to the Bureau of Labor Statistics — with numbers expected to more than double over the next decade. The wind industry is one of the top three fastest growing occupations, according to the Bureau of Labor Statistics (<https://www.bls.gov/ooh/fastest-growing.htm>).

The way we live and communicate has changed completely in just a few decades, new technology has taken over many careers. With SD Works Scholarship and great technical colleges, South Dakota is preparing for the future by arming young people with the skills necessary to meet the new demands of industry. Wind and Solar jobs are the fastest growing job segments in the country. These projects can keep young people home, in SD, who would otherwise move away to find employment. I’ve seen many friends leave the state to pursue other careers and opportunities because there were no options for a good career near home. If I wasn’t pursuing this career path, I’d like be — —???? (I have no clue where I’d be and likely pursuing a degree I wouldn’t use after graduation while I pile up debt.)

Young people across the country are excited for clean energy. Most of the supporters here tonight look to be near or over retirement age, they won’t have to live with the impacts of wind projects for the entire 25+ year life time and the decommissioning of the project like myself and my wife (hopefully) will. Young

people want clean energy, we'll be alive a lot longer and be left to deal with increasing energy costs and pollution. The shift to cleaner energy is happening, as technology improves and the cost of renewables declines.

I hope you'll consider all the way wind development is impacting SD, young people, the environment and economy and approve the permit.

[REDACTED]

Watertown SD 57201

profits over people - set backs would make the project impossible

PUC Application Dakota Range I, LLC and Dakota Range II, LLC for a Permit of a Wind Energy Facility

Kristi Mogen- Twin Brooks SD, please deny the Dakota Range Application. My family and I already fled one home because of energy companies using us as guinea pigs destroying our health, land, livestock, and wealth. We have dealt with multinational companies and accidents. They are so big not even the state will be able to enforce its rules, let alone local community ordinances. I question if wind participants understand what they have signed or the risk they have put the community in, with these confidential contracts. If everything is so great, why have confidentiality clauses?

Why not
Contract
Pro Value
Property
before
@ 1000
Pro 1000
Pro 1000

Were the contracted landowners planning to retire on this income, only to find out, that plans changed, there will not be a turbine on the property and NOW you will be living under a 500 ft, health killing monstrosity for the rest of your life? If these industrial turbines go in you will lose most of your property value and now can't afford to sell and move away? I know I've been there. Property value, use and enjoyment is diminished. The study by Martin Heintzelman & Carrie Tuttle 2011 – states "values in wind shadowed properties within 1-3 miles of an industrial wind turbine had a negative impact from 15% to 31%. Kurt Ckielisch 2009- *Wind Turbine Impact Study* "...if the property had an industrial wind turbine the value decreases by 65%." In yesterday's Grant County newspaper ad by [REDACTED] it urges you to consider the view of 95% of the people living near wind turbines. He doesn't say they are under confidentiality agreements and can't say anything. Please don't sign away your constitutional rights.

Are there state laws that void the contract if the project isn't started with in a certain amount of time? PUC Board, are any of the submitted easements voided because of state law?

Were you sold a bill of goods just so this out of state company could get a cheap fence to fence easement with the right to assign the lease or easement to a multinational company? Who is the number one buyer of the easements? Will you receive any payment when the easement is resold, or have any say to who or what can be done on your land? Who holds the liability? With the reassignment did the Industrial Wind Turbine company relive itself of all liability? As per taped Industry testimony at the Codington Planning and Zoning hearing on March 12th, an industry representative said decommissioning costs \$170,000K per turbine. That does not match what was submitted in the PUC application.

PUC are there any "bad actors" soliciting investment with no accountability in association with this or any Industrial Wind Turbine contracts or applications?

For your health, your safety, and your wealth and for the greater community please contact an experienced attorney if you feel you signed a contract under misrepresentation, you feel it might be fraudulent or forgery, or non-compliance with certain legal/statutory requirements.

PUC protect our rural communities, please deny this permit. Many studies have shown Industrial Wind Turbines damage the health, safety, welfare, unduly interference with orderly development, and serious injury to social and economic condition of inhabitants.

Kristi Mogen



Twin Brooks SD
57269

My name is Wade Falk

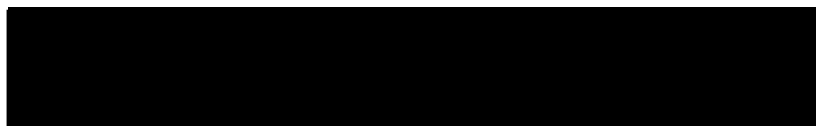
I'm sure in this rural community I don't have to tell anyone here that the farm and agriculture economy isn't where it needs to be. The wind farm would bring much needed income to the landowners. The tax base and you know how our economy works, would trickle down to main street and beyond.

Thank God for good timing! Dakota Range Wind would help everyone in the county just when we will need it most if things don't turn around soon. Lord willing the Ag economy should turn around. The added income would only help the community prosper.

I hope this decision to let them come in will be as simple to you as it is to the landowners who have signed on. This community, this county, and this country needs it. We want it! We are thankful it should be coming soon.

I would like to request the commission to approve the permit for Dakota Range Wind.

Thanks!



Stockholm SD 57264

I would like to share the following prepared statement on behalf of the Governor's Office of Economic Development, which would urge your favorable consideration of the benefits that wind energy projects such as this one, have for South Dakota.

GOED sees tremendous opportunity for our state through investments in wind energy. South Dakota's wind resources continue to attract attention at a national level, and my office regularly receives inquiries about possible projects here. Each of those projects represents economic development potential through capital investment in our state as well as good paying jobs in many of our rural areas.

Apex Clean Energy is an excellent example of the kind of project we support at GOED, and we have been working with them for some time to ensure South Dakota remains a top choice for their planned investment. The specific project subject of today's proceedings, the planned Dakota Range Wind Project, would encompass approximately 300 megawatts of power generation in the state. This capacity would be brought about by over a \$400 million in investment in South Dakota, and generate considerable economic impact to the area through tax revenue as well as job creation.

At GOED, we believe the future of energy production in South Dakota is here and it is real. It is obvious that renewable energy provides a secure, domestic and sustainable source of energy for our state and nation—be it solar or wind. We see tremendous economic development opportunities from these types of projects.

On average, more than 25 percent of South Dakota's power generation comes from wind power. As a matter of fact, South Dakota currently has

over 980 megawatts of wind power capacity and produces enough energy to power more than 260,000 homes.

But this is what excites us even more: we have the *potential* to produce more than 3 million gigawatt-hours of energy on an annual basis, and according to the PUC, if South Dakota was able to harness the entirety of that wind energy potential, we could provide power for almost the entire United States!

While we don't currently have that wind harnessed, South Dakota does rank in the top five states for wind energy potential. We believe our wide open spaces and high quality wind resources can provide much more wind power for the citizens of our state, as well as those in parts of the country that do not enjoy South Dakota's ample wind resource.

In the past decade, South Dakota has seen tremendous job creation and capital investment in renewable energy. Wind power has contributed more than \$2 billion in capital investment and directly created more than 500 jobs. These projects produce ongoing revenue streams for our state – revenue that doesn't depend on taxes on our citizens. And many of the jobs created by these projects are excellent, high-wage jobs based in our rural communities.

We recognize there is an important local discussion that must take place concerning any project, and therefore we do not take a position on siting the projects such as this. However, my office sees clear benefits to expanded wind power production in our state and is quite pleased to offer our support for expansion of wind energy in South Dakota. I would urge your favorable consideration of the project. Thank you.

My name is Steve Schaefer.

I am a land owner in the Dakota Range Wind Project. I have been hearing about wind development in this area for the past ten years, and Apex is the first one to follow through.

In our area we have a lot of rocky pasture land, very few people, and a lot of wind. It is an ideal area to have a wind project. We all want our electricity, and this creates clean and renewable electricity. This project would bring money to the landowners, counties, townships, and schools.

[REDACTED]
[REDACTED]
[REDACTED]. We want this project built!

Therefore, I would like to request the commission approve the permit for the Dakota Range Wind Project. Thank you.

[REDACTED]

HAWCOCK, MD. 56249

... ..
... ..
... ..

Dakota Range Wind Meeting

Waverly, March 21st. 2018

5:30 p.m.

Mr. Chairman
Members of the SD Public Utility Commission

My name is Leonard Stengel from Milbank. I was born and raised on a farm in Grant County and lived most of my life in this vicinity. The land that I have is recorded as RIVERVIEW ESTATE -LLP which is my corporate name for real-estate that I have.

I first owned land in Farmington Twp., in 1952 and 1957. Later bought land in Mazzeppa Twp. In 1958, which is the land under contract with Dakota Range. We have had pleasant working relations with Dakota Range and find the people in this area very good to get along with. To the best of my knowledge we have had no trouble permoting Wind Farms.

I was first exposed to wind Farms in 2006. At that time I was 84 years old and looked forward to receiving a little wind power money for my final retirement. I'm still waiting and will be 96 at my next birthday

Summit School is building on, we need help with township and county roads, and we have young people going to college all of which require financial support.

We have a lot of wind energy to spare and encourage the SD Public utility Commission to look with favor on granting permit for the Dakota Range project.

I personally encourage and support the final approval of the Project.

Thank you for your time with us.

Leonard Stengel, Land owner.

Leonard Stengel

Milbank, SD

My name is Linda Lindgren and I live with my husband on his farm at [REDACTED] South Shore. He has lived on this farm all of his life. I on the other hand am new to the area as I moved here in 2013.

I am daily amazed by the natural beauty all around us. The Wild Turkeys, Deer, pheasants and geese flying overhead. Rolling hills and open skies and pastures and fields going on seemingly forever.

Yesterday I saw a bald eagle between South Shore and our home. The wild turkeys seem at times to come around daily in our area. We soon might need a Turkey crossing sign on the road in front of our house.

Wildlife is so beautiful and essential to our fragile ecosystem. So important in fact that there is a law against killing Bald Eagles. Do any of you know what the penalty for killing a bald eagle is? I will tell you. If a non-developer kills a bald eagle the fine is up to \$250,000 and the person can face up to two years imprisonment.

*A story in the Washington Times reports that Bald and golden eagles may be legally killed or injured in the thousands by high-speed turbines (reaching 170 Miles per hour), under new regulations released by the Obama Administration. The rules, which affect individual wind-energy companies that plan to operate the technology for up to 30 years, allows up to 4,200 of the birds to perish. The U.S. population of bald eagles stands at roughly 143,000, while the Fish and Wildlife Service puts the number of golden eagles at 40,000. 4,200 endangered bird-deaths per company is bigger than it sounds. There are nearly a dozen such "companies" which means (for 10) a whopping 42,000 bald and golden eagles are permitted to be killed by wind developers. The 4,200 limit is fake. Wind developers can break up their corporations into smaller ones.

I am amazed at all the money people spend to travel to our area to go hunting and fishing. It is something they enjoy and it is a good way to share the beauty of our area and the money that comes in helps support the beauty without changing it. Money is spent on hotel rooms, meals, equipment and travel. This will greatly affect the draw that our beautiful state has to offer. Less animals to hunt because of the damage to the ecosystem and less beauty with the wind towers higher than the statue of liberty, marring the beautiful and natural landscape.

*Pages 94 and 95 of Paradise Destroyed by Gregg Hubner

Linda Lindgren

[REDACTED]
South Shore, SD

57263
[REDACTED]

Wind power is Not Green!

I always thought that wind power is green. After all, wind is free and natural. In fact, when you study the effects of wind towers and what goes into them you will see it is just the opposite.

You need a good wind of course for wind power. You also need petroleum and natural gas and coal. It takes tons of coal to make the steel for these giant towers, petroleum for the blades. To keep everything inside the tower working smoothly you need lubrication which means oil.

Making these towers requires tons of rare earth minerals which are mined in China. Obtaining these minerals creates major damage to the earth mainly in China.

Electric companies are forced to buy the non- constant electricity at a high price, while still having to maintain a constant source of electricity to keep the grid running smoothly. Wind power is not constant.

Wind power negatively affects the health of animals and people due to the sound that you can hear and the sound that you can't. The flicker problem, underground vibrations, ice on the blades flying off, etc. to name a few are some of the problems caused by these towers.

How is using tons of fossil fuels, rare earth minerals and oil to make and maintain these huge towers going green? They harm the environment, people's health and the ecosystem.

Please do the research and don't be fooled.

Linda Lindgren

[REDACTED]

South Shore, SD

57213

[REDACTED]

March 20, 2018 Dakota Range PUC Community Meeting – Outline and References

Jim Newcomb, Founder 2006, SummitWind, LLC

Issue: INFRASOUND - FEELINGS VS FACTS -

I can UNDERSTAND your fear of health issues. It is tough enough just getting old. Let's not have another added risk to KEEP US AWAKE at NIGHT.

There has been a long discussion on NOISE from wind turbines affecting our health. It matches up with concerns we have had with MICROWAVES and TRANSMISSION lines. It is easy to ATTRIBUTE a fear of poor health to CHANGES occurring around us. STRESS is involved. FEAR is involved. It is like the first time I operated a combine. STRESS and FEAR were a real problem at FIRST.

Let's examine the FACTS on INFRASOUND:

1. www.wecaresd.org/research.html - Research suggested by the ANIT-WIND GROUP was successful in deterring wind development in LINCOLN CO – a more HEAVILY populated and a higher tax base location than here. I PURUSED some of their LIBRARY. There is some good information and some CLEARLY OUT OF DATE, INCOMPLETE and IRRELEVANT information.
2. Related to INFRASOUND – here is a better SOURCE:
<https://www.theatlantic.com/science/archive/2017/06/wind-turbine-syndrome/530694/> In this article it discusses how one of the researchers, Nina Pierpont, CHANGED her CONCLUSION about INFRASOUND based on FACTS not FEELINGS – focus was too much on symptoms rather than causes.
3. Geoff Levanthall, a senior U.K. acoustician, I quote an EXAMPLE: “The proportion of sleep disturbance, which people attribute to wind turbines, is not very different from the proportion of sleep disturbance reported in GENERAL — about 30 percent. So a lot of people wake up during the night, and if they happen to live near a turbine, they say it was the turbine that woke them up.”

Similarly, it might be only a MATTER of TIME before wind turbines are widely considered a safe, viable clean-energy alternative to fossil fuels, like microwaves and transmission. “Right now there is no EVIDENCE of adverse effects other than through stress,” Leventhall says. “People’s concerns and their feelings ARE REAL. It’s how their FEELINGS have arisen, which are not FACTS.”

The growing list of SYMPTOMS reportedly caused by infrasound arguably culminated in the 2009 publication Wind Turbine Syndrome: A Report On a Natural Experiment, by Pierpont. Her list includes: panic, sleep disturbance, headache, tinnitus, dizziness, nausea, and visual blurring. This list has since become central to a growing anti-wind community, but has not been recognized by any FORMAL international classification. That is to say – unproven. No CAUSATION.

Today there are more than 2,200 anti-wind groups globally. We should not accept information that is CLEARLY OUT OF DATE, INCOMPLETE AND IRRELEVANT! I recommend the SDPUC to accept the development plan for Dakota Range as presented. Copies of referenced websites available HERE.

Jim Neocomb
324 Whispering Pines Rd.
Red Feather Lakes, Co 80545
970.217.5797

Mr. Chairman, members of the committee thank you for this opportunity to express our positions for the Dakota Range Wind Farm Project.

South Dakota Farmers Union works to promote the interests of farmers and ranchers and their families. We work hard to advance sound and beneficial agricultural policies. South Dakota Farmers Union has policy that supports the development of wind energy and we support landowner's rights to develop their property.

Agriculture is the backbone of our rural communities so when the landowners, farmers and ranchers do well so does the community. Wind farms provide a unique opportunity to use our natural resources to bring opportunity and stability to farmers, ranchers, landowners, rural governments and the communities where they live and do business.

America is the greatest country in the world and the agricultural community has been the backbone of this country throughout its history. We honor that history by fighting every day for family farmers, ranchers and the rural way of life.

SDFU was a major contributor in development of the White Lake wind farm near Plankinton, SD This project, along with the South Dakota businesses that supply goods and services to the wind industry, support nearly 2,000 good-paying jobs in our state. Better yet, there are numerous wind power projects being planned across our state and, if built, these wind farms will attract billions of dollars of new private investment, millions of dollars of new revenue for farmers and rural communities, and thousands of new jobs. Many of which ^{WILL BE} ~~are~~ trained right here in S.D. at Mitchell votech.

Today, I am proud to say that South Dakota is one of only two states where wind power provides over

30 percent of in-state power generation. That's power that the whole region can count on.

The growth in wind power in our state and region did not happen overnight or without careful planning and advances in technology. Wind works well with South Dakota's other major power resources such as hydroelectric, coal-fired, and natural gas power plants, adding to our fuel diversity and reducing our reliance on imports.

Beyond helping keep electricity prices stable, wind power can also benefit the families and communities who host the projects on their land. Wind farms now pay approximately \$5 million each year in lease payments, creating a new, drought-resistant revenue stream that can help family farmers and ranchers withstand market fluctuations in crop prices.

Renewable power is proving its worth throughout the Great Plains, and South Dakota is committed to keeping our state open for more wind development. The renewable energy sector is one of the fastest growing in the nation, and renewable energy will continue to play a crucial role in creating new jobs and growing our state's economy. As wind power has grown to be nearly a third of our energy production, our grid is as reliable as ever. With this experience in mind, I and SDFU will continue to support the expansion of renewable energy in South Dakota.

I have heard some of the objections to wind farms and want to respond to a couple of them. I served on the SDWP Board of Directors and I can tell you that only a hand full of birds were found in the wind field and it could not be determined that their deaths were because of hitting the wind blades and that is over the seven years that I was on the board.

Another note of opposition Greg Hubner – Author of Anti-Wind Book – I hope that Mr Hubner does not use the our highway system as it is subsidized, so how can ^{we} say that some subsidies are good and other are not.

Mr. Hubner has written numerous publications in opposition to wind development stating subsidies as the only reason big corporations are in the wind business.

One could also ask [REDACTED] about farming subsidies he received.

According to EWG ^{TO} date [REDACTED] is shown receiving Personal tax Subsidies of \$227k over the last 21 years for an average of over \$10K per year.

[REDACTED], why do you receive farm subsidies?

Now, for the record I am a farmer too. I know as a farmer these subsidies go back into our economy in one form or another. The same goes for wind

subsidies. Some of those dollars could come back ^{HERE} to Waverly.

Currently, family farmers and ranchers including their rural communities are challenged with short falls in their budgets. Imagine, what our townships, counties, and school districts budgets would look like if you were to increase them with revenue from the Dakota Range wind farm.

Mr. Chairman and members of the committee

Thank you for giving me this opportunity to exercise our democratic right to voice our opinion on this extremely important issue to our family farmers & ranchers, their neighbors and communities.

As Vice-president of South Dakota Farmers Union I thank you for the work you do!

Respectfully,

Wayne Soren

21264 446th AVE LAKE PRESTON SD

SDFU Vice-President

VICSOREN@YAHOO.COM

EL18-003 - In the Matter of the Application by Dakota Range I, LLC and Dakota Range II, LLC
for a Permit of a Wind Energy Facility in Grant County and Codington County, South Dakota,
for the Dakota Range Wind Project

Hi I'm Vince Meyer from Grant County. I am asking you to deny the Dakota Range application because the turbines will affect the health and safety of my community

On Tuesday of this week the Grant County Commissioners were asked to sign a letter of support for the Dakota Range Project, they refused. In addition they are considering a resolution for safer setbacks because Industrial Wind Turbines may not fit with our county zoning ordinances.

Here are a few of the issues

Whereas Grant County Compiled Zoning Ordinance dated 1-25-2018 Section 103 are "... adopted for the promotion of the public health, safety, morals, or general welfare..."

Whereas Grant County Compiled Zoning Ordinance dated 1-25-2018 Section 1211.01 WES "... protect(s) the health, safety and welfare of the County's citizens." [Ord. 2004-1, Rev. 2004-1G]

Whereas Industrial Turbines near where people live, work, and enjoy recreation is a human health hazard. October 14, 2014, the Brown County WI, Board of Health declared the Shirley Wind [Farm] a Human Health Hazard. Pierpoint MD PHD 2010 - *Wind Turbine Syndrome*; Chapman - *Facts About Industrial Turbine Noise*

Whereas Grant County Compiled Zoning Ordinance dated 1-25-2018 does not address Flicker (strobe light sensation) vibroacoustic issues, infrasound, stray voltage, and the effects on human and livestock health.

Whereas Grant County Compiled Zoning Ordinance dated 1-25-2018 Section 1101.01 defines the purpose of an Agriculture District: This district is established to maintain and promote farming and related activities within an environment which is generally free of other land use activities

Whereas Grant County Compiled Zoning Ordinance dated 1-25-2018 Section 1300 CAFO. Intent. A supply of healthy livestock, poultry and other animals is essential to the well-being of county citizens and the State of South Dakota.

Whereas Grant County Compiled Zoning Ordinance dated 1-25-2018 Section 1211.03 WES states: "...precautions to protect livestock during all phases of the project's life..." but wind towers cause issues with livestock-- Knuth 2010 - testimony to Public Service Commission; Holler 1978 - *White Paper Engineering and Service Center US Airforce Fish and Wildlife and US Department of Interior*; Yunk 2010 *Testimony Wind Siting Rules Public Service Commission*

Whereas the Industrial Wind Turbine landowner contracts are confidential and maybe in direct conflict with Grant County Compiled Zoning Ordinance; and the assignment and sublease clause in Industrial Wind Turbine contracts could put the greater community at risk.



Be it therefore Resolved: To uphold Grant County Compiled Zoning Ordinance dated 1-25-2018 Grant County establishes a requirement for best practice aircraft lighting detection system and an Industrial Wind Turbine 2-mile setback from a nonparticipating owner property line, allowing for a waiver.

Please deny this permit

Vince Meyer



Milbank SD 57252

Hello, I am Kathy Tyler, [REDACTED] Big Stone City SD, and I am here to speak against the application presented to you today.

First of all, thank you for your time and for traveling to our side of the state. I know that at least one of you is pretty close to home out here. Now imagine those beautiful hills covered with 500 foot wind towers. What a view that is.

3-500

Before I go on any further, I will confess that about 10 years ago I, as my dad's power of attorney, signed a contract with a wind tower firm. After talking and listening to many people and both sides this past month or so, I am so happy that they did not build in my beautiful Coteau Hills. Money cannot buy the vistas that we share.

on our health.
But you know that
But you know all that. You also know that I do my research before making a presentation such as this.

My research this past few days has been on the health effects of the wind turbines. Surprisingly there is research supporting both sides, *but not really.* I will not go into the myriad of peer reviewed articles that I found,

But rather statements that further research is needed

From 2015....read cover of sheet

2nd sheet (recognize issue)

Well, the research is here....hand out packets. Included are various bibliographies of research articles. An excellent resource.

But rather use handouts w/ bibliographies

But you know, you can read all you want...and everything is factual on the Internet, right?

I am asking you to do your research, *first* ~~not~~ by spending hours and hours reading—*and then* ~~even though that would be great,~~ but by visiting a wind tower farm when the turbines are running, having a picnic below one or two of them; talking the people who have spent their life savings building a dream home only to find it uninhabitable after the neighbors signed off their land to the wind tower company—usually in leases they haven't read, leases that give the wind tower total control over their land. Talk to those affected. Ask them how much sleep they lose; ask them about the migraines and the flicker affect. That's your research—those are the facts—those people and their children and their grandchildren are the citizens of this great state; they are the ones to whom you have the responsibility of guaranteeing a healthy environment in which to live.

That's what I am asking you to do...protect them..protect their livelihoods, their *future* environment, and their health. Please deny this application.

Thank you.

decommission
As an addendum to -
you will not find a letter of support
from the Grand Coulee Commission
1. renewable energy

Matt O'Farrell
Resident Marvin, SD

Many people say farmers and ranchers make a lot of money. Some probably do but I would argue that many struggle financially. One of the biggest financial struggles they face is property taxes.

With the latest property tax increase for Summit School my parents are paying over 30% of the income from their land on just the property taxes. Can you tell me any other business that pays 30% of their income on property taxes?

I'm not here to complain about property taxes but I think it is important for people to know the amount of taxes agricultural landowners like my parents pay is substantially more than a non-landowner with the same income. Most of those taxes go to our schools so there is no doubt that agricultural land owners are beneficial to the success of our children.

The unproportionate amount of property taxes that agricultural landowners pay is just one of the many financial issues farmers and ranchers face today. I'm not asking you to change your stance on wind power. I'm asking you to be considerate to the landowner that is struggling and wants to try and supplement some of their income by having wind power on their property.

As we've seen tonight, there are some who are not in favor of wind development and adamantly reject new energy development for a variety of reasons. Some of these opponents are from WE CARE South Dakota. We Care stands for: Wind Energy Concerns About Rural Environment. As their name suggests, if this group was concerned about wind energy development, it would seem they'd be willing to have productive discussions with wind developers about issues, in the least, publish accurate and clear information about wind developments in South Dakota. This does not seem to be the case... They published this ad for a community meeting to inform citizens about "the March 21 meeting in Waverly, *Minnesota* about *Next Era's* project Dakota Range Wind."

The ad also says that the leases could be potentially sold to pipeline companies; in reality Xcel Energy is purchasing Dakota Range Wind and it will provide clean energy to Xcel customers for decades. Apex staff reached out to We Care multiple times to discuss the project and to clarify confusion about Dakota Range Wind and other projects under development in the area. We Care did not return voicemails or emails to arrange a meeting or even a phone call.

If a group with the phrase "wind energy concerns" in their name will not even take a meeting with developers to obtain accurate information about the project, why would they be trusted by any educated citizens to provide information or help the community?

Landowners, community members and economic development organizations within Dakota Range Wind support the project. Apex has been transparent about their process and has gained the trust of community members. The landowners who have signed up deserve clear information and an honest company to work with, we're lucky to have found that with Apex.

It occurred to me this winter that we got to the party about 10 years late. In 2008 the wind industry was busy writing their own laws in Pierre including the Draft Model Ordinance and the Codified Laws. In several areas of the state including mine, wind developers were signing up land easements 8-10 years ago. Developers were doing all their work waiting for the production tax credit to be reinstated, which it was in January of 2013. Now they are really working to get their projects approved before the so-called PTC phase out.

Tonight, I will address the issue of setbacks and how it will affect the health and safety of the residents. Every developer promotes short setbacks from a residence or a property line, the other night in Turner County, they were promoting a 500 ft. setback. Short setbacks increase the developer's profits. In 2008 the wind industry decided setbacks would be 1.1 times the tower height because if the wind or a tornado blew the tower over there would still be a 10% cushion before it hit your house. That was the only perceived threat from a wind turbine. Now we have turbines 600 ft. tall instead of 300 ft. tall and they still want the same setback.

But now the genie is out of the bottle. The Shirley Wind Farm in Wisconsin has been designated a "human health hazard" since 2014 and remains one till this day. It took almost 5 decades until they finally got the tobacco industry to pay \$206 billion in a lawsuit, proving tobacco caused cancer. It took about 50 years to prove that asbestos insulation caused cancer. How about agent orange? How many years did our government cover that up?

In each example, the manufacturers, government, the American Medical Association all lied about any potential danger of their product for financial gain. People all over the world are now waking up to the health hazards of wind turbines.

So, the problem with this project is the same as every project in the state. The setbacks are too short to protect the health and safety of the residents. I'm giving you a whole list of resources, some peer reviewed and some just factual data. Health problems are real, ice throw is real, infrasound is real and shadow flicker is real.

We don't want our grandkids to start smoking cigarettes, or be exposed to Roundup, and we would never buy a house with asbestos insulation. So, likewise, we don't want to raise our families within 2 miles of a wind turbine. I ask you to deny this project because the setbacks are unsafe. Thank you

Gregg Hubner

Avon, SD

Good evening Commissioners, I am Marsha Hubner from Avon South Dakota. I live 10 miles from the Beethoven wind project.

I would like you to think about Wind Energy **as a whole**. Wind energy companies don't build wind projects unless they are paid to by the taxpayer. Then they **force utility companies to buy** their electricity through government policy. And included in the lease that people sign is a **confidentiality clause prohibiting** them from speaking about any ill effects. And then when the non-participants start to complain about **those ill effects**, they pay them with a '**Good Neighbor Agreement**' to keep their mouths shut. And the people who **do not** want to be a part of this '**game**' aren't allowed a proper set back that would make it **possible** for them **to live** among the turbines. It's really quite a deal.

This is not the first meeting where you have witnessed **passionate opposition**. Once again a stable and friendly part of our state has turned into a **split community** that will last **for generations**. Obviously **there are** negative effects on a community.

There is a growing number of people **testifying** that they have had to move away from **their homes** because of the shadow flicker, audible sound and infrasound of wind turbines. We are talking about **homes**, you don't pack up and move away for made up reasons, **or** take wind energy industries **to court** with your own money to shut them down because of the effects, but **that** is what people are doing. The health effects **are real**.

Where is **development** when people refuse to build new houses or move into an area covered with Wind turbines? The **thousands** of acres of land that is leased to foreign or multinational corporations of Big Wind, includes **not** just the area the roads, transmission lines, concrete and turbines are on, but **every acre** pertaining to that lease, fence line to fence line. That **ends other development** for that land owner **for 50 years or more**.

Electricity prices **go up** and property values **go down**, is that not a **threat** to the **economic condition** of inhabitants?

The PUC has the authority to permit Wind Industries, with the criteria of measuring their effects on the community's welfare; social, environmental, health, safety and development. I **hope** your main concern is **just that**. I would

guess most industrial developments make it a priority to insure the safety of those **in** and **surrounding** it. But what I have **witnessed** with Wind Development is that county commissioners and zoning boards, and it seems our state government's **first priority** is making the wind project **possible**. How did it happen that the **foreign corporations** owning these wind projects have taken **priority** over our **states citizens**? That is **so** wrong and short sighted.

I wonder how many times I have heard, "**They are just against Wind Energy**", as if that **negates** anything I have to say. I may see Wind Energy as it is done today, as a colossal waste of taxpayer money and land grab, but that's **not** why I am here. I want **what we all should want**, setbacks that are **safe** and that protect the **health and property rights** of those who made their home here **first**. If that keeps a Wind project from a few more turbines than they want, then **so be it**. What do **we owe** corporations in France, Canada, Germany, Italy, Spain?

Our **first** priority must be the **safety** and **well-being** of the **citizens** of South Dakotans.

EL18-003 Application by Dakota Range I, LLC and Dakota Range II, LLC for a Permit of a Wind Energy Facility in Grant County and Codington County, South Dakota, for the Dakota Range Wind Project

Public input hearing March 21, 2018, at 5:30 p.m., CDT
Waverly-South Shore School Gymnasium, 319 Mary Place, Waverly, S.D.

(Ruby Holborn Gary, SD)

My husband and I are small acreage owners in Deuel County and belong to the new statewide organization named SD for Safe Responsible Renewable Energy (SDSRRE).

It appears the local ordinance for Dakota Range I and II are at odds with the manufacturers recommended turbine safety zones. Appointed and Elected County Officials are setting Wind Ordinances "fashioned by the Wind Developers" with little or no consideration regarding our health, safety, and welfare.

Dare I mention the negative impact on residential property values?

Big Government Mandates and Production Tax Credits with the aid of the Wind Developers have ripped our community to shreds.

Many of us have lost good friends.

On March 10, 2018 my husband visited with Senator John Thune.

Senator Thune was unable to offer any solution to this problem and he did not offer to live in a Wind Farm.

For some reason, often, the rural non-participants have closer turbine siting's to their homes than the participants. Consequently, many landowners are upset with each other.

We should never have to pay taxes on property we are unable to use due to turbine placement on adjacent properties. Quiet enjoyment of one's property should not be "casually taken" by Wind Developers through "government fiat".

When an adjacent landowner has turbines on his property, all of its negative effects should remain on his property. This is accomplished by further setbacks. Does this application unequivocally abide by Manufacture Safety Zones?

Some of our neighbors are concerned about their family's well-being. Often, when a turbine is sited too close to children they may become sleep deprived. This can have a negative impact on their cognitive learning skills for the rest of their lives. Does this mean the schools will use the money from "Big Wind" to hire additional Special Education teachers?

"Big Wind" operates in different places, with different people, but with the same outcome. Wherever the turbines appear, problems accompany them.

This is all for the promise of more money.

Since High School, I dreamed of living in neighboring Deuel County. I viewed it as a beautiful quiet community full of streams, rolling hills, and oak trees.

Like areas here, near Waverly, it is within one of two Ecoregions of SD; the Prairie Coteau. I cannot convey with words, how much my husband and I have enjoyed living where we live.

In 2008 I retired and my husband and I were blessed to be able to build our retirement home by the landscape we loved, by Gary, SD. We had owned property in Deuel County for more than 30 years, so we knew this is where we wanted to retire. We both were raised on SD farms. We were blessed to make wonderful friends. It had been paradise in every way.

Just what retirement should be!

But now many of our new like-minded friends are now leaving our county. This exodus began nearly a year ago. They are moving to places unlikely to ever have turbines.

There are about 6 families, roughly 22 people that plan to leave or who have left, and most assuredly there will be more.

1. Northern MN.: There are plenty of lakes and trees.
2. Harmony, MN: "The Sink Hole of the US".
3. Hot Springs, SD: There is a poor wind resource there and their property on two sides adjoins the National Forest.
4. Two other families I am not sure where they are going, but they are leaving.
5. Yes, my husband and I will be moving to Sioux Falls. This is where the Wind Developers and the Politicians seem to live.

We do not know how many hundreds of thousands of dollars it will cost us to extricate ourselves from Deuel County, but we will let you know.

- **People moving out of the community do not bring Economic Development to Main Street.**
- **Few will be enriched while many taxpayers and ratepayers will be impoverished.**
- **This renewable wind energy project is marketed and mandated only for Economic Development and the promise of more money.**
- **This application should be Denied until Health Professionals, educated on the adverse health effects caused from Industrial Wind Turbines, are included in our Wind Energy Ordinances and permitting process.**
- **My husband and I, and others like us, are forced to either live among the turbines with NO consideration regarding our health, safety, and welfare OR LEAVE. "Paradise Destroyed!"**

References

1. Hearing and Health Matters
"Wind Turbine Noise and Human Health: A Four-Decade History of Evidence that Wind Turbines Pose Risks" Jerry L. Punch, Richard R. James
2. Bulletin of Science Technology and Society published online August 17, 2012
Industrial Wind Turbines and Health: Wind Turbines Can Harm Humans if too close to Residents Compiled September 14, 2012 Wind Turbine Acoustic Investigation: Infrasound and Low-Frequency Noise-A-Case Study
Stephen E. Ambrose, Robert W. Rand, Carmen M.E. Krogh

Ruby Holborn

[REDACTED]

Gary, SD 57237

EL18-003 - In the Matter of the Application by Dakota Range I, LLC and Dakota Range II, LLC for a Permit of a Wind Energy Facility in Grant County and Codington County, South Dakota, for the Dakota Range Wind Project

Public input hearing on the Application on March 21, 2018, at 5:30 p.m., CDT, at Waverly-South Shore School Gymnasium, 319 Mary Place, Waverly, S.D.

(George L. Holborn)

The wind developers paid experts have claimed for years:

“What you can’t hear can’t hurt you”. No surprise, they are wrong!

The Wind Industry has known this for more than 35 years.

Dr. Neil Kelly found people complained as far away as 1.8 miles about sleeplessness, headaches, nausea, etc. Those kinds of misery were linked to a 2.0MW turbine.

In this application, I’m told the wind developer is proposing turbines as large as 4.2MW. There are no 4.2 MW turbines operating in SD or MN.

Steven Cooper has taken Dr. Kelly’s studies a step further.

He found “dba does not work”. It is correlated well with wind speed but not with noise from the turbine.

This is so important:

“It was not until we tried the complaints versus the infrasound that the sensation came out as the major impact.”

“We tried plotting the Greatest Level of Sensation (when the residents actually left their properties or wanted to leave) & found Patterns of Disturbance related to power output...”

I understand someone suggested installing fewer larger turbines & feathering (depowering). Cooper’s work seems to indicate this may not be a good idea. You would be using non-participants as test subjects without their knowledge.

This is crucial, as Cooper continues: “What we have found is that we can present to people inaudible wind turbine noise & get a reaction whilst we can provide inaudible road traffic noise or wind noise at similar levels & not get any reaction.”

“For the people who are adversely affected by wind turbines to the extent that it affects their daily lives and in extreme cases causes them to abandon their homes, it is clearly a problem...”

So, Cooper has identified & can reproduce the IWT signature.

This next quote is so crucial: “It appears the residents’ report a greater sleep disturbance over time & more people have had to abandon their homes.”

Because of Cooper’s research, medical studies are now able to confirm the actual impact on people that live among the turbines. Until those studies are completed, the precautionary principle should be applied.

That being a moratorium/do no harm.

People need to come before profits. For example at a County Commission Meeting in Clear Lake, S.D. a wind developer representative talked on and on about 30 hours of flicker. Finally, one of the commissioners asked him “If it is such a small amount, why don’t you turn the turbines off?” After a brief pause, the wind developer replied “That would affect the profitability of the project.”

What about the profitability and adverse health effects of the people who are forced to live among the turbines?

Until the regulatory agencies use other than wind paid experts & Government bias reports to justify harmful government mandates, the misery of rural communities will continue in countless more ways than I have noted here.

Cooper concludes with seven questions that need to be answered by Regulatory Authorities in relation to the criteria that those authorities have issued to permit wind turbines to operate in proximity to residential receivers.

- 1. Please provide studies upon which the wind turbine farm criteria have been developed?**
- 2. Please identify the noise source(s) that have been used in the studies related to question 1?**
- 3. Please provide the dose-response data related to wind turbine/farms on which the criteria are based, and the corresponding level that represents 10% of the population that is highly affected?**
- 4. The most common complaint from residents relates to sleep disturbance. Please provide the studies of wind farm noise that identifies the noise (in any relevant acoustic index) that gives rise to sleep disturbance?**
- 5. Please provide studies of wind farm noise that identify the noise level (in any relevant acoustic index) that will not give rise to sleep disturbance.**
- 6. Please provide studies of wind farm noise that identifies the noise level that would protect the acoustic amenity of residents in proximity to wind farms.**
- 7. In light of the above, please identify who would be liable (in a damages claim) for the consequences of adverse impacts.**

References

National Wind Watch December 14, 2017 "In the Shadows of Wind Farms"
Emily Le Coz & Lucille Sherman, Gate House Media

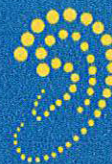
Master Resource: "Sensing but Not Hearing: The Problem of Wind Turbine Noise" (Sherri Lang Interview with acoustician Steven Cooper, AU Feb. 18, 2018)

Proceedings of Meetings on Acoustics Volume 30
173rd Meeting of Acoustical Society of America and 8th Forum Acusticum
Boston, Mass. June 25-29, 2017
"Subjective perception of wind turbine noise" by Steven Edwin Cooper

Acoustical Society of America Dec. 2017 Volume 31 174th Meeting of the Acoustical Society of America "Subjective perception of wind turbine noise – The stereo approach" by Steven Edwin Cooper and Chris Chan

George L. Holborn


Gary, SD 57237



48.GHR.L1:MSC

27th February, 2018

Mr George Holburn

GARY SD 57237

USA

Dear Sirs,

PERMISSION TO REFER TO

TWO PUBLICATIONS PREPARED BY S COOPER AND ISSUED BY THE ACOUSTICAL SOCIETY OF AMERICA, AND AN INTERVIEW BY SHERRI LANGE IN RELATION TO A SUBMISSION REGARDING THE CROCKER WIND FARM AND TRANSMISSION PERMIT APPLICATION

You have provided to me a copy of a letter from the South Dakota Public Utilities Commission identifying the need for a commenter relying upon material authored by another requires proof of the right to redistribute that material.

You have requested permission from me to distribute the following material recently placed in the public domain:

- "Subjective perception of wind turbine noise", being Proceedings of Meetings on Acoustics (Vol 30, Acoustics'17 Boston) published by the Acoustical Society of America
- "Subjective perception of wind turbine noise – The stereo approach", being Proceedings of Meetings on Acoustics (Vol 31, 174th Meeting) published by the Acoustical Society of America
- "Sensing but Not Hearing: The Problem of Wind Turbine Noise (Interview with acoustician Steven Cooper, AU) published by MasterResource (<https://www.masterresource.org/windpower-health-effects/sensing-not-hearing-problem-wind-turbine-noise-interview-acoustician-steven-cooper-au/>)

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The Interview was placed in the public domain by MasterResource and I have no objection to that interview being included in your submission with the following qualification:

- In the response to the 6th Question in providing the reciprocal of the pulsing frequency the timing in an earlier version stated 1.77 seconds. That was corrected to 1.177 seconds. Accordingly, the submission should have that current version to correct that error (and some other typos).
- The public forum should be directed to the section on sleep disturbance and the seven questions that I have raised. As these questions are critical to the assessment of wind farms, answers to those questions must be provided by the Commission to safeguard the community from adverse sleep and health effects.

Yours faithfully,

THE ACOUSTIC GROUP PTY LTD



STEVEN E. COOPER



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Subjective perception of wind turbine noise

Steven Edwin Cooper

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Acoustics `17 Boston



173rd Meeting of Acoustical Society of America and 8th Forum Acusticum

Boston, Massachusetts

25-29 June 2017

Noise: Paper 4aNSb1

Subjective perception of wind turbine noise

Steven Edwin Cooper

Head Office, The Acoustic Group, PTY, Ltd., Lilyfield, NSW, 2040, AUSTRALIA; drnoise@acoustics.com.au

The evaluation of wind turbine noise impacting upon communities is generally related to external noise environments and has a problem with separating wind turbine noise from ambient noise (which includes the presence of wind) which is not normally the case for general environmental noise. Subjective testing of wind turbine noise to examine amplitude modulation and subjective loudness has tended to use large baffle speaker systems to produce the infrasound/low-frequency noise and one high-frequency speaker - all as a mono source. Comparison of mono and stereo recordings of audible wind turbine noise played back in a test chamber and a smaller hemi-anechoic space provides a distinct different perception of amplitude modulation of turbines. A similar exercise compares use of high-quality full-spectrum headphones with the two different sound files applied to just the ears is discussed.



1. INTRODUCTION

Measurements conducted in proximity to wind turbines, generally at ground level, permit identification of noise characteristics that reveal a variation in the noise levels over time and under different wind conditions.

Figure 1 presents the statistical results in one third octave bands for a 10-minute sample at a position 150 m from the base of a 3 MW turbine tower, where the orientation of the microphone is to the side of the turbines and on a line at 90° to the wind direction [1].

In the low-frequency and infrasound region of the spectra there is a significant difference between the ambient L90 background noise level and the Leq noise level of the turbines, whilst a small increment for the mid band and high frequency components.

Of significance with respect to low frequency and infrasound components is the greater difference between the L1 levels attributed to the operation of the turbine versus the background level. One would expect maximum peak levels to be higher than shown in Figure 1.

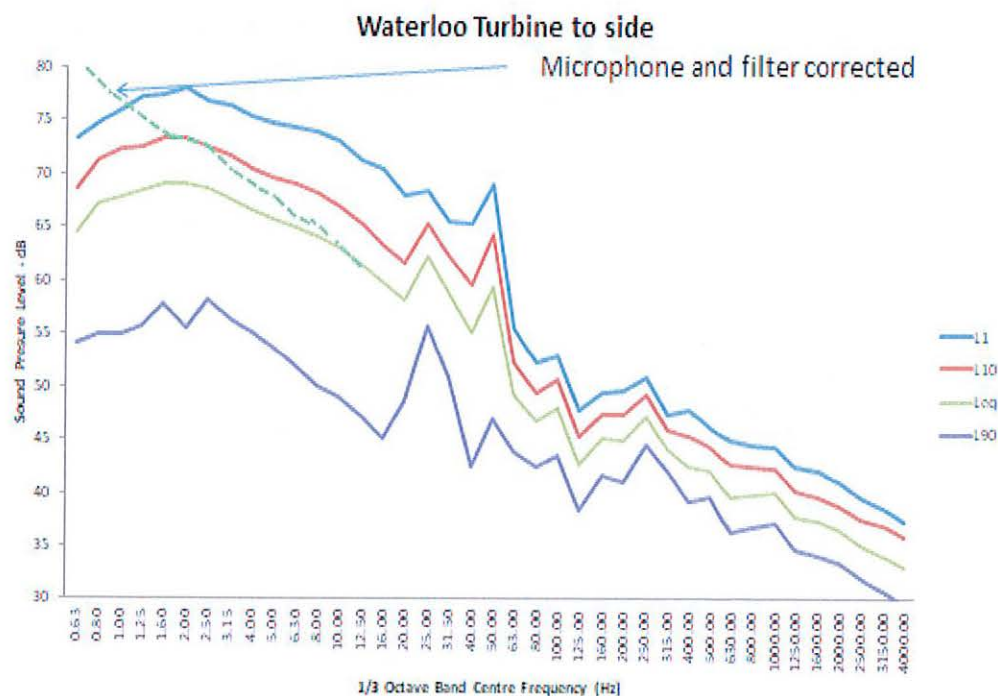


Figure 1: Statistical Results near turbine – 10-minute sample.

The operation of turbines at residential receivers often contains a modulation of the A-weighted value that occurs at the rate of the blade pass frequency of the turbine. Interference/phasing effects between multiple turbines can lead to significant changes in measured levels over time.

Access to individual turbines in the nearfield identifies by use of acoustic cameras and objective assessments, a maximum noise level to occur at about a 2 o'clock position when looking from the upwind side of the turbine.

Depending upon the power output of the turbine, related to the available wind speed at the time [2], the depth of the modulation can vary significantly (Figure 2).

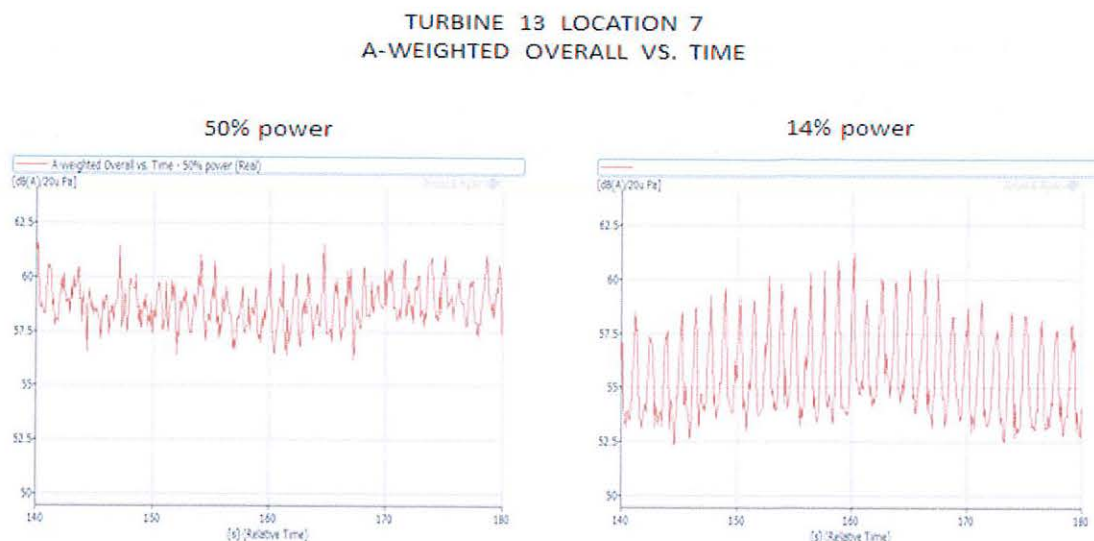


Figure 2 – Different power settings – CBW Study – ref [2]

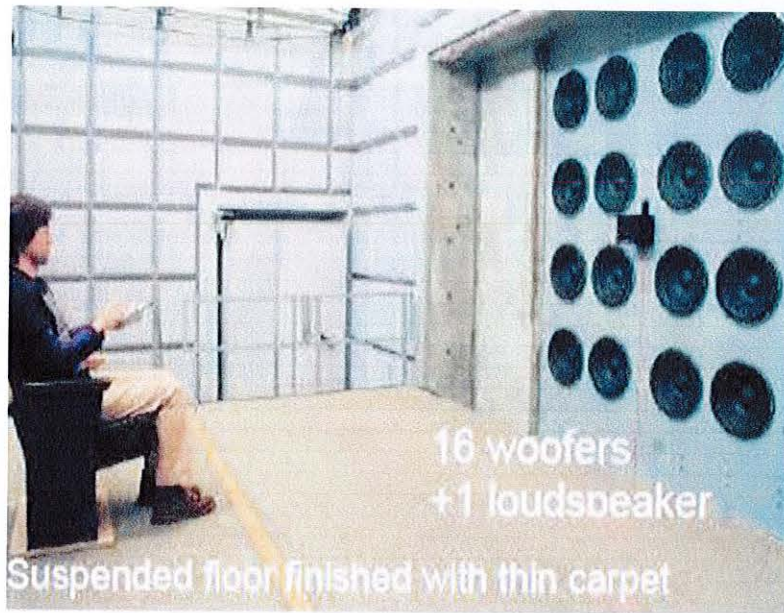
2. AUDIBLE CHARACTERISTICS OF WIND TURBINES

Narrowband (FFT) Leq analysis of turbine noise indicates in the infrasound region, a signature showing the presence of the blade pass frequency, with multiple harmonics of that frequency, with narrowband tones (with side bands) in the region of 23 to 33 Hz (depending upon the make and model of the turbines) and broadband noise at higher frequencies.

The presence of periodic pulses of noise emitted from the turbine (at an infrasound rate) that can be seen in the time domain, have consistently identified the level of FFT derived “infrasound” at residential receivers (determined by FFT analysis) to be significantly below the threshold of hearing. The presence of infrasound (or not) in the real wave file signals does not appear to address the perception of the operation of turbines when such signals are played back on systems designed to replicate (or “synthesise”) such pulsations.

Common complaints in relation to the subjective nature of wind turbine noise identify a general low-frequency tone or broadband drone commonly expressed as “like the sound of the plane that never lands”, whilst other observers refer to periodic pulsation of the noise which typically may be identified as a “swish” noise which tends to be broadband mid frequency noise that varies in its amplitude at an infrasound rate being the blade pass frequency. The amplitude modulation of the total noise as a variation in pressure to the body (and not just the ears) has been suggested as triggering the startle reflex [3] [4].

Dependent upon different wind speed conditions, the depth of the modulation of the swish noise can vary significantly on a subjective basis. Subjective testing in relation to this component has focused on what has been described as the amplitude modulation for turbines as a “special audible characteristic”.



Simulated tests of amplitude modulation have tended to use test subjects in a controlled environment. In an endeavour to obtain sufficient energy in terms of a balanced spectrum have utilised large speaker installations such as shown in Figure 3, with the assessment in that study reporting the A-weighted value correlation with the noticeable impacts of the turbine noise and that frequencies below 100 Hz do not create impacts in terms of subjective loudness [5].

Figure 3: Subjective Testing –
Tachibana ref [5]

With respect to the debate of infrasound generating sensation/perception of noise for residents, the baffle situation by Tabinachi [5] was implemented in a 126-cubic metre reverberation room that also evaluated audibility of infrasound and low-frequency noise with pulsations.

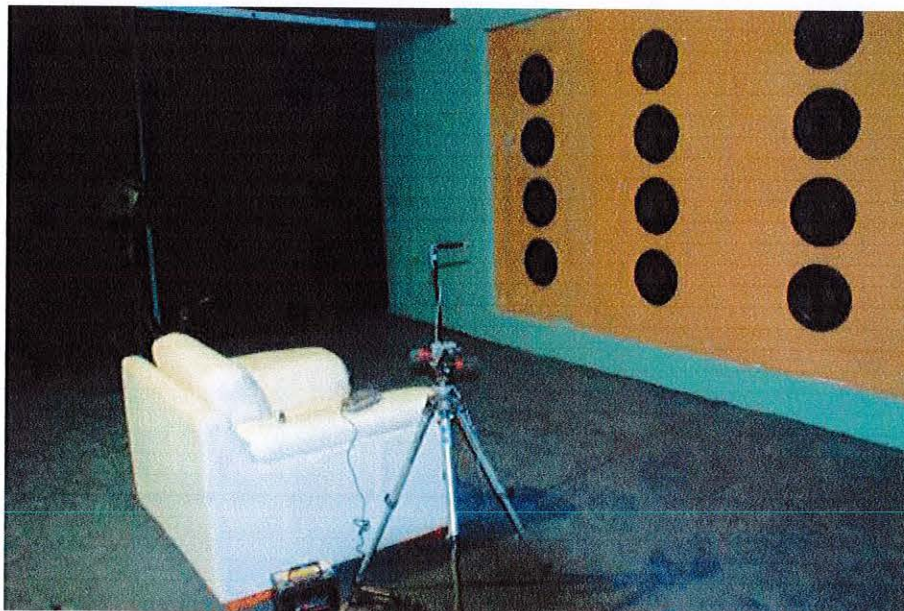


Figure 4: TAG Test Room 1

The difficulty in undertaking that work was obtaining a relatively flat response of the speaker system, clean reproduction of the sound signal, and appropriate signal-to-noise ratios, where the digital to analogue converter and amplifier combination generated its own self noise that interfered with the results.

General analysis of frequency spectrum associated with wind turbine noise utilise free running averaging triggers. Walker [6] [7] has utilised a triggered result based upon the blade pass frequency pulses to identify patterns of periodic noise in the spectra and the groupings of those patterns identified as "haystacks".

Focusing on the issue of infrasound and low-frequency noise for the detection of wind farms, Walker has normally utilised a speaker with a synthesised infrasound signal for evaluation with test subjects. However, in one instance Walker [7] presented the use of external wave files with an adjustment for outside to inside attenuation, then being synthesised and an evaluation of different combinations of frequency cut-offs with test subjects.

Walker identified that the presence of infrasound made no difference to the test subjects. However, about two thirds into the paper there is a remarkable acknowledgement of the sensation of the turbines was more apparent when frequencies above 80 Hz were evident.

Walker [6] refers to use of the FFT spectrum from the Cape Bridgewater study [2] with a derived synthesis of the pressure wave. However, the derived synthesis does not agree with the original time signal noting that the original time signal includes discrete peaks in the low frequency component of the audio spectrum that also influence the time signal. Audible comparison, spectral analysis and time analysis of the original time signal and the Walker synthesised presented in Figure 12 of reference 7 found they were different.

The original CBW signal presented in Figure 12 of reference [7] represented an internal level of 18 dB(A). The provision of an additional 50 dB gain to present a clearly audible signal found on a subjective basis the synthesised signal was vastly different to the original signal.

The Cape Bridgewater study conducted in 2014 [2] was not a matter of a compliance test but was a specific study with a brief to investigate and determine certain wind speeds and sound levels that related to complaints from specific local residents.

Simultaneous indoor/outdoor monitoring at a number of houses occurred over a nine-week period, resulting in over 9 TB of data which in some instances are still being processed three years later. Figure 5 presents simultaneous outdoor/indoor measurements in Pascals for a standard 10-minute sample for a vacant room in a house 1.6 km from the nearest turbine.

Figure 5 includes an expanded timescale view for both locations that indicate the presence of modulation in the pressure waveform that is not so obvious when converted into a trace of Linear (unweighted) decibels over time.

Figure 6 presents the one third octave 10-minute Leq inside the bedroom for the outside versus inside. The outside results do not reveal any distinct peaks. The left-hand graph presents the two 1/3 octave band results in a linear weighting whilst the right-hand graph presenting the results as A-weighted one third octave values.

There are limitations in terms of the dynamic range of the measurements that were recorded, based upon Pulse IDE module which has a maximum of 80 dB dynamic range and the instrumentation set to ensure maximum levels with wind gusts did not overload the system.

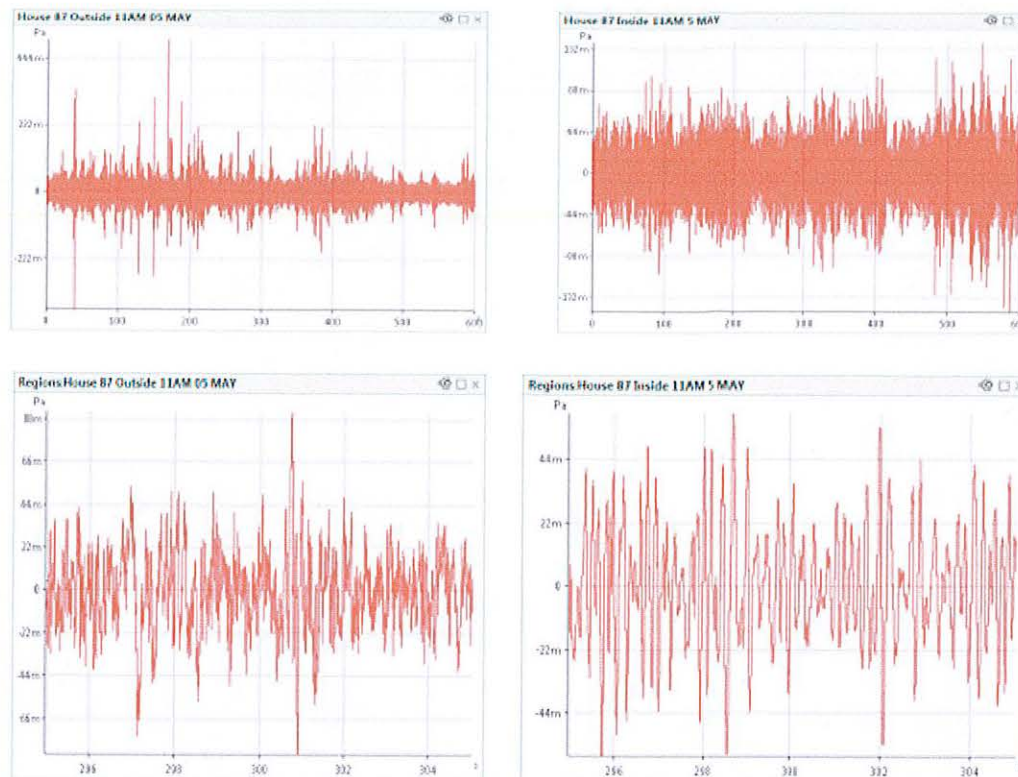


FIGURE 5: Simultaneous Inside and Outside pressure traces. Upper traces 10 minute sample, lower traces 10 second extract, ref [2]

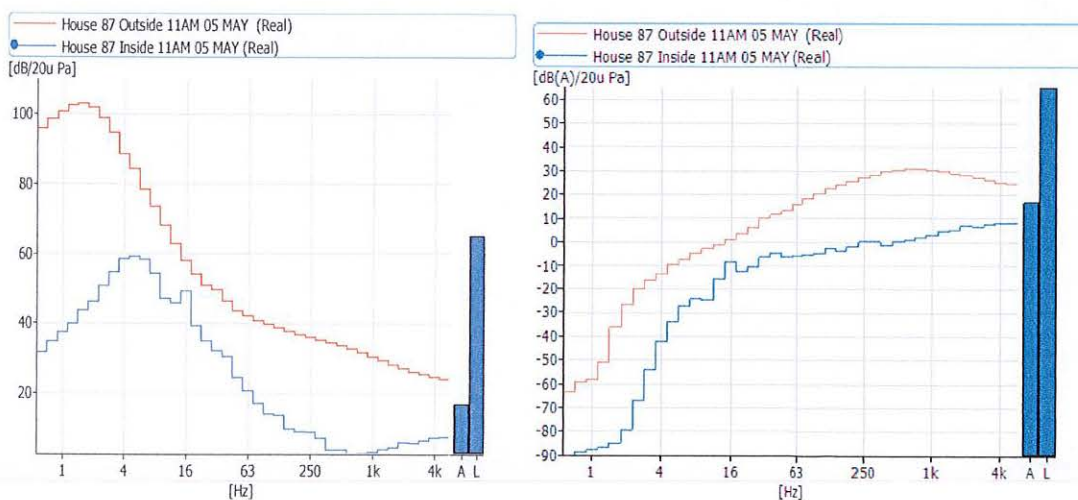


Figure 6: 1/3 Octave Band Results for Figure 5 (10 minute sample)

Utilising a UK method of assessing amplitude modulation by identifying peak 1/3 octave bands and then viewing those bands in the time domain would indicate focus on the peaks at 80 Hz, 125 Hz and 250 Hz, and basically ignore the other components in their modulation technique is looking for distinct peaks (see Figure 7).

However, the expanding the spectra in Figure 6 indicates that there are other peaks in the region of 800Hz to 4000 Hz that in themselves have higher A-weighted values but do not stand out as distinct peaks because there is a broadband increase rather than the concept of peaks on a double sided 1/3 octave band analysis.

The interesting matter about this dwelling and the results, is that the residents could detect the operation of the turbines during the test program, but the author was unable to identify any such noise.

Listening to the broadband wave file signals with some 50 dB gain did not detect any appreciable noise or characteristics inside the bedroom.

Utilising the actual wave files and adjusting the spectrum with a graphic equaliser enabled by eliminating the frequencies below 500 Hz and above 2 kHz (and with the benefit of some 50 or 60 dB gain) one could easily hear the swish of the turbines occurring in the audio signal.

Similarly, enhancing the frequencies between 25 Hz and 60 Hz found that on comparing the wind farm on and off tests (within half an hour under the same wind conditions) there was a rumble when the turbines were operating that was not present when they were off.

Based upon the audibility testing, the individual 1/3 octave band results were extracted for comparison with the A-weighted value. Figures 7 & 8 compare the A-weighted value with the 80 Hz and 1 kHz one third octave band time splices to show that the fluctuations in the A-weighted level tend to have agreement with the individual 1/3 octave bands and that the fluctuations in the 1 kHz band are at or above the threshold of hearing.

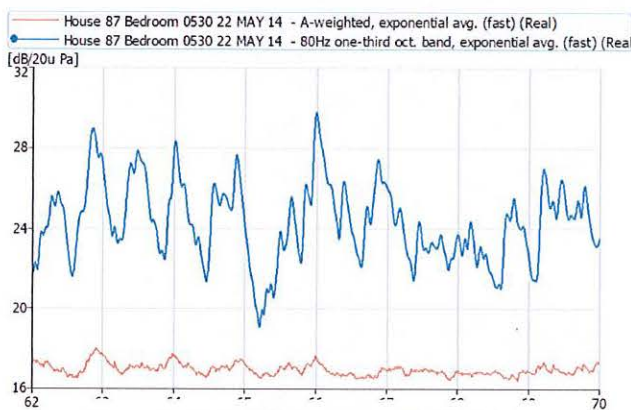


Figure 7: 80Hz 1/3 Octave vs dBA inside bedroom (from Figure 5)

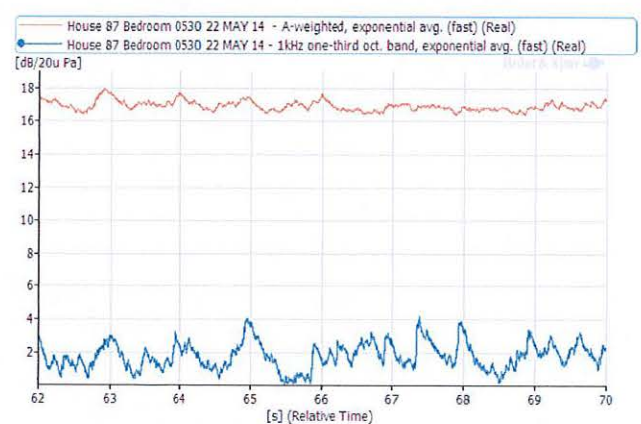


Figure 8: 1kHz 1/3 Octave vs dBA inside bedroom (from Figure 5)

For evaluating the perception of wind turbine noise additional measurements were conducted in proximity to the Capital Wind Farm, about a three and half hour drive SW of Sydney, where measurements conducted at 800 m from the nearest turbine included in one sample for a relatively short period of time the presence of audible amplitude modulation, barely audible amplitude modulation, and no audible amplitude modulation. The dominant peak in the low frequency regions was 25 Hz (see Figure 9).

Extraction of the 25 Hz 1/3 octave band found different levels of with modulation of the 25 Hz one third octave band that was masked by the broadband noise (see Figures 10 & 11).

The exercise in looking at the 1/3 octave bands during the audible swish (the amplitude modulation) revealed relationship between the A-weighted value and the frequencies between 600 Hz and 1.6 kHz.

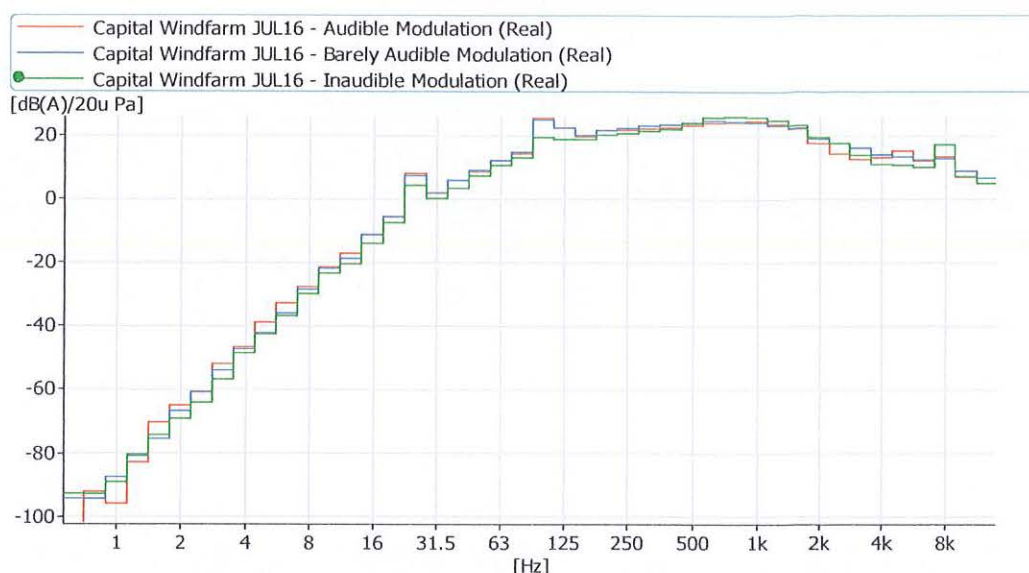


Figure 9: 1/3 Octave Band Spectra for Audible Modulation, Barely Audible Modulation and No Audible Modulation.

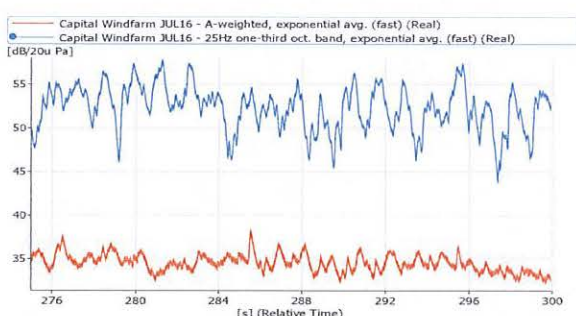


Figure 10: 25 Hz 1/3 octave band – audible swish

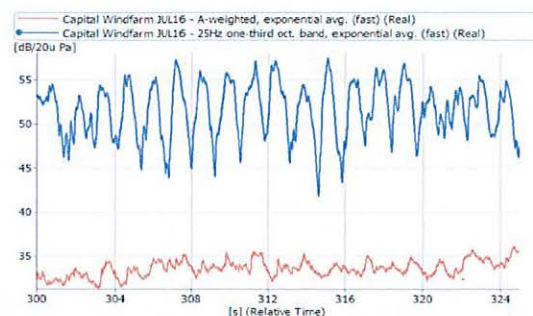


Figure 11: 25 Hz 1/3 octave band – barely audible swish

On a subjective basis, listening to music with the big baffle speaker system found that the clarity of low-frequency noise was subject to phasing issues and simply was not of an appropriate quality when compared to the placement of a single full-spectrum system in the same room. This observation questioned the Tachibana method for a subjective assessment.

Preliminary experiments by use of a small anechoic room indicated that a better appreciation of the differences in audibility of wind farm noise occurs in such a listening environment.

Persons familiar with audio recording techniques would know of the different methodologies for obtaining a stereo signal with a preference for an AB testing of individual instruments having a relatively short space between the microphones so as to not create a wide and unrealistic stereo image.

Different combinations of recording techniques were tried on several occasions at the Capital Wind Farm using a standard reference location, leading to different sampling speeds and different analysis resolutions being obtained.



Figure 12: Multiple microphone setup

There are standards in relation to the measurement of wind turbines that look to the preference of grazing incidence for the sound source (similar is that to aircraft noise) so that the diaphragm does not alter the signal.

The results which have the best promise for subjective testing involved a set up that incorporated four simultaneous measurements at a time where two microphones were placed 180° apart, but parallel to the wave front of the wind turbines, to have the sound passing the microphone at grazing incidence (see figure 12). A microphone was placed in a vertical orientation to obtain grazing incidence, and a fourth microphone pointed directly towards the windfarm and thereby not having grazing incidence.

Whereas the recording industry may use microphones with cardioid patterns, to have a focus on the noise source, in the acoustic industry one uses omnidirectional microphones with a precise linear frequency response. The use of the combination of precision microphones described above permits one to undertake normal acoustic testing and provide accurate signals recorded by the microphones. The directional response for the two microphones used for the stereo locations show that there was general consistency in the frequencies although there is slight variation in the high-frequency region which is not dissimilar to the human ear.

Utilising the wind farm microphone setup for the same sample, revealed an audible difference between the vertical microphone versus horizontal microphone. However, with the nearest turbine being to the left of the microphone position the use of the stereo sample was most significant in its perception of turbines and audible amplitude modulation that varies during the sample in response to variations in the wind.

The sound field that is recorded for subjective listening on headphones is different to that for listening on speakers and must take account of the difference in directivity that the ear experiences, particularly with the ear having an emphasis in the high-frequency region.

When running the same exercise by use of headphones where the single microphone result of a sound level recording becomes mono in both ears is an entirely different perception of the stereo signal.

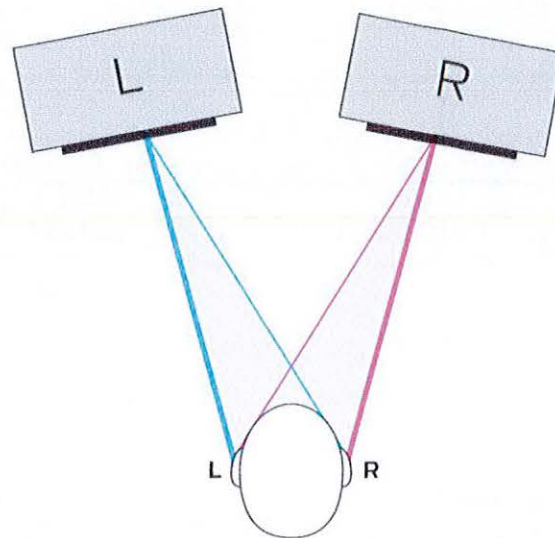


Figure 12 Spatial Orientation from Stereo Signals

3. CONCLUSIONS

Experiments with the method of large speaker baffles for the subjective perception of infrasound and low-frequency sound associated with wind turbine noise found difficulties in relation to accurately reproducing a signal which is discussed in another paper.

In looking at the subjective perception of wind turbine noise, it would appear that in the case of rural residents in Australia there is a perception of a pulsating noise source. The pulsations in some instances is described as a “swish”, when in proximity to the turbine, but when removed from the turbine and subject to substantial amplitude modulation has a reduction in the high-frequency noise and is described as a “thump”. In the UK, there is “amplitude modulation” and “excessive amplitude modulation”.

Multiple experiments at a set position for the Capital Wind Farm under different wind conditions (over 12 months) found the presence of amplitude modulation under certain wind conditions and at other times there being no audible amplitude modulation yet in discreet frequencies amplitude modulation was always present.

In relation to the A-weighted value the major contributor to the audible modulation was found to be associated with the mid-band frequencies between 500 Hz and 1.6 kHz.

In seeking to reproduce a sound in a laboratory situation that may be used for audible tests, the use of a hemi-anechoic room with line array speakers in stereo mode provided a more realistic situation and permits the detection of amplitude modulation more easily than in the use of a mono (single) speaker system. Use of stereo speakers with a mono signal is not recommended.

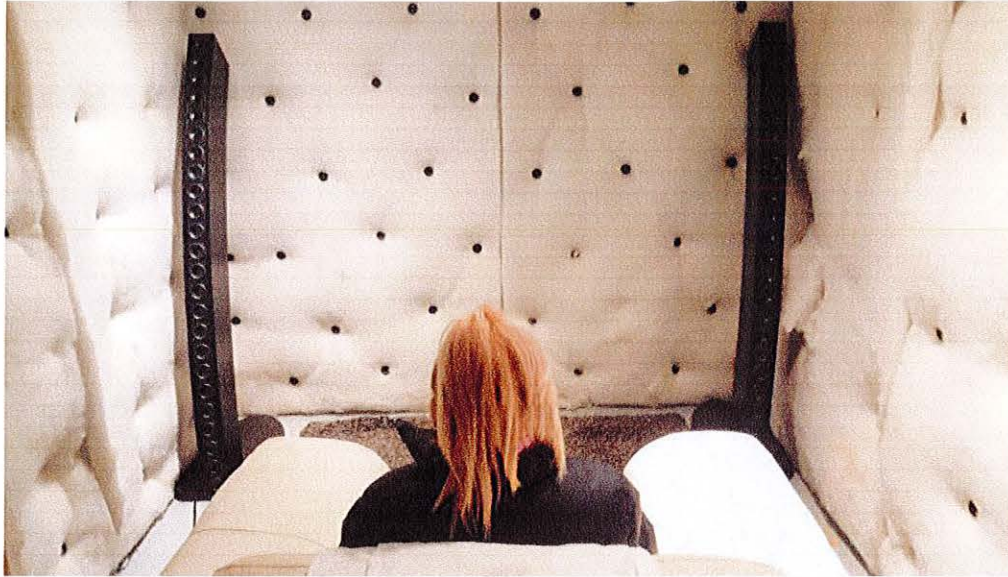


Figure 12: TAG hemi-anechoic room with line array speakers

Compliance testing of wind farms has required post-processing to assess “special audible characteristics”.

Listening on headphones to a mono signal from a sound level meter automatically reduces the ability to assess the noise to that that would have been obtained in-situ.

Most of us listen with two ears and most people in gaining a high-quality perception of, or listening to high-quality music listen using speakers. The use of stereo recordings played in a hemi-anechoic space was vastly superior to the large baffle system in the lined reverberation room.

The use of headphones for monitoring purposes or evaluating the perception of wind turbine noise requires a different measurement procedure to that for using speakers.

The next stage in the investigations is to evaluate recordings using manikins versus parallel microphone 180° apart, and a set of microphones 1.9 m apart (to agree with the line array speaker systems) being directly pointed towards windfarm.

4 REFERENCES

1. Cooper S.E., “Hiding Wind Farm Noise in Ambient Measurements – Noise Floor, Wind Direction and Frequency Limitations”, 5th International Conference on Wind Turbine Noise, Denver 2013
2. The Acoustic Group, “The Results of an Acoustic Testing Program, Cape Bridgewater Wind Farm”, Dec 2014 <http://waubrafoundation.org.au/resources/cooper-s-acoustic-group-resultscape-bridgewater-acoustic-investigation/2>
3. Cooper S.E., Can inaudible and audible low level infrasound and low frequency noise be an acoustic trigger of the startle reflex?”, Acoustical Society of America Meeting, Hawaii, December 2016
4. Cooper S. E., “A new methodology for investigating ILFN Complaints”, ICBEN 2017, Zurich. June 2017
5. Yokoyama S, Kobayashi T, Sakamoto S & Tachibana H “Subjective experiments on the auditory impression of the amplitude modulation sound contained in wind turbine noise”, International Meeting on Wind Turbine Noise, Glasgow 2015.
6. Walker B, Celano J, “Progress Report on Synthesis of Wind Turbine Noise and Infrasound”, 6th International Meeting on Wind Turbine Noise, Glasgow 2015.

7. Hansen K, Walker B, Zajamsek B & Hansen C "Perception and annoyance of low frequency noise versus infrasound in the context of wind turbine noise", 6th International Meeting on Wind Turbine Noise, Glasgow 2015.

Subjective perception of wind turbine noise - The stereo approach

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Subjective perception of wind turbine noise - The stereo approach

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The conduct of stereo measurements for both playback in high-quality headphones and in a hemi-anechoic room has been undertaken for a number of wind farms and other low-frequency noise sources as an expansion of the material previously presented at the Boston ASA meeting. The results of the additional monitoring, evaluation, and subjective analysis of this procedure are discussed and identifies the benefits of monitoring noise complaints and assessments of wind farm noise in stereo. The laboratory mono subjective system was used to reproduce the audio wave file obtained in a dwelling. The test signal, being inaudible, was presented as a pilot double blind provocation case control study to 9 test subjects who have been identified as being sensitized to wind turbine noise and low frequency pulsating industrial noise. All test subjects could detect the operation of the inaudible test signal. The use of a stereo manikin to investigate detected inaudible "hotspots" is discussed.



1.0 INTRODUCTION

The subjective assessment of wind turbine noise, and in particular the perception of amplitude modulation, have been undertaken using a mono noise source that may be generated by multiple speakers mounted on a baffle [1], [2] or use of a three-sided speaker located in a corner of the room as an extension to the use of that speaker for the generation of synthesised infrasound [3], where in the main the source being reproduced is an external signal.

Reproduction of an internal signal has tended to use a synthesised signal (rather than an actual signal recorded inside a dwelling) with an assumption of building attenuation and disregarding the influence of room mode or building element resonances.

In relation to the accurate reproduction of wind farm noise over the infrasound region and the low frequency region the use of actual wave files is preferred, once one overcomes the technical challenges that are presented [4].

Having conducted measurements and assessments at residential premises in proximity to wind farms, on a subjective basis our experiments have found a significant difference on comparing the reproduced signals to the actual sound of wind turbines observed in the field.

Our previous paper on this topic presented at the Boston ASA meeting [5] identified an overwhelming support by test subjects for the use of stereo recordings for the subjective evaluation of external wind turbine noise.

The use of line array speakers in a hemi-anechoic room for a mono signal (from a precision sound level meter) versus a stereo signal from precision microphones set 1.9 m apart found a dramatic difference in the perception of external wind turbine noise. For the test subjects that have experienced the comparison there is 100% agreement that one must use stereo assessment for subjective assessment of wind turbine noise and in particular when evaluating special audible characteristics.

Further evaluation of special audible characteristics and/or subjective assessment of wind turbine noise has been undertaken using headphones with a frequency response of 4Hz – 45 kHz [6] and a D Class amplifier. The previous presentation postulated the concept of using manikins to be superior to two microphones orientated 180° apart (back to back). The principal basis of the hypothesis was the omnidirectional characteristics of precision microphones versus the directional characteristics that occur for humans (and manikins), due to the attenuation of the head with respect to the individual ears/microphones.

Having an individual in a stationary position whilst listening to a person moving 360° around that individual, and continuously talking with the speaker's mouth oriented towards the listener is a simple method to identify the difference in the sound that an individual hears where that sound comes from different directions.

2.0 OBTAINING THE STEREO SOUND FIELD

The cost of professional head and torso systems used for the acoustic evaluation of headphones or room acoustics [7] is not one that lends itself to fieldwork with respect to unfunded investigations.

A cost-effective solution utilised hollow manikins with Type 1 precision microphones mounted in each pinna, utilising a microphone extension rod from older precision sound level meters (rather than an expensive 90° adapter), with preamplifiers on the end of each extension rod, is a practical solution (see Figures 1 & 2).

Field testing was undertaken of microphone set ups using two microphones spaced 1.9 m apart pointed directly towards the noise source, two microphones in line but 180° apart and parallel to the wavefront from the noise source of the investigation, and the stereo manikin concept identified in Figure 1. In all cases the microphones used are GRAS 40AZ with B & K 2669 preamps to a LANXI multichannel Pulse System with a sample recording rate of 113 kHz per second. The stereo wave file signals were compared directly with a wave file from a B & K 2250 Sound Level Meter using a B & K 4193 microphone. All system combinations permit full-spectrum monitoring down to and including the infrasound region.

Comparison of the stereo measurements versus the single mono channel measurement have for every test subject found the stereo material (when compared to mono) to be superior whether utilising speakers or headphones.

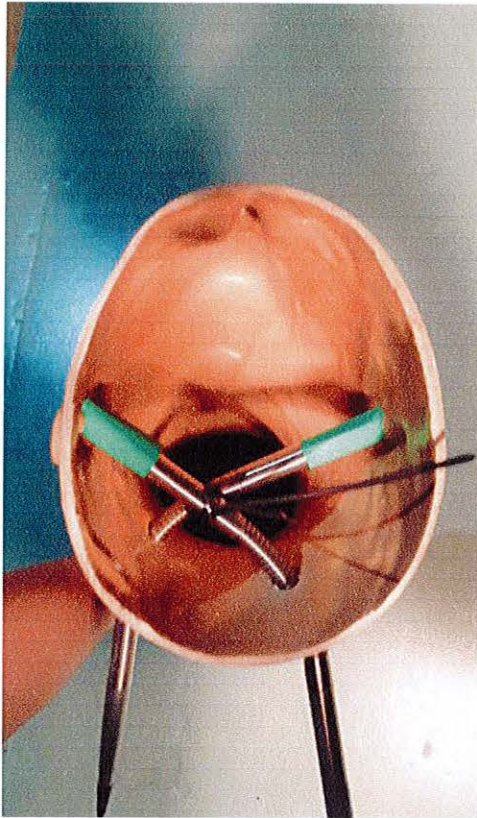


Figure 1 View of Microphone set up

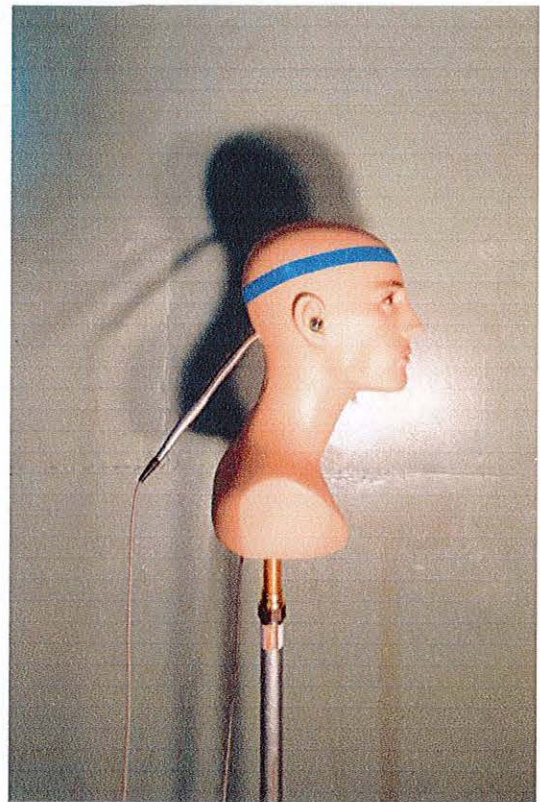


Figure 2 Manikin mic in ear and preamp on extension rods

Utilising the headphones for playback, the manikin measurements were found in the opinion of all the test subjects to be superior in terms of its presentation of the stereo image, and the degree of subtle differences that did not arise from the use of omnidirectional precision microphones where there is no separation in terms of directivity from sound from the other side of the sound field that is present.

Table 1 presents the rankings from the subjective assessment of wind turbines using headphones versus the line arrays.

Ranking	Headphones	Line Arrays in Hemi-Anechoic Space
1	Manikin	Spaced mics towards source
2	Spaced mic towards source	Mics 180° apart
3	Mics 180° apart	Manikin
Do not use	2250 (mono)	2250 (mono)

Table 1: Stereo Subjective Assessment Recommendations for External Noise Sources

3.0 SENSATION INVESTIGATION

Because of a presentation by Dr Michaud at the ASA Salt Lake Meeting Wind Turbine Session in relation to the Health Canada investigations [8], discussions from other presentations [9] [10], and the session attendees, it appeared that several of the houses in the two study areas had been abandoned by residents, citing the issue of disturbance from wind turbines. Therefore, not all persons who may be considered sensitive to wind turbine noise were included in the Health Canada study [11].

Dr Michaud indicated to the attendees that in light of discussions in the Wind Turbine Session he would propose to Health Canada to undertake additional investigations of persons who had resided in the two study areas but had abandoned their houses because of disturbance, where such a study would be undertaken with the assistance of the community to obtain access to those individuals. The results of the suggested study had not been presented and as such, still left a question as to the relevance of sensitised people in terms of their ability to sense the operation of wind turbines.

To address the perception of persons who may be considered sensitised to wind turbine noise and examine the claim of residents sensing the operation of the turbines without actually hearing the noise, a series of experiments were undertaken utilising persons in Australia who have been identified as being sensitive to wind turbine noise, and low-frequency noise that exhibits pulsations occurring at an infrasound rate ("test group 1").

In 2013 Schomer proposed the possibility that a limited number of residents subject to noise from wind turbines may be experiencing motion sickness and suggested the construction of a test facility that utilise special transducers to extend down to very low frequencies (0.05 Hz or lower) [12]. Schomer proposed to undertake sensing tests that could then lead to further medical examinations on animals to develop an understanding why the phenomenon seems to affect some residents near wind farms and establish who are affected by wind turbine infrasonic emissions in various ways.

We have previously utilised one of our reverberation test chambers (having a volume of 126 m³) with twelve 15" sub-woofers mounted on in the aperture between the reverberation chambers to investigate threshold of sensation versus threshold of hearing in the infrasound region [13], investigations into the 'infrasound signature' from wind turbines [14], [15] & [16]. Those investigations were undertaken using pure tones or external (free-field) noise measurements of wind turbine noise.

The chamber has been used to investigate the generation of recorded wind turbine noise versus field measurements to identify the issue of pulsations across the entire spectrum and that the synthesis method that has been proposed for creating the source signal over a wide band of frequencies [17] and a concept of synthesising a digital signal from analysed Leq FFT results but limited to just the infrasound region [18]. Those investigations found the synthesised results did not agree with our analysis of the original external source data that has been obtained in the field. Utilising a synthesised signal from an averaged (Leq) FFT to produce a steady signal lacks the on/off transitions, transients and variations that existed in the original time record.

For the subject study the original wave files obtained at house 87 from the Cape Bridgewater study [19] was used with a focus on the region of 30 Hz – 1250Hz. The source wave file signal obtained from measurements inside dwelling 87 at Cape Bridgewater, that have been used by several authors as a reference FFT Leq spectrum, was reproduced in the chamber utilising the sound system described above and provided the 1/3 octave band spectra shown in Figure 3. For the frequency range of interest the reproduced signal approximated the original signal as a 10 minute Leq level.

As a pilot study, 9 persons identified as sensitive to wind turbine noise or pulsating low-frequency industrial noise (test group 1) have attended our test chambers to participate in an experiment along the lines of the sensing tests in the format described by Schomer. A control group of 9 persons not previously exposed to turbine noise or pulsating low-frequency industrial noise (including 4 acousticians) participated in the same tests.

The reverberation room, with the addition of acoustic absorption treatment, satisfies the requirements of European Broadcasting Union Technical Document 3276 *Listening Conditions for the Assessment of Sound Programme Material: Monophonic and Two-Channel Sound* [19]. The maximum noise level under that standard for a mono signal is set at 85 dB(A). The distribution of absorption around

the perimeter of the reverberation room leads to the absence of lateral reflections from wall surfaces. As the walls of the chamber are core filled blockwork, from sound intensity and vibration measurements it was established that neither the walls, floor or ceiling of the chamber are generating structure borne noise from the speakers mounted on the baffle in the aperture.

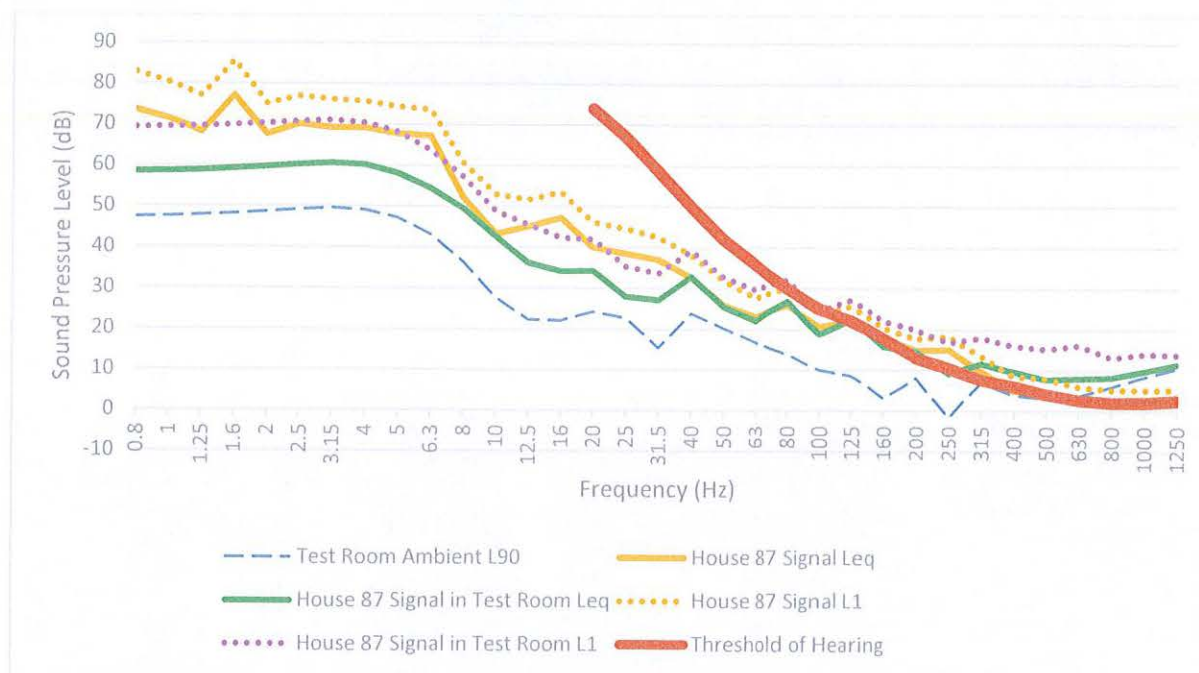


Figure 3: Spectra of Test Sample

The levels that were generated in the room approximate the 1/3 octave band levels obtained in house 87 (in the Cape Bridgewater study) [20] over the range of 40 – 1250 Hz. The response that falls off below 16 Hz reflects the absence of any graphics or parametric equalisation, and the limitations of the A-D converter.

Table 2 presents the measured sound levels of the generated and ambient levels in the test chamber, with the derived sound level contributions in both the Leq level and the L90 level.

By any of the general measurement parameters used for wind farm assessments, the test signal contribution is at or below the ambient level. Of relevance to researchers of wind turbine noise, the testing had the wind turbine noise contribution as an Leq level of 12 dB(A) in a background level of 23 dB(A).

Weighting	Parameter	Ambient	Test Signal	Test Signal Contribution
Linear	Leq	69	69	60
	L90	57	57	49
dB(A)	Leq	24	24	12
	L90	23	23	9
dB(A) LF	Leq	8	10	8
	L90	-1	7	6
dB(C)	Leq	41	41	36
	L90	31	34	30

Table 2: Measured Levels and Derived Contributions of Test Signal

For the levels that were generated, the testing was undertaken in accordance with Australian Standard AS 1269.4 *Occupational Noise Management, Part 4: Auditory Assessment* [21] and the testing conducted in accordance with the ASA *Ethical Principles of the Acoustical Society of America for Research Involving Human and Non-Human Animals in Research and Publishing Presentations* [22]. An observer was present in the reverberation room during the testing.

The testing was conducted as multiple blind study tests. At no point in time were any of the participants advised what signal (if any) was being applied.

After a period of between 45 seconds to 3 minutes, all the 9 people in test group 1 could sense the presence of the wind turbine signal on 100% of the occasions in which the signal was presented, even though they were unable to hear the signal. At no point in time did any of these test subjects detect any audible signal.

One test subject (from the test group 1) identified a disorientation in the room where there was a perception of a tilt in the floor of about 20°.

The control group were exposed to the same test set up. After a period of some two minutes 2 people (including one a very distinguished Australian acoustician) could identify sensation, whilst the remainder of the control group never detected any sensation.

3.1 Observed Differences in the Sound Field – Hotspots

All the test group 1 subjects were requested to move around the room and identify any hotspots where there was a perception of a greater impact.

Two general areas were identified on either side of the radiating pattern for the baffle speaker systems (see Figure 4).

The test subjects identified the sensation that they were experiencing occurred in different parts of the body.

Seven people from test group 1 noise identified sensation in the back of the neck or the back of the head, and in four subjects there was also a tingling in the legs.

All the people from test group 1 were requested to rotate 360° to identify whether there was any position at which the sensation became stronger.

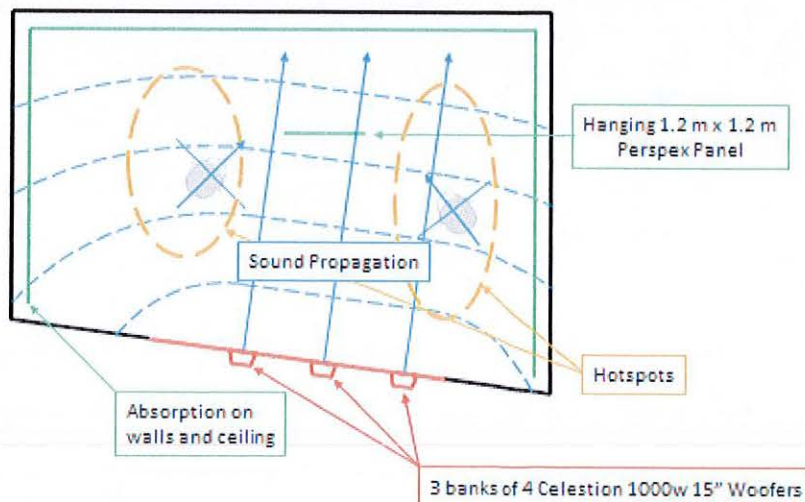


Figure 4 – Hotspots

In all cases except for two women (one person who has a hearing impairment), the test subjects identified that the greatest sensation occurred for an orientation where the back of the head was towards the speaker baffles but the body was turned at an angle of 45° so that the ear adjacent the baffle propagating sound field was closer to the speakers (see Figure 4).

The test subjects were then presented with audio headphones [6] that provide an SLC 80 attenuation of 11 dB, and then a set of hearing protectors [23] providing an SLC 80 of 26dB.

All test subjects (except the two women noted above) identified there was a difference in the perception of sensation in their head, but had difficulty expressing what that difference was. Both woman identified the test signal produced a sensation across the forehead. The headphones provided a slight difference but when using the ear muffs both participants felt the onset of nausea and the experiment was terminated. Does this result support the observation by Salt [24] of a greater Guinea pig ear response when there was less high frequency masking?

3.2 Manikin Investigation of Hotspots

The use of the manikin in the main chamber at the hotspots (identified by the subjects from test group 1) found no timing difference in terms of the arrival of pulsations for either ear, but that the orientation that produced the greatest level of disturbance to the test subjects revealed a slight pressure difference either side of the head.

For the two hotspot regions and the most sensitive angle to the sound field (135° for the LHS and 225° for the RHS – where 0° is facing the speakers, as shown in Figure 5) the differences were noticeable in the mid band region of 250Hz – 2000 Hz.



Figure 5: Manikin at RHS hotspot set at 0° position (facing speaker baffle)

A one third octave band analysis of the test signal revealed the following polar plots for the manikin (see Figure 5). This Leq pressure differential between the two ears as a result of the pulsating 2signal may be an area for further research (by others) as suggested by Schomer [11].



Figure 5 – Manikin at hotspots (degrees represent angle of nose to speakers)

3.3 Vibration on Hanging Perspex Panel

Testing of vibration levels inside dwellings in the Cape Bridgewater study, to evaluate whole-body vibration criteria, found insignificant levels of vibration with respect to the relevant Australian or British Standards [25] [26] that may be transmitted to the body.

If sensations are not just restricted to the inner ear and can also include response of the vestibular system of the body, a question arises as to the degree of vibration that may be induced into the body by way of the sound pressure field from turbines.

A perspex panel was suspended off the roof of the test chamber and could be seen to respond to the movement of people in the room and/or closing the nearest door to the panel. The panel required a long settling time (6 – 9 minutes) to return to a stationary position.

Observation of the panel with the application of the test signal found no perceptible vibration. However, examination of the shadow of the panel outline on the floor (from an elevated light) showed movement of the bottom of the panel.

Normal accelerometers cables used for vibration monitoring were found to be microphonic for the sound generated in the room (either by use of charge amplifier or voltage amplifier inputs). Higher sensitive accelerometers used for low-frequency seismic measurements were also found to have cables that resulted in pickup of the inaudible sound generated by the test signal and excessive mass that affected the damping of the panel, thereby presenting difficulty in obtaining vibration measurements using standard instrumentation.

However, the use of DC response accelerometers (Bruel & Kjaer Type 4575) [27] overcame that issue and found vibration levels obtained at the bottom of the swinging perspex panel were less than $1/50^{\text{th}}$ of the 31.5 Hz acceleration level and $1/20^{\text{th}}$ of the 4 Hz acceleration levels suggested for the protection of the comfort of individuals subject to low-frequency vibration [25].

Further investigation into the response of the physical pressure wave on individuals is outside our expertise, and may be an area of interest to other researchers with access to the appropriate persons and instrumentation.

4. CONCLUSIONS

Testing of the response of individuals to audible wind turbine noise in recent years has typically utilised a mono noise source with a large bank of speakers in a modified reverberation room or listening environment.

Other testing purporting to assess the impact of infrasound from turbines, has not actually used the infrasound signal but has used either pure tones [28] [29] or a synthesised signal based a result of an FFT Leq analysis of the original signal and incorrectly claimed such noise sources as being “wind farm infrasound”.

Analysis of wind farm noise using wave files of actual wind farm noise (rather than any synthesised format or digitally designed signal) has found the typical FFT acoustical analysis is incorrect in terms of the fundamental formula of $BT=1$ for frequency analysis. That is, a finer resolution or small B requires a large T , and therefore a low temporal resolution to make the result valid. In the infrasound region the pulses are not present long enough to satisfy $BT=1$.

A modification of the Infrasound Logger from Huson Associates (Mark II) incorporates a modified filter and increased sample rate to address signal droop and obtain a faithful wave file to 150Hz.

Analysis of the wave files recorded at Cape Bridgewater reveals the presence of a dynamically pulsed amplitude modulation of the signal that occurs across the entire audible frequency band. The dominant bands where such noise is audible are in the low and mid frequency region.

All our field work to date that provides FFT or 1/3 octave band measurement data in relation to wind turbine infrasound, identified levels well below the nominal threshold of hearing. The limitation of instrumentation and sampling rates to provide an accurate and valid spectrum measurement in the infrasound region has been questioned ($BT=1$).

The previous work by the authors that identified the analysis/signature of pulses that occur at an infrasound rate, leads investigators to view the signal in the time domain and examine/describe/review the method of modulation with dynamically pulse amplitude modulation suggested as a more accurate description.

In endeavouring to reproduce an accurate signal in the time domain we have raised the issue of much higher sampling rates than normally encountered [31].

There are also issues with the creation of wind turbine “infrasound” in the laboratory [4].

The authors are of the opinion that experimental research limited to just wind turbine “infrasound”, whether tones or synthesised digital signals, is a waste of research time and money.

Reproducing and analysing the wind turbine signal including the audible range is an easier and simpler task to undertake and permits the essential work of identifying what creates sleep disturbance and physical impacts from wind turbine noise. Such research should be undertaken inside dwellings (in the field) and (subject to qualification of the sound field) may be undertaken in the laboratory.

Utilising wave files and playback of such signals at inaudible levels without requiring reproduction of infrasound is an easier and simpler task to undertake. The benefits of using a stereo signal for subjective assessment is clearly a superior method and a logical approach for any serious investigation into wind turbine noise.

Our previous paper into the stereo effect [2] found microphones spaced 1.9 metres apart for recording the signal and playback in a hemi anechoic space using line array speakers to be the preferred method by all test subjects for the subjective assessment of external wind turbine noise.

For utilising headphones, the recent testing has confirmed that the use of a stereo head torso (or in this exercise a cheaper version identified as a manikin) is the appropriate mechanism for undertaking further investigation into the subjective effects of wind turbines.

The application of the manikin to support the investigation of the subjective response of wind turbine affected persons in a mono generated sound field, utilising inaudible wind turbine noise, identified slight differences between the “ears” at the position identified by the test group as the hotspots (i.e. a greater perception of sensation with their backs to the sound source and one ear on an angle of 45° to the sound source).

The sensation perceived by the specific sensitive people (rather than the control group) was significantly stronger in the sound field exposed to the entire body when compared to just utilising headphones.

The results of the sensitivity testing require the expertise of other disciplines to explain the mechanisms by which the test subjects perceive the wind turbine noise to their entire body [30] and should be of interest to other researchers.

1. Yokoyama S, Kobayashi T, Sakamoto S & Tachibana H "Subjective experiments on the auditory impression of the amplitude modulation sound contained in wind turbine noise", International Meeting on Wind Turbine Noise, Glasgow 2015.
2. Kelley N.D, "A Proposed Metric for Assessing the Potential of Community Annoyance from Wind Turbines Low-Frequency Noise Emissions", Windpower '87, San Francisco, October 1987
3. Walker B, Celano J, "Progress Report on Synthesis of Wind Turbine Noise and Infrasound", 6th International Meeting on Wind Turbine Noise, Glasgow 2015.
4. Cooper S, "Reproduction of wind turbine infrasound and low frequency noise in a laboratory", Acoustical Society of America Meeting, Boston, June 2017
5. Cooper S, "Subjective perception of wind turbine noise", Acoustical Society of America Meeting, Boston, June 2017, ASA POMA Vol 30/10.1121/2.0000639
6. Audio-Technica, "ATH-M79x Studio Monitoring Headphones", <http://audio-technica.com.au/products/ath-m70x/>
7. Bruel & Kjaer, "Sound Quality Head and Torso Simulator Type 4100", <https://www.bksv.com/-/media/literature/Product-Data/bp1436.aspx>
8. Michaud D, "An evaluation of how nightly variations in wind turbine noise levels influence wrist actigraphy measured sleep patterns", Acoustical Society Meeting, Salt Lake City, May 2016
9. Nissenbaum MA, "Industrial wind turbines and adverse health effects: Where we are, where we need to go, and the need for regulations and predictive models to recognize human physiology" Acoustical Society Meeting, Salt Lake City, May 2016
10. McMurty R.Y, "Patient Centered Medicine and Soundscape – A bridge between clinicians and acousticians", Acoustical Society Meeting, Salt Lake City, May 2016
11. Health Canada, Wind Turbine Noise and Health Study: Summary of Results", <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/noise/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html>
12. Schomer P.D, Erdreich J, Boyle P & Pamidighantam P, "A proposed theory to explain some adverse physiological effects of the infrasonic emissions at some wind farm site", 5th International Conference on Wind Turbine Noise, Denver August 2013
13. Cooper S, "Threshold of hearing v threshold of sensation for low frequency and infrasound", Acoustical Society of America Meeting, Salt Lake City, May 2016, ASA POMA vol 26/10.1121/2.0000432
14. Cooper S, "Reproducing wind farm infrasound for subjective testing – Just how accurate is the reproduced signal?", Acoustical Society of America, Salt Lake City, May 2016
15. Cooper S, "Wind Farm Infrasound – Are we measuring what is actually there or something else? (part 2)", Acoustical Society of America Meeting, Salt Lake City, May 2016
16. Cooper S, Chan C, "Can inaudible and audible low level infrasound and low frequency noise be an acoustic trigger of the startle reflex?", Acoustical Society of America Meeting, Hawaii, December 2016
17. Hansen K, Walker B, Zajamsek B & Hansen C, "Perception and annoyance of low frequency noise versus infrasound in the context of wind turbine noise", 6th International Meeting on Wind Turbine Noise, Glasgow April 2015
18. Tonin R & Brett J, "Response to Simulated Wind Farm Infrasound Including Effect of Expectation, International Meeting on Wind Turbine Noise, Glasgow 2015.
19. The Acoustic Group, "The Results of an Acoustic Testing Program, Cape Bridgewater Wind Farm", Dec 2014 <http://waubrafoundation.org.au/resources/cooper-s-acoustic-group-results-cape-bridgewater-acoustic-investigation/>
20. European Broadcasting Union Technical Document 3276 "Listening Conditions for the Assessment

- of Sound Programme Material: Monophonic and Two-Channel Sound, 1998
21. Australian Standard AS 1269.4 "Occupational Noise Management, Part 4: Auditory Assessment", Standards Australia, 2005.
 22. Acoustical Society of America, "Ethical Principles of the Acoustical Society of America for Research Involving Human and Non-Human Animals in Research and Publishing and Presentations", http://acousticalsociety.org/for_authors/ethical_principles
 23. "EMLU 60 Hearing Protector",
<https://www.scotssafety.com/en/anzp/DocumentandMedia1/Protector%20EMLU60%20HB%20Ear%20muffs%20Datasheet%20ANZ.pdf>
 24. Salt A. "Perception-based protection from low frequency sounds may not be enough", Internoise 2012, New York
 25. Standards Australia, "AS 2670.2-1990, Evaluation of human exposure to whole-body vibration, Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)", Standards Australia 1990.
 26. British Standard 6472-1992 "Guide to evaluation of human exposure to vibration in buildings (1Hz to 80 Hz)". British Standards Institute
 27. Bruel & Kjaer, "DC Response Accelerometer Type 4575", <https://www.bksv.com/-/media/literature/Product-Data/bp2170.ashx>
 28. Crichton F, Dodd G, Schmid G, Gamble G & Petrie K, "Can Expectations Produce Symptoms From Infrasound Associated With Wind Turbines?", *Health Psychology*, 33(4), 360-364 (2014)
 29. Crichton F, Dodd G, Schmid G, Gamble G, Cundy T & Petrie K, "The Power of Positive and Negative Expectations to Influence Reported Symptoms and Mood During Exposure to Wind Farm Sound?", *Health Psychology*, American Psychological Association 2013
 30. Cooper S.E., "Can inaudible and audible low level infrasound and low frequency noise be an acoustic trigger of the startle reflex?", Acoustical Society of America Meeting, Hawaii, December 2016
 31. Cooper S.E., "Are Sample Rates for Wave File Recordings Too Low for Transient Signals?", Acoustical Society of America Meeting, Boston, June 2017



Ruby Holborn <rubyholborn@gmail.com>

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Ruby Holborn <rubyholborn@gmail.com>

Fri, Mar 30, 2018 at 4:07 PM

To: kodaisl@rogers.com

Cc: Ruby Holborn <rubyholborn@gmail.com>

Thank You Sherri for your permission, but the South Dakota Public Utilities rejected my information because I did not have the copyright permission from Master Resource, the publisher of the article.

I am not able to locate an email for Master Resource so could you please forward this to them?

Thank You ! :

I would like your permission **quickly** to reproduce material from Master Resource for the South Dakota Public Utilities Commission in the matter of the permitting process of industrial wind turbines. I need your copyright permission from Master Resource so that it can be placed on our SD docket. The article that I would like to reprint is the Sherri Lange & Steven E. Cooper interview:

Master Resource*Sensing but Not Hearing: The Problem of Wind Turbine Noise**(Interview with acoustician Steven Cooper, AU**February 2, 2018*

I need your permission in just a few days, before the deadline to submit material to our SD PUC.

"Thank You!"

Regards,

George L. Holborn

Gary, South Dakota

rubyholborn@gmail.com

Sherri Lange <kodaisl@rogers.com>

Fri, Mar 30, 2018 at 4:38 PM

Reply-To: Sherri Lange <kodaisl@rogers.com>

To: Ruby Holborn <rubyholborn@gmail.com>, Rob Bradley <rbradley@iertx.org>

Dear Ruby

I can foresee no problem whatsoever. Please consider this your formal permission to reprint, and use as you see fit.

I will copy Robert Bradley, who is the owner and publisher and had first permission to use the interview, and publish. It has since been picked up on various blogs, such as Friends Against Wind, in France.

February 2, 2017

Sensing but Not Hearing: The Problem of Wind Turbine Noise

Sensing but Not Hearing: The Problem of Wind Turbine Noise

Interview with acoustician Steven Cooper, AU.

As far as I am personally concerned, as the author, you have full permission. It is my original work, and it was offered to Master Resource blog, and I regularly appreciate the offer of MR publishing my original un-compensated for, writing.

Let me know, and Rob, kindly copy me with your reply.

Kind regards,

Sherri

Sensing but Not Hearing: The Problem of Wind Turbine Noise (Interview with acoustician Steven Cooper, AU) - Master Resource

Sensing but Not Hearing: The Problem of Wind Turbine Noise (Interview with acoustician Steven Cooper, AU) - Master Re...

Editor Note: Steven Cooper has advanced our understanding of how people react to real recorded pressure pulsatio...

Sherri Lange
CEO, NA-PAW, North American Platform Against Wind Power
Executive Director, Canada, Great Lakes Wind Truth
VP Canada, Save the Eagles International
kodaisl@rogers.com
www.na-paw.org
Twitter: #torwinaction

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Thank you!



From: Ruby Holborn <rubyholborn@gmail.com>
To: kodaisl@rogers.com
Cc: Ruby Holborn <rubyholborn@gmail.com>
Sent: Friday, March 30, 2018 5:07 PM
Subject: Copyright permission from Master Resource
[Quoted text hidden]

Rob Bradley <rbradley@iertx.org>

Fri, Mar 30, 2018 at 5:50 PM

To: Sherri Lange <kodaisl@rogers.com>, Ruby Holborn
<rubyholborn@gmail.com>

Permission granted, but we are really open source.

- Rob

From: Sherri Lange <kodaisl@rogers.com>

Sent: Friday, March 30, 2018 4:39 PM

To: Ruby Holborn <rubyholborn@gmail.com>; Rob Bradley
<rbradley@iertx.org>

Subject: Re: Copyright permission from Master Resource

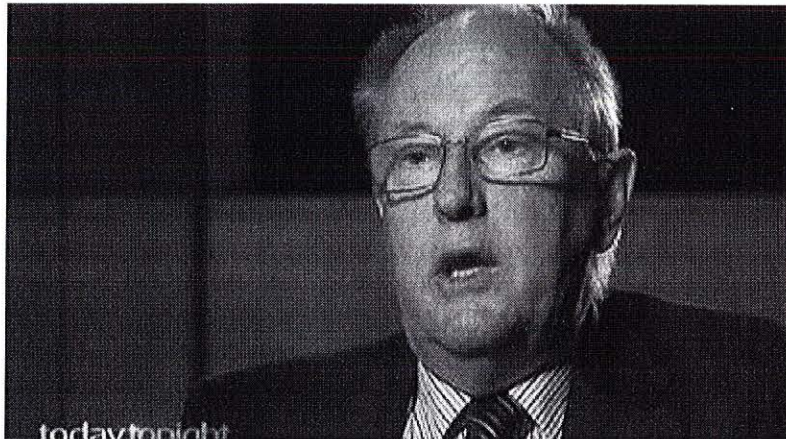
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February 2, 2017

Sensing but Not Hearing: The Problem of Wind Turbine Noise



Sensing but Not Hearing: The Problem of Wind Turbine Noise

Interview with acoustician Steven Cooper, AU.

[Quoted text hidden]



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Sherri Lange <kodaisl@rogers.com>

Sat, Mar 31, 2018 at 8:33 AM

Reply-To: Sherri Lange <kodaisl@rogers.com>
To: Rob Bradley <rbradley@iertx.org>, Ruby Holborn
<rubyholborn@gmail.com>

Thanks, Rob.

Enjoy your Easter weekend!

Sherri

Sherri Lange
CEO, NA-PAW, North American Platform Against Wind Power
Executive Director, Canada, Great Lakes Wind Truth
VP Canada, Save the Eagles International
kodaisl@rogers.com
www.na-paw.org
Twitter: #torwinaction

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Thank you!



From: Rob Bradley <rbradley@iertx.org>
To: 'Sherri Lange' <kodaisl@rogers.com>; 'Ruby Holborn' <rubyholborn@gmail.com>
Sent: Friday, March 30, 2018 6:50 PM
Subject: RE: Copyright permission from Master Resource
[Quoted text hidden]

Ruby Holborn <rubyholborn@gmail.com>
To: Sherri Lange <kodaisl@rogers.com>
Cc: Rob Bradley <rbradley@iertx.org>

Sat, Mar 31, 2018 at 9:46 AM

SD PUC Docket EL18-003 should now place this reference material on their website.

Thank You for your timely permission.

Regards,

George & Ruby Holborn

Gary, So.Dak.

Sent from my iPad

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Sensing but Not Hearing: The Problem of Wind Turbine Noise

Interview with acoustician Steven Cooper, AU.

[Quoted text hidden]



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Sherri Lange <kodaisl@rogers.com>

Sat, Mar 31, 2018 at 3:06

PM

Reply-To: Sherri Lange <kodaisl@rogers.com>

To: Ruby Holborn <rubyholborn@gmail.com>

Cc: Rob Bradley <rbradley@iertx.org>

Thank you so much, Ruby. It is important that these pieces get around, and to the places where decisions are made.

Kind regards,

Sherri

Sherri Lange

CEO, NA-PAW, North American Platform Against Wind Power

Executive Director, Canada, Great Lakes Wind Truth

VP Canada, Save the Eagles International

kodaisl@rogers.com

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Thank you!



From: Ruby Holborn <rubyholborn@gmail.com>

To: Sherri Lange <kodaisl@rogers.com>

Cc: Rob Bradley <rbradley@iertx.org>

Sent: Saturday, March 31, 2018 10:46 AM

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Sherri Lange <kodaisl@rogers.com>

Sat, Mar 31, 2018 at 3:13

PM

Reply-To: Sherri Lange <kodaisl@rogers.com>

To: Ruby Holborn <rubyholborn@gmail.com>

Is this the file? I would like to record that it is there, also, for our files. I did not see it yet.
Please let us know?

Kind regards,

Sherri

<http://puc.sd.gov/Dockets/Electric/2018/el18-003comments.aspx>

Sherri Lange

CEO, NA-PAW, North American Platform Against Wind Power

Executive Director, Canada, Great Lakes Wind Truth

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Twitter: #torwinaction

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To: Sherri Lange <kodaisl@rogers.com>

Cc: Rob Bradley <rbradley@iertx.org>

Sent: Saturday, March 31, 2018 10:46 AM

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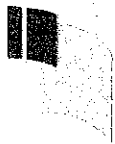
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MAY 03 2018

**SOUTH DAKOTA PUBLIC
UTILITIES COMMISSION**

TO: Amanda Reiss



GateHouse Media™

To: South Dakota Public Utilities Commission Staff

Re: Consent to redistribute material ("In the Shadow of Wind Farms")

April 4, 2018

To whom it may concern,

I am the editor and one of the authors of the newspaper investigation titled, "In the Shadow of Wind Farms," that was published online and in print publications nationwide in December 2017.

I understand that George and Ruby Holborn wish to submit this investigation to the South Dakota Public Service Commission. I further understand that the Commission requires Mr. and Mrs. Holborn to obtain explicit consent from the copyright holder of "In the Shadow of Wind Farms," for the reproduction/redistribution of this work.

GateHouse Media holds the copyright to this work. As a top editor at GateHouse Media who is authorized to make this decision, I hereby provide Mr. Holborn consent on behalf of GateHouse Media to reproduce "In the Shadow of Wind Farms" in order that it may be submitted to your Commission.

Don't hesitate to contact me should you have further questions regarding the investigation or my consent to have this work submitted to the Commission.

Cordially,

Emily Le Coz



GateHouse Media™

To: South Dakota Public Utilities Commission Staff
Re: Consent to redistribute material ("In the Shadow of Wind Farms")

Feb. 26, 2018

To whom it may concern,

I am the editor and one of the authors of the newspaper investigation titled, "In the Shadow of Wind Farms," that was published online and in print publications nationwide in December 2017.

I understand that George Holborn wishes to submit this investigation to the South Dakota Public Service Commission and that my explicit consent for the reproduction/redistribution of my work for this purpose is required. I hereby provide that consent.

Don't hesitate to contact me should you have further questions regarding the investigation or my consent to have it submitted to your commission.

Cordially,

Emily Le Coz

National Data Projects Editor, GateHouse Media
(662) 871-4433
elecoz@gatehousemedia.com



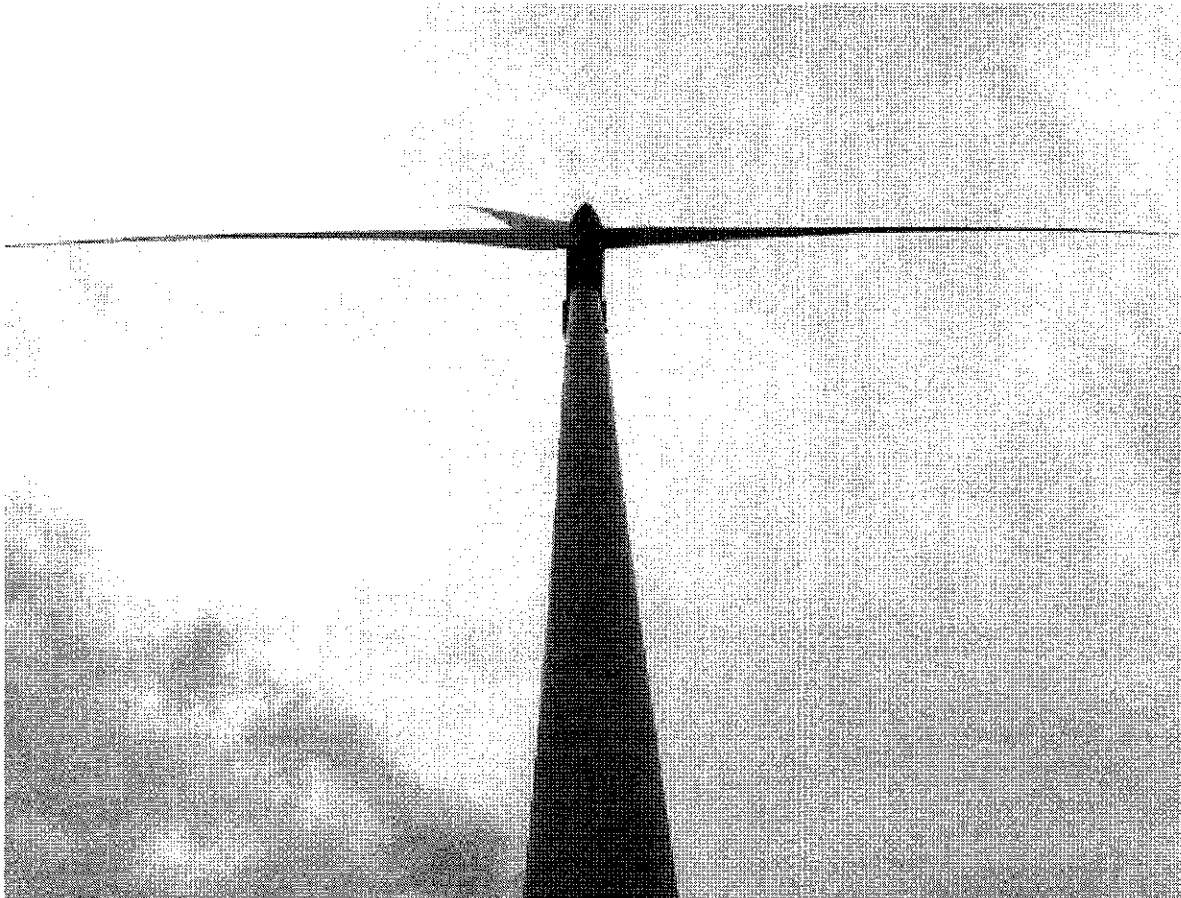
December 14, 2017

Kansas, Michigan, New York, Oklahoma, U.S., Wisconsin

In the shadow of wind farms

BY EMILY LE COZ & LUCILLE SHERMAN, gatehousenews.com

A six-month GateHouse Media investigation found that wind developers representing some of the world's biggest energy companies divide communities and disrupt the lives of residents forced to live in the shadow of their industrial wind farms.



[1]

An industrial wind turbine stands 476 feet tall in Mason County, Michigan. | Lucille Sherman

Reporters interviewed more than 70 families living near three dozen current or proposed wind farms. They also spoke to 10 state and local lawmakers, read hundreds of pages of public-service-commission records about wind projects, reviewed court filings in seven wind-related lawsuits and inspected lease agreements from at least eight wind farms.

GateHouse Media also identified through public documents and media reports an additional 400 families living near industrial wind turbines that have publicly complained about

shadow flicker, noise, health problems and/or misleading statements by wind companies in an effort to solicit land agreements.

The investigation found that companies convince landowners to sign away their property rights for generations based on the promise of potential profits and the minimization of potential problems associated with wind turbines.

Those problems include shadow flicker, loud noises and low-frequency vibrations that have driven dozens of families from their homes. Many of them claim to have suffered serious health issues from the turbines before departing. Some say they'll never be the same.

The wind industry has known about these issues for years – many of its contracts contain clauses acknowledging these effects – but it denies turbines affect human health, even as complaints mount nationwide.

Landowners often overlook potential problems until it's too late. Many who sign contracts can't terminate the agreements, even if they later beg for relief from what they deem intolerable living conditions. Some covenants bar people from suing or even publicly criticizing the projects.

Those who don't sign agreements can face the same impact of living near wind turbines erected on neighboring properties. But they receive no compensation for the shadow flicker, noises and vibrations.

Many of these residents have become vocal opponents of the industry. Dozens of them, including the Shineldeckers, have sued the wind companies for destroying their quality of life.

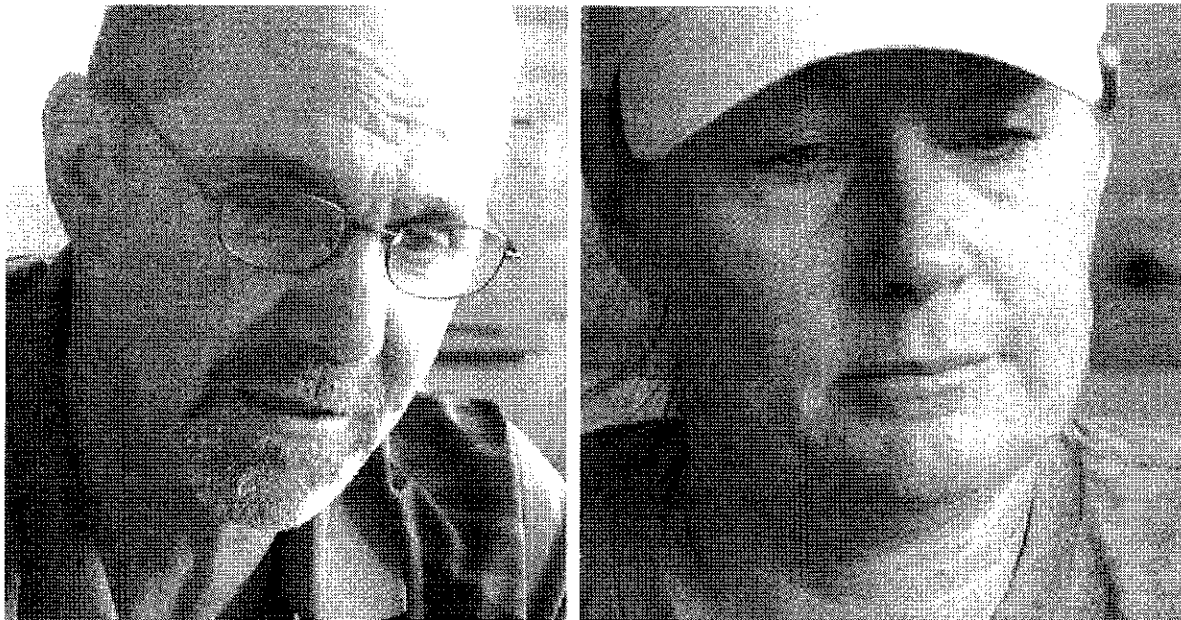
Wind developers have settled more than a half-dozen such cases nationwide, even while admitting no wrongdoing. Among the companies to settle is Michigan-based Consumers Energy, which owns Lake Winds Energy Park. The Shineldeckers were among several neighbors who sued the company.

Consumers Energy spokesman Terry DeDoes declined repeated requests to answer questions for this story. The company previously denied the Shineldeckers' claims in court filings.

Proposed wind projects also have fractured rural communities across America, pitting neighbor against neighbor in fights over property rights and money.

Many worry about the impact these turbines will have on their homes – some families interviewed have moved out of their houses after wind farms started operating; others have stayed but suffer from shadow flicker, noises and vibrations.

Elected officials tasked with voting on these developments have, in many cases, signed their own contracts with the wind companies, raising concerns about conflicts of interest.



[2]

Cary and Karen Shineldecker in their Mason County, Michigan, home. | Lucille Sherman | GateHouse Media

Among the investigation's findings:

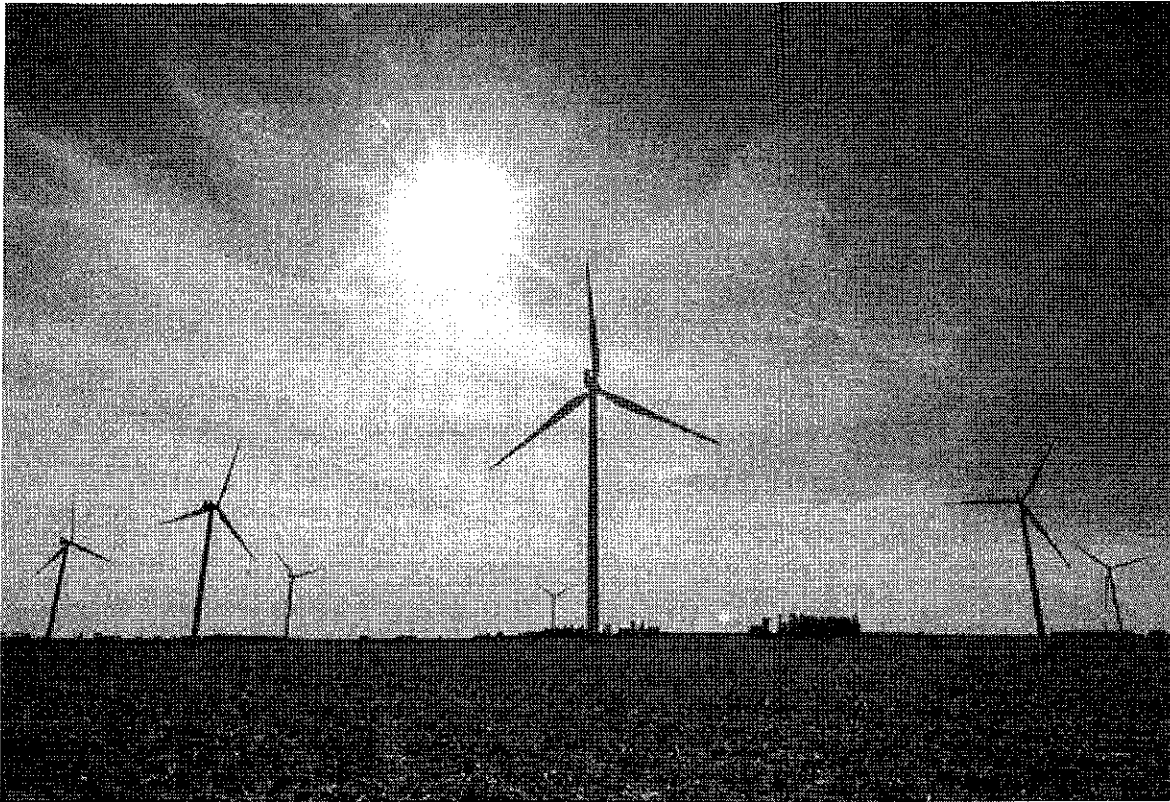
Despite a growing chorus of complaints, the wind industry has expanded largely unopposed. Ten years ago, less than 300 industrial wind farms dotted the U.S. landscape. Today, more than 1,000 exist. Much of the growth has been funded by American taxpayers. Billions of dollars in state and federal incentives have made wind farms so profitable that companies are racing to develop them before the handouts disappear.

Industrial wind turbines generate countless complaints nationwide about sleep disturbances, migraines, nausea, ear pressure, blurred vision, tinnitus and heart palpitations. Rampant reports about such effects from the Shirley Wind Farm in Brown County, Wisconsin, prompted the local Board of Health to declare the turbines a human health hazard.

Wind industry officials have denounced people who complain about these symptoms, calling them misinformed or "anti-wind." Some wind companies offer money or other concessions to frequent complainers, often in exchange for silence and a waiver for turbine-related claims. "I call it a shut-up clause," said Jim Miller of South Dakota, who refused to sign such an agreement with Florida-based NextEra.

Wind developers have used what some landowners describe as misleading tactics to get their contracts signed. Attorneys asked to review several such contracts called them one-sided, giving wind companies sweeping control over people's property with few rights for the landowner.

Wind farms have divided communities across America. Contracted landowners eyeing profits spar with neighbors opposing turbines near their backyards. Lifelong friendships can end. Families sometimes fray. Hopkinton, New York, resident Janice Pease said she stopped talking to relatives who support a proposed wind farm in their town. Pease adamantly opposes it.



[3]

Turbines from the Glacier Hills Wind Park in Columbia County, Wisconsin, churn in the late afternoon sun. | Arturo Fernandez | GateHouse Media

Wind industry denies claims

GateHouse Media reached out to seven wind energy companies, including some of the nation's largest, and two nonprofit groups that support the wind industry. Those representatives denied almost all of the investigation's findings.

Every wind industry official interviewed said that relatively few people complain about wind turbines compared to the thousands of Americans living peacefully among the structures.

"We have 1,300 turbines in operation across the United States," said Duke Energy spokeswoman Tammie McGee. Except for one wind farm in Wisconsin, "we don't see these types of complaints at our other turbines."

Many of the people who do complain, several representatives said, are well-known among industry insiders and comprise a small but vocal group of anti-wind activists.

"There are a good number of people who seem to pop up in different states and fight any wind project they can find," said Dave Anderson of the Energy and Policy Institute, a nonprofit [?] group that supports the renewable energy industry.

Some wind representatives questioned why GateHouse Media would write this story, citing study after study finding no evidence that wind turbines cause health problems.

When asked about the studies that do establish a link, those same wind officials disputed the validity of those papers and the credentials of the researchers.

People might be annoyed by wind turbines, several wind representatives said. But they're not getting sick from them.

"We do recognize that they can be bothersome to people, and our companies try to do things to minimize that both pre- and post-construction," said Mike Speerschneider, senior director of permitting policy and environmental affairs for the American Wind Energy Association in Washington DC. "But is it making people sick? Is it having physiological and medical impacts? No."

Rather than divide communities, they said their projects improve the lives of all residents. Some towns hold festivals commemorating their wind farms. Enyo Renewable Energy Principal Christine Mikell mentioned the Wind Fest in Spanish Fork, Utah, which hosts a nine-turbine wind farm.

"We have hundreds of landowners who are pleased to have us come to their communities," said Bryan Garner of Florida-based NextEnergy Resources, the biggest wind energy producer in America with more than 100 wind farms.

Wind representatives all declined to discuss specific contracts, saying they are private agreements between the companies and the landowners. In general, though, most officials called them relatively standard lease agreements.

Garner said NextEra even pays landowners the cost of hiring private attorneys to review the contracts.

Wind company representatives also said they follow all local, state and federal rules regarding wind farm development. They said they conduct extensive sound and environmental testing. And they said they reach out early and often to community members.

"We make an effort to be available to answer questions, to address concerns in a variety of forms, over the years-long process of development," said Paul Copleman, a spokesman for Spanish utility giant Iberdrola, one of the world's largest wind farm operators.

To be sure, wind farms harness a clean and renewable energy source that lessens the country's dependence on fossil fuel and foreign oil.

Improved technology has made today's turbines more efficient and thus cheaper to run, lowering energy costs for everyone.

Communities can also benefit financially from wind farms. The construction of these multi-million-dollar projects employs hundreds of temporary workers and adds new, taxable revenue to local and state coffers.

Some communities get fixed, annual payments instead of tax revenues. Barber County, Kansas, for example, earns \$500,000 a year in such payments from the Flat Ridge Wind Project. It also gets \$5,000 for every megawatt of electricity the project produces.

Landowners, too, can make a lot of money, receiving as much as \$14,000 annually for every turbine they host. Perry Burchill of Luverne, North Dakota, was able to retire from farming two years after the Ashtabula Wind Energy Center erected 13 turbines on his land.

Burchill said the turbines don't bother him.

His neighbor, Mark Askerooth, also hosts a turbine but says he notices the noise, and it bothers him.

"The wind farm is wonderful as far as the local economy goes," Askerooth said. "But if I'd have known at the time what I know now, I don't think I would have done it. They are not telling the truth when they say the sound doesn't affect you. They intimated when we signed the agreement that we wouldn't notice the noise. But we definitely notice it."

A booming industry

Wind energy development has soared in the past decade. Industrial turbines that once occupied mainly barren landscapes like California's Mojave Desert now stretch from the western plains to the rolling hills of New England.

The majority straddle the Midwest, where average wind speeds clock higher and stronger inside a column snaking from the Texas panhandle north to the Dakotas.

Residents accustomed to unimpeded vistas of prairie grass and farmland now see massive turbines churning in the breeze.

"When we turn to the west now, we're looking right at a forest of machines," said Geoffrey Standing Bear, principal chief of the Osage Nation in Oklahoma.

The Osage Nation has fought to block wind development on its ancestral lands, but its efforts failed to prevent construction of an 84-turbine project that started operations in 2015.

The tribe believes the turbines stand atop ancient burial grounds. They also say the structures violate their religious teachings, which hold the horizon as a sacred meeting place of heaven and earth.

They still worship the horizon in special, sunrise ceremonies. The turbines have ruined those gatherings, they said.

"It's really a fight between those who want to take advantage of the money and those who believe they're an eyesore and just interfere with a way of life," Standing Bear said. "It's not like Greenpeace versus the others. We're Native Americans; we consider ourselves environmentalists as well."

Ten years ago, just 300 wind farms comprising 15,000 turbines dotted the country, according to data from the U.S. Energy Information Administration.

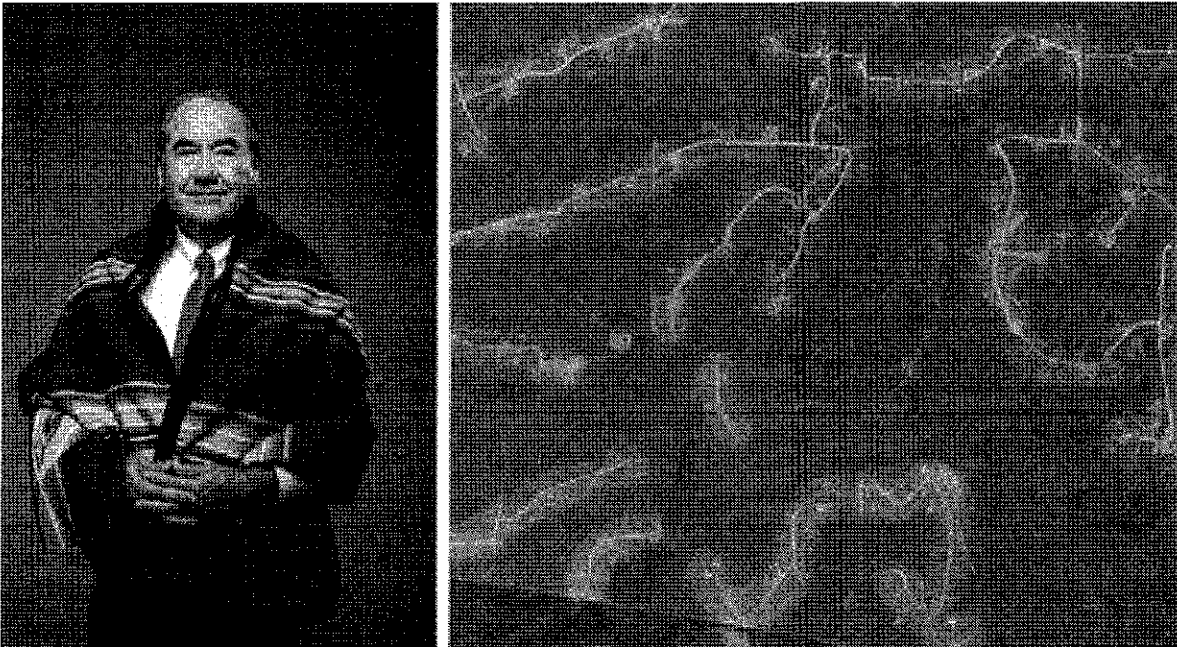
Today, those numbers have swelled to more than 1,000 wind farms in 41 states representing over 53,000 turbines, EIA data show.

Osage Wind is one of more than 40 industrial wind farms in Oklahoma, which ranks third in the nation for wind energy production.

Only the Southeast, with its unfavorable wind conditions and lack of renewable energy targets, remains relatively free of industrial wind farms.

That's starting to change. Newer, taller turbines can harness wind where old technology couldn't. The first large-scale project in North Carolina went live last year – 104 turbines towering 500 feet now produce energy for the online retailer Amazon.

Developments like these catapulted wind energy's contribution to the nation's electrical grid. In 2007, wind provided less than 1 percent to the grid. In 2016, it rose to 5.6 percent. It's estimated to reach 10 percent by the end of the decade.



[4]

Left: Osage Nation Principal Chief Geoffrey Standing Bear | Geoffrey Standing Bear | Submitted | Right: Highlighted satellite imagery of a section of the Osage Wind Project. | Bing.Com/Maps | Used with permission from Microsoft | www.bing.com/maps

Incentives and mandates

Two factors fueled the boom.

First, states began mandating electricity from green sources. Renewable Portfolio Standards require utilities to either purchase or produce anywhere from 2 to 55 percent of their power from renewable energy.

Twenty-nine states now have mandatory standards; eight others have voluntary targets. The majority passed after 2000.

Second, the federal government started incentivizing wind energy development with the Renewable Energy Production Tax Credit in 1992.

Other programs followed, including the Investment Tax Credit, 1705 Energy Loan Guarantee, and Section 1603 Grants, all of which either started or expanded under the American Recovery and Reinvestment Act of 2009.

Wind companies will have benefited from an estimated \$32 billion in Production Tax Credits alone between 2008, when the industry exploded, and 2020 when the program is phased out, according to data from the U.S. Congressional Joint Committee on Taxation.

Companies have received an additional \$13 billion in Section 1603 payments since 2009, U.S. Treasury data show.

Although wind energy remains relatively new, its major developers are not. Established fuel titans like NextEra, Iberdrola, BP and Duke Energy are among the industry's biggest players.

By bundling federal giveaways with state and local subsidies, companies can slash wind farm development costs by more than half.

Taxpayers funded nearly two-thirds of Caithness Energy's Shepherds Flat Wind Farm. It has 338 turbines across 32,100 acres in northern Oregon.

The company received more than \$1.2 billion in state and federal incentives for the \$1.9 billion project, one of the largest in the nation.

Shepherds Flat was flagged in a memo to then-President Barack Obama by his advisors as an example of developers abusing the subsidies by "double dipping."

The 2010 memo also noted the connection between tax incentives and wind development: Each time wind tax credits expired, industry investment slowed, only to resume upon their renewal.

The Production Tax Credit program will expire again – and potentially forever – in 2020. But it's unlikely to slow the boom this time. Cheaper wind technology and increased demand for renewables will continue to drive the sector, said AWEA spokesman Evan Vaughn.



[5]

Sue Hobart, right, consoles Nancy Shea of Burlington, Vermont, during a wind-farm protest at the Falmouth Village Green in February 2016. | Merrily Cassidy | Cape Cod Times file

Forced to move

As the wind industry continues to expand, so do its critics.

Hundreds of residents nationwide have claimed industrial wind turbines make them sick. Several families say the structures have forced them from their homes.

Ed and Sue Hobart sold their retirement home in Falmouth, Massachusetts, after Notus Clean Energy erected a turbine near their property. They say it triggered nausea, dizziness, migraines and anxiety.

Dozens of other Falmouth residents reported similar symptoms to the town Board of Health.

"People don't give up their homes for no reason," Ed Hobart said, responding to claims the symptoms were all in his head. "It had financial and emotional and health impacts on me and my wife that we will never be fully recovered from."

Jeff and Sandra Wolfe got sick after turbines from the Golden West Wind Energy Center started spinning near their property in Calhan, Colorado, the couple said.

The Wolfes moved 300 miles away to escape the tinnitus, headaches, anxiety and sleep disturbances they developed, said Sandra Wolfe. Three other families in the same wind farm told GateHouse Media they left their homes for similar reasons.

"There is no reason to hate them unless they make you sick," Sandra Wolfe said of the 145 turbines in the project, most of which she could see from her house. "And they made us sick."

Three families also left their homes in the Shirley Wind farm near Green Bay, Wisconsin, after complaining about numerous health issues and sleep problems they blamed on the eight-turbine project.

"We had to choose between our home and our health," said Susan Ashley, the matriarch of one of those families. "We chose our health."

Dozens of other residents also complained about Shirley Wind, so much so that the local board of health declared it a human health hazard in 2014.

"There is no question there are negative effects," said Jay Tibbetts, a physician and member of the Brown County Board of Health. "Even if you don't perceive any symptoms, it doesn't mean you're not affected. There are subtle changes that can take place in your body."

Duke Energy, which owns Shirley Wind, disputes its turbines constitute a human health hazard.

"These are very common symptoms," said Duke spokeswoman Tammie McGee. "They could be caused by anything."

Unlike the wooden windmills of Holland, industrial turbines are sleek structures that can reach heights of a 50-story skyscraper. A single blade can surpass the wingspan of a Boeing 747.

Some turbines can generate a noise likened to the engine of a jet airplane that never lands, a whooshing roar or a rhythmic "whomp, whomp, whomp."

The air-pressure change caused when their spinning blades pass their pedestals has been linked to migraines and sleep disturbances. In bats that fly too close, the effect can fatally burst the capillaries in their delicate lungs, killing them.

When the sun passes behind those blades, it creates a strobe-like phenomenon called shadow flicker that can disorient and nauseate those forced to live with it.

Shadow flicker

Shadow flicker forced Rod and Sandy Kok out of their ranch-style home in rural Randolph, Wisconsin.

The Koks had signed a lease agreement with NextEra subsidiary FPL Energy in 2004. In exchange for hosting an industrial wind turbine in their backyard, the retired couple would receive annual payments of \$5,000.

FPL representatives said they would "barely notice" the massive structure, the Koks recalled. They said Wisconsin-based WE Energies made the same claim after it purchased the wind development and land contracts from FPL in 2007.

But when the Glacier Hills Wind Park started operating in 2011, Sandy Kok said she developed nausea, headaches and vertigo from the persistent shadow flicker infiltrating nearly every room in the house.

The family logged 330 hours of the strobe-like effect the first year alone, according to a complaint filed with the Wisconsin Public Service Commission.

The flicker came not only from the turbine in their yard but from four others nearby. Sandy said she spent hours each day hiding in the basement until the sun shifted or the clouds came.

After the Koks discovered they couldn't terminate the agreement, they begged WE Energies for relief.

The company tried several methods to mitigate the shadow flicker, but none of them worked to the couple's satisfaction, according to a February 2013 Wisconsin Public Service Commission document.

WE Energies installed room-darkening shades on the family's windows, but the flicker peeped through the cracks. The company also halted one of its turbines during the offending hours, but nearby turbines continued to spin and cast shadows.

WE Energies refused to stop the other turbines, estimating it would lose up to \$76,000 annually in profits, the state record shows.

So the flicker continued. And Sandy's symptoms worsened.

WE Energies eventually purchased the Kok's home in November 2013 so the couple could move away. The Koks said they got a fair price, but they never wanted to leave in the first place. They raised their children there. They planted every tree in the yard.

"It's hard to talk about it," Sandy said. "We try not to think about it anymore. But sometimes you go to these dark places. It still affects you."

WE Energies spokeswoman Cathy Schulze said the company worked closely with the community and the state Public Service Commission on project development and turbine placement.

"We continue our commitment to being good neighbors, and work with any impacted homeowners one-on-one to mitigate concerns related to our operations," Schulze said in an email.

Shadow Flicker



Shadow flicker infiltrated the Kok's home some 300 hours a year. It happened when the sun passed behind nearby turbines in the Glacier Hills Wind Park in Columbia County, Wisconsin. | The Koks | Submitted

Vibrations

Low-frequency sound waves from the Lake Winds Energy Park forced Cary and Karen Shineldecker to leave their home in Mason County, Michigan, the couple said.

The Shineldeckers had opposed Lake Winds prior to its construction; they worried about the effects its 56 turbines would have on nearby families, including their own.

Cary spoke at county meetings and urged local officials to pass tighter wind regulations, ones that would keep turbines away from his home.

His activism earned the family enemies in the community, especially among neighbors who signed up for the turbines, the couple said. They lost friends over the issue and believe someone poisoned their dogs in retaliation.

Despite Cary's efforts, Consumers Energy erected four turbines within a half-mile of the family's two-story farmhouse – the closest loomed less than 1,200 feet away.

The turbines began operating on Thanksgiving Day 2012, and the Shineldeckers immediately noticed problems, they said.

At first it was the noise – loud whistling and whooshing sounds. But soon they could feel thumping vibrations that resonated through the walls of their home like bass-heavy music from a distant, passing car.

This feeling, they said, bothered them during the day and kept them awake at night. They developed headaches, ear aches and pressure behind their eyes.

The couple described it as Chinese water torture – bearable in the moment but insufferable over time.

“You go months and months and months without sleep, and pretty soon, you’re not even the person you recognize,” Cary said. “I literally broke down and cried in front of people, and I’m not proud to say that.”

Karen, a middle-school science teacher started grinding her teeth at night; she had to wear bite splints. Cary, an engineer, started losing concentration during the day; he was demoted at his job.

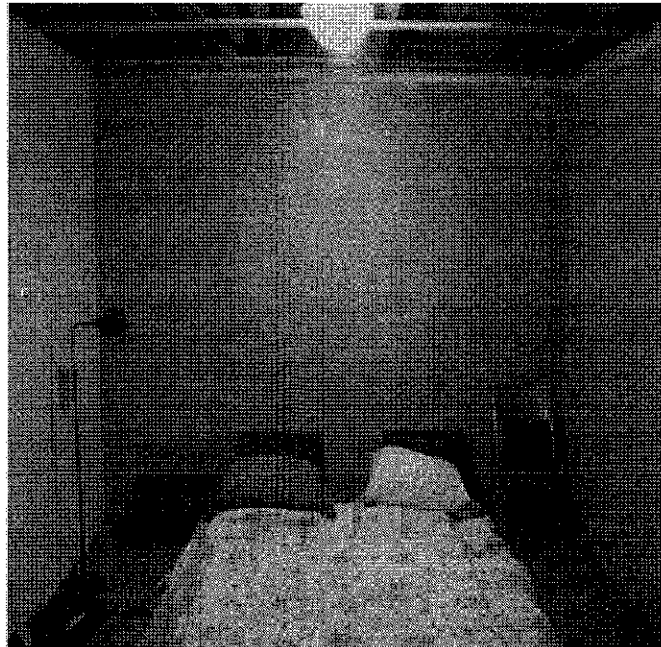
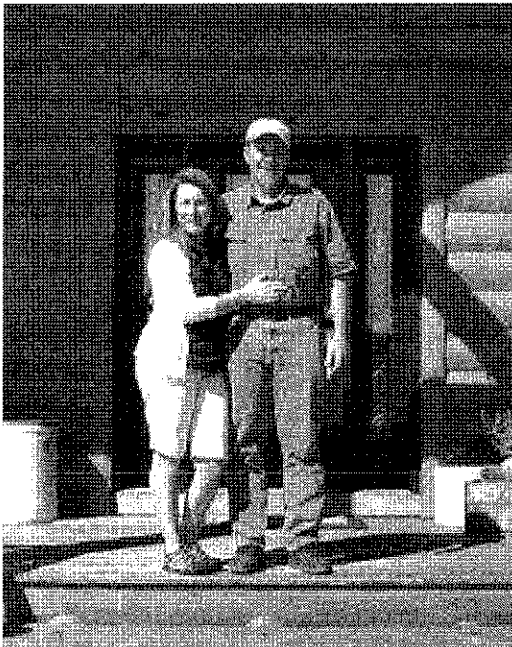
They took sleeping pills and anti-anxiety medication. They moved their bedroom into the basement to hide from the effects, but they still couldn’t escape.

The Shineldeckers didn’t suffer alone. Consumers Energy received 128 complaints about its wind farm in the first year of operation, according to Mason County records.

After about two years living with the turbines, the Shineldeckers moved out. They stayed with a family friend until they could build a new house four miles away.

Consumers Energy spokesman Terry DeDoes repeatedly declined to answer questions for this story but emailed a written statement that touted the company’s renewable energy projects and community engagement.

“It was emotionally devastating to be forced out of your house,” Cary said. “We moved to that house when our oldest son was 5 years old. It was a really nice place to live and raise a family.”



[6]

Left: Cary and Karen Shineldecker stand outside their new home four miles from their previous home. | Lucille Sherman | GateHouse Media | Right: Cary and Karen

Shineldecker slept in their basement for two years to escape the low-frequency vibrations they said they could feel from nearby turbines in the Lake Winds Energy Park in Mason County, Michigan. | Cary Shineldecker | Submitted

Health impact debate

Even as wind farm inhabitants nationwide blame industrial turbines on a cascade of health problems, experts remain split on the veracity of their complaints.

Numerous researchers claim to have established a link between wind turbines and symptoms such as migraines, earaches, tinnitus, eye pressure, dizziness, nausea and sleeplessness; many other researchers conclude no such evidence exists.

"I wish it was something we could have gotten used to," said Illinois resident Ted Hartke, who moved out of his home in the California Ridge Wind Farm. "You sit in bed and pray to God you can get used to the noise. But it got worse."

But even as complaints mount across the nation, the wind industry steadfastly denies turbines impact human health.

"We are aware of some of the cases where individuals come to believe that wind turbines are the cause of their health concerns, and we feel great sympathy for anyone who is suffering from illness of any kind," said Dahvi Wilson of Apex Clean Energy, which owns several wind farms nationwide.

But, Wilson said, science doesn't support their claims. And until it does, the company will continue to build wind farms based on current best practices.

The wind industry frequently cites a 2014 Health Canada study that found no direct association between health problems and wind turbines. The study involved more than 1,200 residents in 18 wind farms.

But the same study also found wind turbines "highly annoy" about one in 10 people, especially those living closest to the structures and those exposed to turbine noises exceeding 35 decibels.

That annoyance is "statistically related" to reports of migraines, tinnitus, dizziness and high blood pressure.

"Although Health Canada has no way of knowing whether these conditions may have either pre-dated, and/or are possibly exacerbated by, exposure to wind turbines," researchers said, "the findings support a potential link between long term high annoyance and health."

Experts on the other side of the debate also cite the Health Canada study, saying it proves turbines sicken people – even if indirectly, because of their annoyance factor.

But they criticize the study's use of only an A-weighted sound meter, which doesn't measure the low frequencies blamed for some of the worst health problems.

To measure those frequencies, you need a C-weighted scale, said Jerry Punch, an audiologist and professor emeritus at Michigan State University who also has researched the issue.

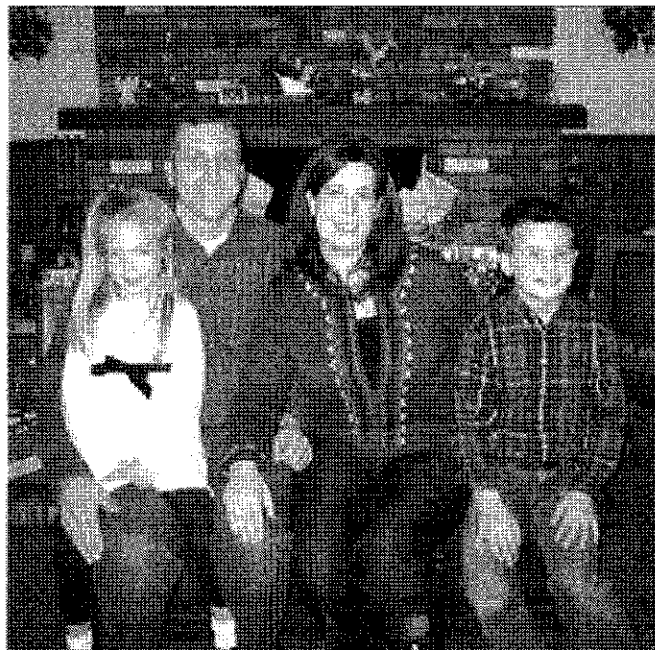
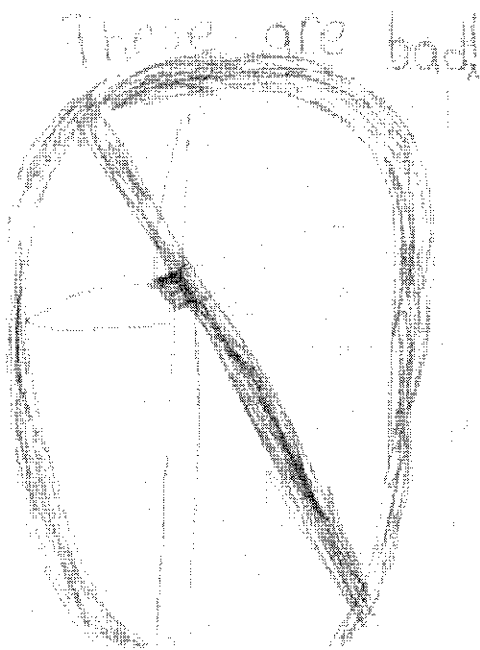
"The A-weighting filter is used by all wind companies and everybody who studies wind turbine noise," Punch said, "and it filters out the sounds that are really the most problematic."

Researchers using low-frequency meters have found a link between wind turbines and "sensations of uneasiness and personal disturbance," as well as "extreme pressure" and "headache or nausea or dizziness."

One of the first to do this was Neil Kelley, a now-retired scientist from the National Wind Technology Center in Denver. The U.S. Department of Energy and NASA hired Kelley three decades ago to investigate complaints about their wind turbine near Boone, North Carolina.

Kelley and his colleagues determined after extensive testing that "the annoyance was real and not imagined," the result of acoustic impulses.

Kelley did not return calls for comment.



[7]

Left: A drawing by Sophia Hartke when the family was still living in the wind farm. | Ted Hartke | Submitted | Right: The Hartke family (from left: Sophia, Ted, Jessica and Phillip) moved out of their home in Fithian, Illinois, after suffering sleepless nights and health problems they blamed on nearby turbines from the California Ridge Farm. | Ted Hartke | Submitted

Like motion sickness

These acoustic impulses – or low-frequency sound waves – stimulate parts of the inner ear responsible for balance, motion and spatial orientation and that they provoke symptoms similar to motion sickness, some researchers say.

"If you're sitting still and something is causing the same fluids to move, your brain doesn't know that it's a false signal," said Rick James, an acoustical engineer who has written papers on the subject. "But you open your eyes and say, 'I'm sitting still, but I feel like I'm moving.'"

The Minnesota Department of Health noted the phenomenon in 2009 paper. It found low-frequency waves cause more problems inside a house than outside because, rather than block the pulsations, the walls amplify them.

Darlene Mueller wept as she described how turbines in the Blue Sky Green Field Wind Energy Center in Fond du Lac, Wisconsin, sickened her inside her home.

"I would pace the house like a lion in a cage," she said. "I would leave the house at 2 or 3 in the morning and go to Walmart just to escape the noise. You go days and days and days without sleep, and it's just madness."

Other experts dispute the low-frequency claim. The Department of Energy, which hired Kelley for its North Carolina study, now says on its website that wind turbine sounds – including low-frequency and infrasound – have no direct human health impact.

Humans are biologically unique individuals, said physician Robert McCunney, an MIT researcher who has researched the issue. Perhaps some people suffer from noise sensitivity, he said, but that doesn't mean wind turbines pose a human health hazard the way asbestos or lead does.

"Not to dismiss their complaints, because I believe these people are sincere," McCunney said, "but there are other things that can cause these symptoms."

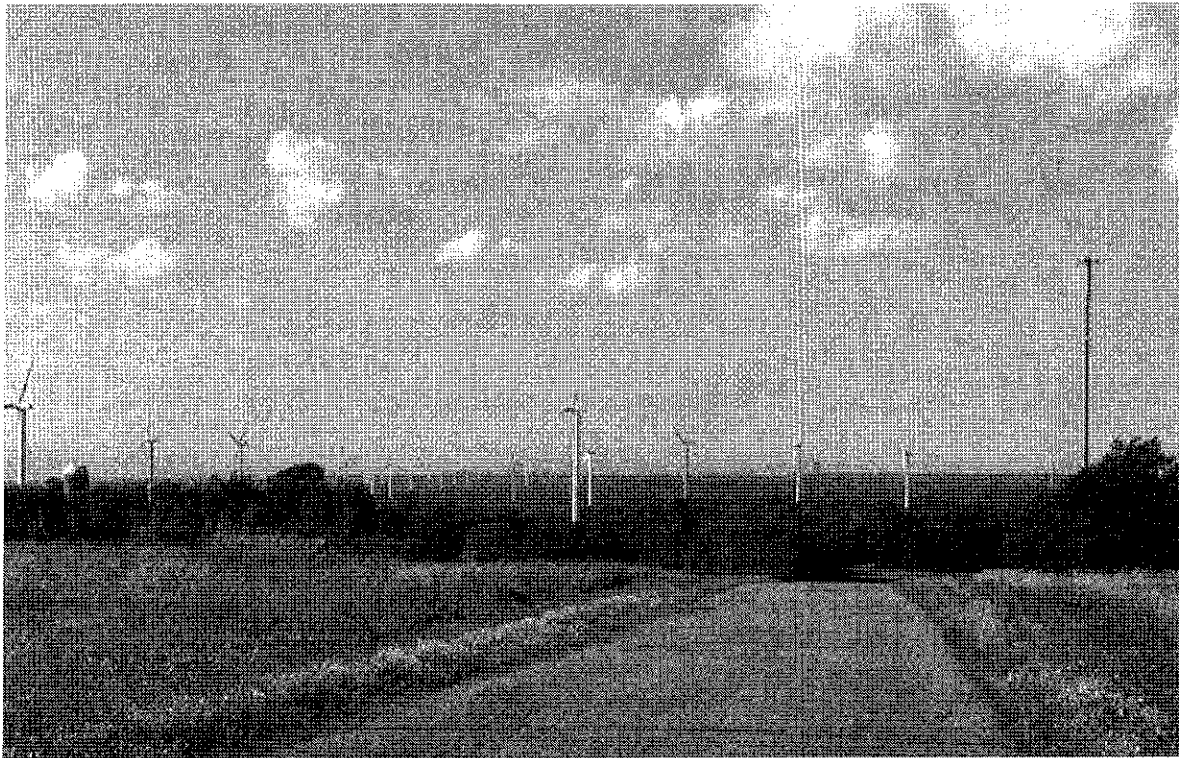
Despite the lack of scientific consensus, acoustical engineer Paul Schomer said he believes wind turbines genuinely cause human suffering.

He also thinks wind companies truly believe their turbines are safe.

"I think there are enough people that work for the industry that have put out papers and stuff that the waters are muddy," said Schomer, who has conducted work both for the wind industry and its opponents.

Instead of waiting for science to settle the debate – which Schomer said may never happen – the engineer thinks it's time for a compromise.

Wind companies should admit turbine noise hurts some people and agree to greater setbacks and lower decibel limits, Schomer said. And wind farm opponents should accept reasonable sound limits and buffer distances instead of trying to outright ban turbines.



[8]

More than 100 wind turbines from two different projects – Noble Clinton and Noble Chateaugay – rise from the rolling hills of Franklin County in northern New York. | Lucille Sherman | GateHouse Media

Dragged through the mud

But some wind farm residents who spoke out about their problems said the industry belittles them. It dismisses their complaints as unfounded or labels them troublemakers, multiple people said.

It has silenced many of their neighbors whom they said suffer the same symptoms but fear the consequences of speaking out.

Falmouth, Massachusetts, resident Todd Drummey bemoaned the problem in 2012 at a public meeting about the town's controversial wind turbines.

"I have spoken to several people who have watched the events of the last two years," Drummey told the board at the time, "and simply concluded no point in subjecting themselves to this type of punishment."

After Cary Shineldecker went public about his experience in Michigan's Lake Winds Energy Park, an energy company executive singled him out at a meeting several states away.

Mike Blazer of Chicago-based Invenergy claimed to know Shineldecker's medical history. He told a crowd in Clear Lake, South Dakota, that Shineldecker's health woes stemmed from alcohol use, obstructive sleep apnea and an irregular heartbeat – not wind turbines.

Blazer shared the information at a December 2016 city meeting about his company's proposed wind farm. He did it to quell fears about wind turbines and to provide "an example of the impact of the type of misinformation that is spread by wind opponents," Blazer said in an email.

Shineldecker said he was stunned to learn about the incident from an attorney who attended the meeting. He said he has neither sleep apnea nor alcohol problems and never received a diagnosis for those problems.

"All I ever had to go on was my integrity and honesty and work ethic," Shineldecker said, "and then to be belittled and treated like some whack-job psycho liar is kind of unbelievable."

Iowa wind farm resident Terry McGovern said he faced disparagement by Apex Clean Energy.

The Virginia-based company accused McGovern of holding "a personal anti-wind agenda" and claimed he would spread misinformation and generate unfounded fear of wind energy ahead of a public presentation he gave.

Apex made the claims in a July 2017 letter it sent to landowners discouraging them from attending the presentation, held near the site of its proposed Upland Prairie Wind farm in northwest Iowa.

McGovern denies holding an anti-wind agenda but is publicly critical of the industry and its business practices. His Iowa Wind Action Group calls for greater setbacks for industrial turbines to protect human health.

"Instead of focusing on the issues, they try to discredit the person," McGovern said. "That way, they can avoid talking about the facts."

Apex sent the letter to clear up confusion about the presentation, not to disparage McGovern, company spokeswoman Dahvi Wilson said.

"It was not our intent to attack the speaker, as it appears he has suggested," Wilson said, "but to explain that the presenter was unaffiliated with Apex and provide project participants with some information about his credentials, which we believe to be accurate."

A Minnesota lawmaker recently criticized the industry for dismissing wind farm residents' concerns, saying it hurts its own credibility.

"What's frustrating to me is when we take the taxpayer money and use it for these projects and then turn around to the taxpayer and completely blow off their concerns," said Republican state Sen. Andrew Mathews at an October legislative hearing on wind turbine siting.

To hear the industry say "it's all bias and not based on facts or science and it's fear and annoyance and rumors, I have tough time then trying to decide how much to consider is credible" from these companies.

Mathews wants the industry to work on solutions to these problems instead of denying they exist. He said it's time the state and its regulatory agencies do more to protect residents from harm.



[9]

Gary Steinich of Columbia County, Wisconsin, walks near one of the turbines in the Glacier Hills Wind Park. | Arturo Fernandez | GateHouse Media

Misleading tactics

Some landowners solicited by wind farm developers claim the companies used misleading statements in their bids to secure land rights for the projects.

Among the statements these landowners cited: That they should sign agreements because their neighbors already did; that the wind turbines would be quiet and unobtrusive; that they could exit the agreement at any time. Several of those who signed said they now regret doing so.

Large-scale wind farms need thousands of acres per project. Because it's not feasible to purchase the property, companies must seek leases with landowners.

Gary Steinich signed a lease agreement with FPL Energy in 2004 to host two turbines in exchange for annual payments of \$10,400.

Representatives "wined and dined" Steinich and told him he could end the contract at any time, he said. They also promised not to disturb his 160 acres of corn, soybeans and wheat. The turbines would go on the edge of his property, they told him, not in the fields.

But before it built the wind farm, FPL sold the project and its land agreements to WE Energies. The Wisconsin-based utility altered the original plan. It now called for larger turbines in different locations on the existing properties, all of which the agreements allowed.

WE Energies spokeswoman Cathy Schulze said the company did alter the wind project plans after purchasing the development. But she said it worked closely with the community and the Wisconsin Public Service Commission to meet their standards.

Steinich tried to terminate his contract after learning the turbines would stand in the middle of his crops, but he said WE Energies refused to release him. He formed a group and hired a lawyer to fight the project, but he couldn't stop it.

"You lose complete control of your land," Steinich said. "They decide everything."

He ultimately sold his acreage and stopped farming.

Steinich's contract contains a common clause rendering moot any verbal promises. It doesn't matter what developers told him if it's not in the agreement.

"This Agreement and the attached Exhibits shall constitute the entire agreement between the Parties and supersedes all other prior writings and understandings," Steinich's contract states.

Other agreements contain similar language, as Wisconsin farmer Allen Hass learned after contracting to host two turbines in the Blue Sky Green Field Wind Energy Project – a decision he now regrets.

"Everything they tell you is a lie unless it's documented in writing," Hass said.

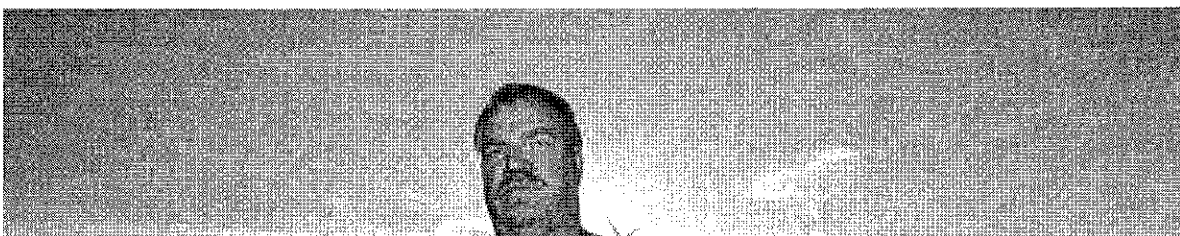
Both men also said wind company representatives falsely claimed their neighbors had signed lease agreements and that the wind projects were coming no matter what. They might as well profit, too.

They said they later learned their neighbors hadn't signed up – at least not at that point. Steinich said he discovered he was the first to sign.

FPL Energy is a subsidiary of NextEra, whose spokesman Bryan Garner declined to comment on Steinich's contract negotiations because he has no direct knowledge of what happened. In general, though, he said the company is truthful to landowners.

Add to story queue:

How some politicians have personal interests in wind energy





[10]

Like a 'securities offer'

At least two Wyoming landowners said they also experienced "aggressive" tactics from wind farm developers.

One of those landowners, former state legislator Diemer True, said representatives of Utah-based Wasatch Wind approached him in 2009 to lease his land for the Pioneer Wind Park.

After True refused, he said, the group continued to pressure him.

"They assured me that because they had, or would have, our neighbors' land leased that I would experience the associated impacts. As a result, I might as well enjoy the income which would come with leasing to them," True wrote as part of a complaint about Wasatch's practices sent to the U.S. Securities and Exchange Commission.

True checked with several of his neighbors, and none had signed a lease with the company, he said in the complaint.

The 2009 SEC complaint came from a citizens' group to which True belonged called the Northern Laramie Range Alliance. It alleged Wasatch used "aggressive sales practices" to solicit development rights worth more than its payment to landowners – akin to a speculative investment and no different from a securities offer.

The alliance also claimed Wasatch, now called Enyo Renewable Energy, failed to disclose the risks associated with the project's development.

"In effect, you're making an in-kind investment in their business," said Kenneth Lay, alliance member and a former SEC enforcement lawyer. "But you don't make anything unless their development is successful."

It's unknown if the SEC took action on the complaint.

Enyo Principal Christine Mikell declined to comment on the alliance's claims, because she wasn't involved in the land negotiations nor was she heading the company at the time. She said Pioneer Wind Park's participating landowners are happy with their contracts.

Lay said he still believes the contracts require serious scrutiny.

Who the contracts favor

The agreements work in the favor of companies in almost every sense, according to several attorneys who have reviewed these types of documents.

Contracts with wind developers can last decades, sometimes with no exit clause for the landowner but language allowing the company to terminate at any time.

Most of the agreements obtained by GateHouse Media allow the company broad access to the property while restricting the landowner's use of the terrain. Some limit the landowner's ability to landscape or erect new structures.

Many contracts also demand the landowner's support of the project in both word and deed.

A lease with Consumer's Energy in Michigan, for example, bans landowners from taking "any action to in any manner attempt to wholly or partially prevent, or otherwise to in any manner oppose," the project even if years later the landowner comes to despise living among the turbines.

Some contracts ban landowners from filing lawsuits against the company, making formal complaints against it before a regulatory agency or lobbying against its future plans to expand the wind farm.

Many agreements also require landowners accept the very effects wind companies claim pose no risk: noises, air-pressure changes, shadow flicker and television and radio interference.

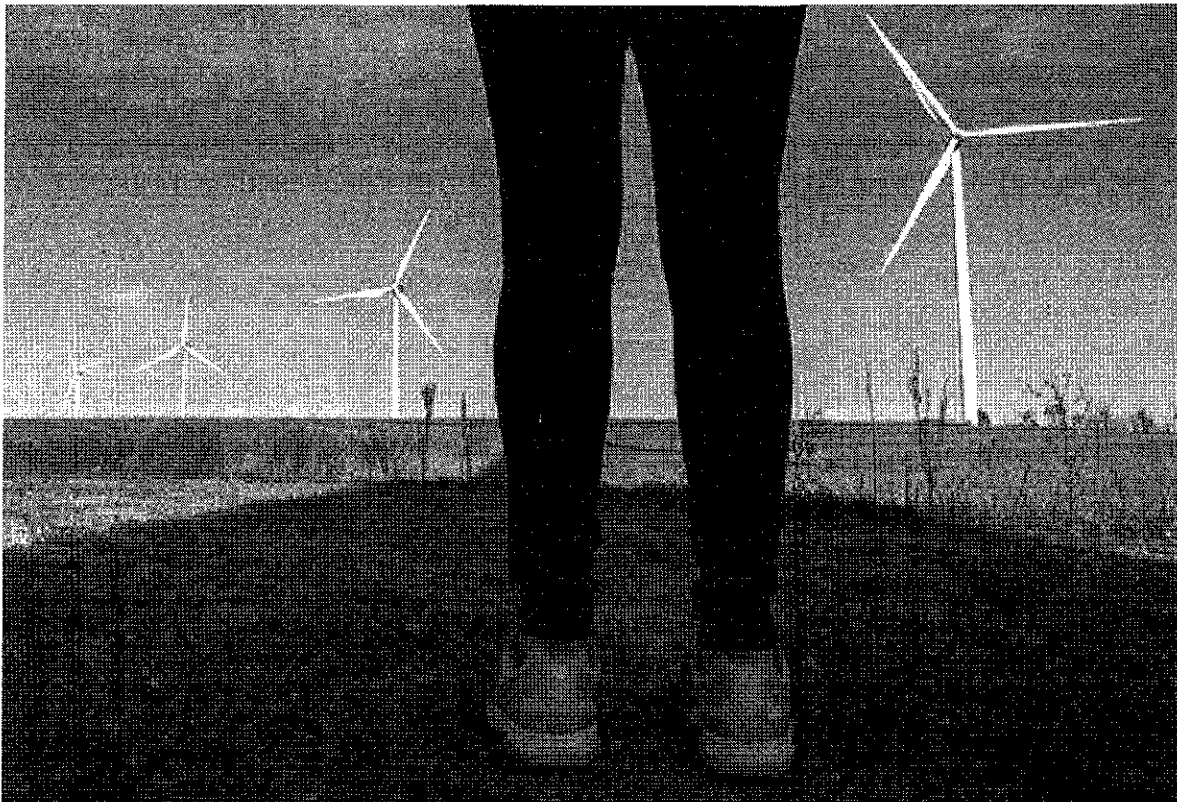
Several agreements contain clauses that let developers renew the terms, sometimes with the landowner's further consent and sometimes without. An Atlantic Wind lease obtained by GateHouse Media shows the company can extend its contract by 26 years without further approval from the landowner.

"These are the most atrocious contracts I've ever read in my life," said Roger McEowen, a professor of agricultural law and taxation at Washburn.

Contracts for land rights vary but all typically contain three components – an exploration phase allowing developers property access to determine project feasibility; a construction and operational phase allowing them to install and operate equipment on the property; and a decommissioning phase covering equipment disassembly and land restoration.

Together these phases' terms can last decades.

Landowners receive different payments depending on the contract phase and the type of equipment – if any – they host. They can range from a one-time sum of less than \$100 to annual installments of tens of thousands of dollars.



[11]

Sandy Kok of Columbia County, Wisconsin, stands near some of the turbines in the Glacier Hills Wind Park. | Arturo Fernandez | GateHouse Media

'Shut-up clause'

Some agreements obtained by GateHouse Media prohibit landowners from making any public statement against the company or the project.

Such was the case with an agreement NextEra offered Jim and Mary Ann Miller after the North Dakota couple complained about relentless shadow flicker from the company's Ashtabula Wind Energy Center.

The flicker was so bad, Jim Miller said, it forced the couple to build a windowless addition to their house.

NextEra agreed to pay them a lump sum of \$15,000 if they signed the waiver.

One of its provisions: "The Parties acknowledge and agree that this prohibition extends to statements, written or verbal, made to anyone, including but not limited to, the news media, investors, potential investors, any board of directors or advisory board or directors, industry analysts, competitors, strategic partners, vendors, employees (past and present) and clients," according to an agreement by Ashtabula Wind II.

The Millers refused to sign.

"I call it a shut-up clause," Jim Miller said.

Such clauses can appear not just in land contracts, but in waivers and so-called “good neighbor agreements.” Companies make agreements with property owners who didn’t sign land deals but live close enough to the project to experience its effects.

In exchange for money, the landowners release the company from liability for these issues and sometimes forfeit their right to complain about it.

Jericho Rise Wind Farm offered Nate Rogers of Chateaugay, New York, \$1,000 upfront and an additional \$1,000 annually to accept noise, shadow flicker, air turbulence, weather hazards and radio and television interference from the turbines near his land, according to a document Rogers shared with GateHouse Media.

The contract does not forbid landowners from complaining about the effects, but it removes their right to seek any legal claim against the company.

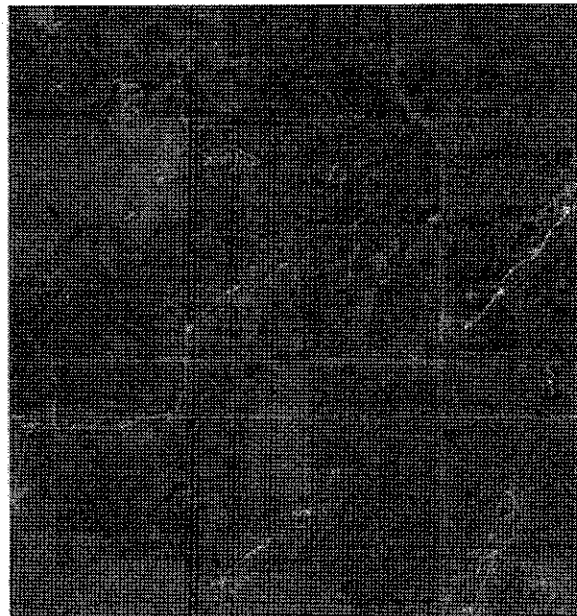
Rogers refused to sign, but he said he still lives with the effects of the nearby structures.

His brother’s family lives up the road, and Rogers said it’s even worse for them. Three giant turbines sit just beyond their property line – obstructing the view, interfering with their television reception, and keeping them up at night with loud noises and blinking lights.

“It makes a metal-on-metal grinding noise,” said Denise Rogers. “I’ve thought about moving. This is not the house we intended it to be.”

Denise and her husband, George, bought the same decibel meter the company uses to measure sound. They said they routinely catch the turbines exceeding the county’s 50-decibel limit and file complaints, but the problems continue.

It’s a never-ending battle, they said.



Left: Denise and George Rogers and their sons, Callahan, 15, and Witt, 12, live near several turbines in the Jericho Rise Wind Farm in Franklin County, New York. | Lucille Sherman | GateHouse Media | Right: Highlighted satellite imagery of a section of the Ashtabula II Wind Energy Center. | Bing.Com/Maps | Used with permission from Microsoft | www.bing.com/maps

'Property value decline'

"Many landowners feel compelled to sign a gag agreement to avoid paying attorney fees to battle the wind farm companies," McEowen said. "One part of what you're getting compensation for is the loss in value for your property."

Wind industry officials deny projects reduce property values. The American Wind Energy Association lists one dozen studies on its website showing no effect on home sales or values.

But other studies have found the opposite, including several conducted by Chicago-based certified residential appraiser Michael McCann.

McCann appraised Cary and Karen Shineldecker's property for \$260,000 when they put it on the market in 2011, shortly before Consumers Energy erected several large turbines near their home. The couple wanted to sell before the wind farm became operational.

The Shineldeckers got no offers for nearly four years.

In early 2015, the family accepted an offer on the house for \$139,000 and sold the surrounding acreage separately for \$40,000 – a total 30 percent loss on the original asking price.

"We were devastated," Karen said.

The Shineldeckers weren't alone. Several neighbors also complained about property devaluation and health problems from the Lake Winds Energy Park. Together, they sued Consumers Energy in March 2013.

The company denied the claims but ultimately settled with the residents in October 2014 for an undisclosed sum.

Dan Williams of Ione, Oregon, also lost value on his property after construction of the Willow Creek Wind Farm, according to real-estate appraiser Richard Barnett.

In court documents related to Williams' lawsuit against the wind farm, Barnett estimated the property's value at \$59,000 without the turbines and \$12,400 with the turbines – a nearly fivefold reduction.

Invenergy, which owns Willow Creek, denied Williams' allegations. The lawsuit settled in January 2016 for an undisclosed sum.

"If you were looking at two identical houses and one had wind turbine and one didn't, which would you pick?" said Bradley Tupi, a Pittsburg attorney who has litigated several wind-related suits.

"There is an obvious impact on property value," he said.

Splitting families, communities

Wind farms bring not only the promise of jobs and money to rural communities across America, but sometimes deep divisions that can rip apart families, friendships and the fabric of once tight-knit towns.

Proposed wind projects have fractured rural communities across the country, pitting neighbor against neighbor in fights over property rights, money and the future of their homes.

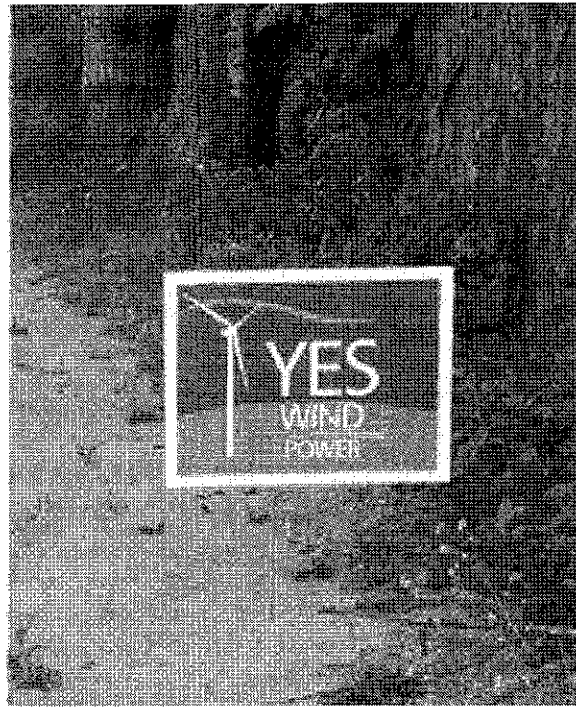
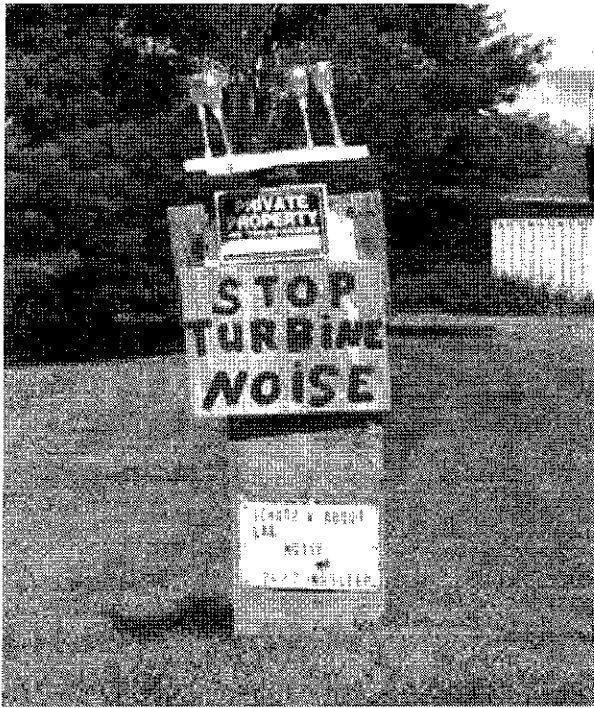
Residents erupted in a shouting match at a town meeting in Ellington Township, Michigan, in December in 2016. One of them had signed a lease with the wind company; the other didn't want the project.

In nearby Almer Township, resident Norman Stephens said somebody destroyed his lawn with Roundup after he spoke out against a proposed wind farm.

Jim and Mary Ann Miller lost friends by opposing the project near their home in Luverne, North Dakota. They said they were taunted at town meetings and shunned by neighbors.

Industry company representatives disputed these projects create community divisions, although they acknowledged some developments spur a period of debate as residents seek information and grapple with impending change.

"These wind farms obviously are creating a big change in these communities," said Evan Vaughn of the American Wind Energy Association, the trade and lobbying arm of the industry. "But it's a change for the better."



[13]

Competing yard signs line the streets in St. Lawrence County, New York, where the community is debating a proposed wind farm that would erect as many as 40 industrial turbines. | Lucille Sherman | GateHouse Media

Split in New York

The neighboring towns of Hopkinton and Parishville in northern New York currently face widespread division over a proposed wind farm that would erect as many as 40 industrial turbines throughout its rural pastures.

A group of residents called Concerned Citizens for Rural Preservation formed to oppose the project. Its members show up at town meetings and pass out yard signs saying “No industrial wind turbines” that now dot lawns across the county.

Other lawns belong to families supporting the development and feature “Yes wind power” signs along the sides of the roads. A pro-wind group called North County for a Brighter Future also formed. It paid for an ad in the local newspaper blaming opponents for using scare tactics.

The controversy flares up at town meetings and in letters to the editor in the local newspaper. It has ended friendships and split families. Project opponent Janice Pease said she no longer speaks to her grandfather, a World War II veteran and major landowner who signed a lease to place two turbines on his land.

“It has divided the community, even families,” said Hopkinton Supervisor Sue Wood. “The majority doesn’t want the wind turbines, but the people who signed leases really want it.”

The project, called North Ridge Wind Farm, would pump \$750,000 annually into local coffers – divided among the county, two towns and the school district. It also would pay participating property owners a combined \$500,000 annually for use of their land.

Avangrid Renewables, a U.S. subsidiary of the Spanish utility giant Iberdrola, is developing the wind farm.

“These investments are, of course, going to represent some amount of change in the community, and we want to do the best that we can to make sure the community is a partner in bringing that change along responsibly and appropriately,” Copleman said. “I think from there people will wrestle with various questions about what it means to develop a wind farm in a community. It’s our job to do the best we can to answer those questions.”



[14]

Janice Pease (left) speaks to Luke Martin inside a cabin that acts as the headquarters of the Concerned Citizens for Rural Preservation group. The group, to which Pease and Martin belong, opposes plans for a wind farm in St. Lawrence County, New York. | Emily Le Coz | GateHouse Media

Accusations of secrecy

Many blame the wind companies for fostering the division, claiming developers enter communities in secret to sign up landowners years before publicly announcing the project.

By the time the general public learns about it, developers already have the easements they need from landowners and the assurances they seek from elected officials to develop their wind farms, several residents said.

Many said they felt blindsided and angry.

"To this date, in all of these projects, there are many people still unaware that these giants are coming to their communities," said Tina Graziano of Villenova, New York, where two companies want to build wind farms.

Graziano made the comments at a Chautauqua County Legislature meeting in January, along with several other people upset about the community division, which many blamed on the wind companies' tactics.

"These wind companies slide, snowball the uneducated board members, keep the notifications at a minimum to deter community opposition," said Graziano said at the meeting. "The community is now split."

Developers aren't being secretive; they're being cautious, said AWEA's Mike Speerschneider. It can take years to determine a project's feasibility due to easements, permitting, environmental studies and other factors. They don't want to announce anything until they're sure they can proceed.

"A very small percentage of projects become anything," Speerschneider said, "so it doesn't make sense to announce it publicly every time you look at a particular piece of property."

But that secrecy, whatever the reason, can drive communities apart. When Cary Shineldecker went door to door informing residents of the proposed wind farm in Mason County, Michigan, he said people were shocked to learn neighbors had signed agreements.

"We had people break down and cry when they found out that people who had been their lifelong friends, who had babysat each other's kids for 50 years, and they never even told their neighbors," Shineldecker said. "They felt so betrayed their friend who lived right next to them had never told them they leased to the company."

The same thing happened when Portuguese energy giant EDP was developing its 77-megawatt Jericho Rise Wind Farm in Chateaugay, New York, residents there said.

Glenda King knows the heartache firsthand. Although she and her family publicly opposed the project, adjacent neighbors quietly signed a lease agreement with EDP to erect three large turbines on their property.

King was devastated when she found out. One of the 496-foot turbines looms just inches from her property line. It screeches whenever the giant motor house rotates in search of optimum wind conditions, and its red lights blink incessantly, keeping the family up at night, she said.

"There is a huge emotional, psychological and physical effect from these things," King said. "It's disgraceful how these companies come into economically deprived area and rip apart families, friends and neighbors."

See also:

Shadow flicker simulation: »» GO »» ^[15]

With data from the Federal Aviation Administration, the U.S. Geological Survey and Google Maps, we've mapped wind turbines across the country. See the growth over time and more details with a look inside the numbers: »» GO »» ^[16]

This investigation found more than 450 families who have publicly complained about the impacts of living near wind farms. **Have a similar experience? Tell your story in your own words:** »» GO »»^[17]

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Michigan wind farm cost a family its health, home^[19]

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[19] Michigan wind farm cost a family its health, home: <https://www.wind-watch.org/news/2017/12/14/michigan-wind-farm-cost-a-family-its-health-home/>

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Okemos, MI 48805

Tel: (517) 507-5067

Email: rickjames@e-coustic.com

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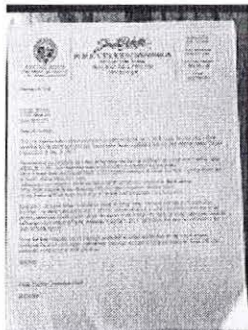


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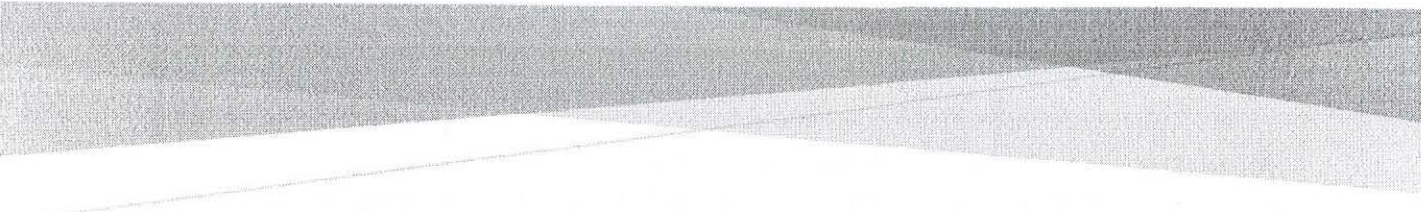
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WIND TURBINE NOISE AND HUMAN HEALTH

A Four-Decade History of Evidence that Wind Turbines Pose Risks

Abstract

Many expert-review panels and some individual authors, in the U.S. and internationally, have taken the position that there is little literature to support concerns about adverse health effects (AHEs) from noise emitted by industrial wind turbines (IWTs). In this review, we systematically examine the literature that bears on some of the particular claims that are commonly made in support of the view that a causal link is non-existent. Investigation of the veracity of those claims requires that multiple topics be addressed, and the following specific topics were targeted for this review: (1) emissions of infrasound and low-frequency noise (ILFN) by IWTs, (2) the perception of ILFN by humans, (3) the evidentiary bases for establishing a causative link between IWTs and AHEs, as well as the physiological bases for such a link, (4) recommended setback distances and permissible noise levels, (5) the relationship between annoyance and health, (6) alternative causes of the reported health problems, (7) recommended methods for measuring infrasound, (8) foundations for establishing a medical diagnosis of AHEs due to IWTs, (9) research designs useful in establishing causation, (10) the role of psychological expectations as an explanation for the reported adverse effects, (11) the prevalence of AHEs in individuals exposed to IWTs, and (12) the scope and quality of literature addressing the link between IWT noise and AHEs. The reviewed evidence overwhelmingly supports the notion that acoustic emissions from IWTs is a leading cause of AHEs in a substantial segment of the population.

Original: October 4, 2016

Revised: October 21, 2016

Jerry L. Punch: Professor Emeritus, Department of Communicative Sciences and Disorders, Michigan State University, East Lansing, MI, USA

Richard R. James: E-Coustic Solutions, LLC, and Adjunct Professor, Department of Communication Disorders, Central Michigan University, Mt. Pleasant, Michigan, USA

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Wind Turbine Noise and Human Health: A Four-Decade History of Evidence that Wind Turbines Pose Risks*

Jerry L. Punch,ⁱ Richard R. Jamesⁱⁱ

Abstract

Many expert-review panels and some individual authors, in the U.S. and internationally, have taken the position that there is little literature to support concerns about adverse health effects (AHEs) from noise emitted by industrial wind turbines (IWTs). In this review, we systematically examine the literature that bears on some of the particular claims that are commonly made in support of the view that a causal link is non-existent. Investigation of the veracity of those claims requires that multiple topics be addressed, and the following specific topics were targeted for this review: (1) emissions of infrasound and low-frequency noise (ILFN) by IWTs, (2) the perception of ILFN by humans, (3) the evidentiary bases for establishing a causative link between IWTs and AHEs, as well as the physiological bases for such a link, (4) recommended setback distances and permissible noise levels, (5) the relationship between annoyance and health, (6) alternative causes of the reported health problems, (7) recommended methods for measuring infrasound, (8) foundations for establishing a medical diagnosis of AHEs due to IWTs, (9) research designs useful in establishing causation, (10) the role of psychological expectations as an explanation for the reported adverse effects, (11) the prevalence of AHEs in individuals exposed to IWTs, and (12) the scope and quality of literature addressing the link between IWT noise and AHEs. The reviewed evidence overwhelmingly supports the notion that acoustic emissions from IWTs is a leading cause of AHEs in a substantial segment of the population.

Key Words: Adverse health effects, human health, industrial wind turbines, infrasound, inner ear, low-frequency noise, wind turbine noise

Introduction

Whether infrasound and low-frequency noise (ILFN) from industrial wind turbines (IWTs) is detrimental to human health is currently a highly controversial topic. Advocates of industrial-scale wind energy assert that there is no credible scientific evidence of a causal relationship, while many reputable professionals believe that there is sufficient scientific evidence to establish a causal link between IWTs and detrimental health effects *for a non-trivial percentage of individuals who reside in communities hosting IWTs*. The veracity of claims regarding the effects on human health is being debated on a global scale by the wind industry; individuals living near

*Revised October 21, 2016

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ⁱⁱE-Cooustic Solutions LLC, and Adjunct Professor, Department of Communication Disorders, Central Michigan University, Mt. Pleasant, Michigan, USA

IWTs; attorneys and expert witnesses in courts of law; print and web-based media; documentary films (which currently include *Windfall*, *Wind Rush*, and *Down Wind*); and scientists and other professionals in government reports, on the Internet, and in scientific and professional papers presented at society meetings and published in peer-reviewed journals.

The debate surrounding IWTs extends to many controversial issues, including physical safety, visibility, shadow flicker, and threats to property values and wildlife. Many problems involving wind turbines, including mechanical failures, accidents, and other mishaps, have been discussed on the Internet. At least one website has extensively catalogued these incidents,^[1] and the large number of incidents reported by that site is described by its webmaster as grossly underestimating the actual number of documented incidents. The most vigorous debate, however, centers on ILFN and its effects on human health.

The overall purpose of this article is to provide a systematic review of legitimate sources that bear directly and indirectly on the question of the extent to which IWT noise leads to the many health complaints that are being attributed to it. The authors accessed most articles and reports referenced in this review by employing Google, Google Scholar, and PubMed as the primary search engines. Our basic aim was to provide a comprehensive and representative—though not exhaustive—review of the literature that is relevant to many of the claims made by wind industry advocates. An exhaustive review is an elusive and impractical goal, given the large volume of directly and indirectly related work done in this area over the past several decades and the current pace of such work.

The role of evidentiary facts

Adverse impacts on people and property are among the most contentious issues that are typically the focus of legal proceedings involving IWT noise. Based on the forensic and research experiences of the authors, we believe that a resolution of the controversial aspects of this debate will require not just relevant scientific research, but rather a series of legal judgments based on the effective evaluation and interpretation of the existing research. In fact, much research and some already-rendered legal decisions show convincingly that some segments of the population suffer damaging effects from exposure to wind turbine noise (WTN). What is needed among the scientific community, local and national governmental agencies, and political leaders, is honest discourse about methods for reducing carbon emissions in ways that do not turn some rural communities into *sacrifice zones*.^[2, 3]

Many symptoms and complaints of adverse health effects (AHEs) related to IWTs have been self-reported by individuals living near wind turbines and described in published case reports.

There is a group of core symptoms and complaints, however—including sleep disturbance, headache, dizziness, vertigo, and ear pressure or pain—that are remarkably common worldwide. Dr. Nina Pierpont was the first to report these core symptoms in a case series,^[4] and she termed these core symptoms *Wind Turbine Syndrome*. For the sake of brevity, we will on occasion refer to Wind Turbine Syndrome as a substitute for this group of common symptoms and complaints, even though the phrase itself is currently not utilized as a medical diagnostic entity.

Numerous reviews of the literature have already been published that allege that there is no credible link between WTN emissions and AHEs. Those reviews have typically been sanctioned by state or provincial government agencies that have missions to support the development of wind energy, and which in turn appoint *expert panels* whose members hold views that regularly favor the wind industry and, therefore, may have conflicting interests. Too often, in the opinion of the authors, such reviews are biased in support of political policy decisions that promote the financial interests of wind developers, and perceived financial benefits to local communities, over the common good. None of those reviews has been specifically targeted toward describing or explaining the relationship between exposure to complex, dynamically modulated infra- and low-frequency sound from wind turbines or other industrial sources (e.g., noise-induced Sick Building Syndrome) and AHEs. Our primary objective in this article is to review the existing scientific and professional literature that is frequently overlooked in such reviews conducted by wind energy proponents. Such literature can be useful in legal proceedings in questioning and articulating the available evidence of risks to people who live in the footprint of utility-scale wind energy projects.

Some of the published reviews have been criticized for their failure to meet the standards noted by Horner,^[5] who reminds us that readers should regard literature reviews with caution, and employ an audit strategy in evaluating their completeness, accuracy, and objectivity. Authors, including ourselves, have an inherent obligation to ensure that such reviews cite all known legitimate sources that serve as the basis for their views of the issues and reflect accurately the contents of all references cited.

Some courts of law in the U.S. and other countries now tend to rely heavily on testimony that adheres to the principle that proof of evidence of causation of AHEs from IWTs be based on the peer-reviewed literature. Presumably, that practice in the U.S. stems at least partially from advocacy by the Office of Management and Budget^[6] that internal and external government science documents be peer-reviewed government-wide for the purpose of increasing the quality and credibility of scientific information generated by the federal government. Peer-review standards are considered paramount in that effort.

While the peer-review process has many virtues, it also has its shortcomings, which are well known. For example, not all journals or individual reviews of submitted manuscripts are of equal quality, as specific journals and specific reviewers may have ideological or philosophical biases, which may or may not be surmised from the journals' mission statements. Nonetheless, the peer-review process is one of the most widely acknowledged ways to control the quality of published works. We contend, however, that there are other credible sources of information, even though those sources may not have been subjected to as rigorous a peer-review process as that employed by many scientific journals. Such sources include papers presented at meetings of scientific and professional societies; reports and other documents commissioned by state and local governmental agencies, especially if such documents are authored by independent researchers; legal testimony given under oath by qualified scientists and professionals; and some information available on the Internet, especially if written by professionals who have reputable track records in their disciplines. Although we will emphasize the peer-reviewed literature in this article, we will also cite some of these additional sources as authoritative. Our citing of selected non-peer-reviewed reports, with a few exceptions, is based on our familiarity with the professional reputations of the authors of those reports, normally earned through publication of a solid body of work in the peer-reviewed literature and by acceptance of their work by other professionals and peers. Typically, individuals so referenced enjoy positive national or international recognition in their respective fields of expertise.

We begin this review by calling attention to a quote from geophysicist Marcia McNutt, who once headed the U.S. Geological Survey and is now editor of the prestigious journal *Science*. McNutt has been quoted as stating: "Science is not a body of facts. Science is a method for deciding whether what we choose to believe has a basis in the laws of nature or not."^[7] In fact, science consists of a variety of overlapping methodological approaches, which must be interwoven to discover answers to complex problems. That conviction has guided our attempt to re-examine the controversial topic at hand.

Review of wind industry claims and positions

Our review is organized by summarizing the past and present literature that addresses each of 12 selected statements, listed below, that encapsulate specific claims, or positions, commonly taken by advocates for the wind industry:

1. Infrasound is not an issue, as infrasound generated by wind turbines is not perceptible to humans.
2. There is nothing unique about wind turbine noise, as infrasound and low-frequency noise are commonly produced by the body and by many environmental sources.

3. There is no evidence that wind turbine noise, audible or inaudible, is the cause of adverse health effects in people, and there are no physiological mechanisms to explain how inaudible acoustic energy can be harmful.
4. Setback distances of 1,000-1,500 ft. (approximately 0.3-0.5 km) are sufficiently safe to protect humans from harm, regardless of height or other physical characteristics of the IWTs.
5. Annoyance is a nuisance, but it is not a health issue.
6. Noise cannot account for all of the complaints of people living in the vicinity of wind turbines; there must be another, unknown reason for the complaints.
7. Infrasound from wind turbines is sufficiently correlated to the A-weighted sound emissions to allow an A-weighted model to be used to predict how much infrasound is present in homes.
8. Wind Turbine Syndrome has not been accepted as a diagnostic entity by the medical profession, so medical professionals cannot diagnose or treat it.
9. Peer-reviewed epidemiological literature is the only acceptable basis for proving a causative relationship between wind turbine noise and adverse health effects.
10. The nocebo effect, a manifestation of psychological expectations, explains why people complain of adverse health effects when living near wind turbines.
11. Only relatively few people, if any, are adversely impacted by wind turbine noise, and the majority have no complaints.
12. There is no evidence in the literature to support a causative link between wind turbine noise and adverse effects.

Statement 1: Infrasound is not an issue, as infrasound generated by wind turbines is not perceptible to humans.

The argument that infrasound as a cause of AHEs is not an issue has been advanced in the published literature primarily by Dr. Geoff Leventhall,^[8, 9] with support from several other researchers. Those researchers have dismissed the influence of infrasound on human health by describing it as not exceeding the thresholds of audibility, and therefore ineffectual, without noting that those thresholds were established using steady pure tones instead of the complex, dynamically modulated tones emitted by wind turbines. Leventhall claims that infrasound from wind turbines is not a problem and that it is misunderstood largely because of mischaracterization by the media and by “those with limited knowledge” (p. 29). He states that there may be noise problems associated with wind turbines, but that such problems are due to

audible swishing sounds due to interactions of the blades with the tower. Supporters of wind energy have generally followed Leventhall's lead, although his own research has shown conclusively that exposure to modulated ILFN produced by large industrial equipment, including heating, ventilating and air-conditioning (HVAC) systems, leads to mental fatigue, lack of concentration, headaches, reduced performance, and work dissatisfaction. Indeed, there is a long history of noise-induced *Sick Building Syndrome*, stemming from investigations in the 1970s-1990s of the effects of low-frequency noise on knowledge workers (see James^[10] and Schwartz^[11] for reviews of that research). Leventhall^[12] stated:

"Low frequency noise causes extreme distress to a number of people who are sensitive to its effects. Such sensitivity may be a result of heightened sensory response within the whole or part of the auditory range or may be acquired. The noise levels are often low, occurring in the region of the hearing threshold, where there are considerable individual differences" (p. 4).

Later in the same document, he states:

"There is no doubt that some humans exposed to infrasound experience abnormal ear, CNS (central nervous system), and resonance induced symptoms that are real and stressful. If this is not recognised by investigators or their treating physicians, and properly addressed with understanding and sympathy, a psychological reaction will follow and the patient's problems will be compounded. Most subjects may be reassured that there will be no serious consequences to their health from infrasound exposure and *if further exposure is avoided* (emphasis added) they may expect to become symptom free" (p. 60).

Leventhall has also stated that the ear is designed to protect us from infrasound and that, in essence, *If you can't hear it, you can't feel it*.^[13, 14] The idea that ILFN from wind turbines does not affect health was further reinforced in a 2009 white paper co-authored by Leventhall and sanctioned by the wind industry,^[15] to be reviewed later.

The position that infrasound from wind turbines is not harmful to humans because it is not perceptible to the human ear also has support from Møller & Pedersen,^[16] who investigated noise emissions from 48 wind turbines with electrical output capacities of between 2.3 and 3.6 MW. They stated:

"The turbines do emit infrasound (sound below 20 Hz), but levels are low when human sensitivity to these frequencies is accounted for. Even close to the turbines, the infrasonic sound pressure level is much below the normal hearing threshold, and infrasound is thus not considered as a problem with turbines of the investigated size and construction" (pp. 3742-3743).

Evans et al^[17] found that levels of infrasound measured at two residential locations near wind projects in South Australia were within the range of infrasound levels experienced in other urban and rural environments. Although Colby et al^[15] and Bolin et al^[18] dismiss wind turbines as a cause of AHEs, they acknowledge that turbines emit ILFN. A number of authors indicate that large turbines emit more such noise than smaller turbines (see, for example, Bolin et al^[18] and Møller & Pedersen.^[16]) George Kamperman (personal communication, 2009) has concluded that the amount of low-frequency noise generated by IWTs increases by 3–5 dB for every megawatt of electrical power generated.

Evidence that IWTs produce perceptible levels of infrasound, in addition to audible low-frequency noise above 20 Hz, has been available since the 1980s. In their seminal research on large-scale wind turbines, which was funded by the U.S. Department of Energy, Kelley et al^[19] measured noise levels emitted by a DOE/NASA MOD-1 wind turbine operating near Boone, North Carolina, in response to noise complaints. They concluded that:

“...one of the major causal agents responsible for the annoyance of nearby residents by wind turbine noise is the excitation of highly resonant structural and air volume modes by the coherent, low frequency sound radiated by large wind turbines. Further, there is evidence that the strong resonances found in the acoustic pressure field within rooms actually measured indicates a coupling of subaudible energy to human body resonances at 5, 12, and 17-25 Hz, resulting in a sensation of whole-body vibration” (p. 120).

Those conclusions were further strengthened in a subsequent report.^[20] In a second follow-up report, also funded by the Department of Energy, Kelley^[21] electronically simulated three interior environments resulting from low-frequency acoustical loads radiated from both single and grouped upwind and downwind turbines. (These terms refer to the placement of the rotor and blades with respect to the tower. With upwind designs, the more contemporary design, the airflow strikes the blades before striking the tower, and with downwind designs, the airflow strikes the tower before striking the blades.) Relatively low levels of low-frequency acoustic noise from a single, 2-MW MOD-1 wind turbine led to annoyance of residents of the surrounding community, largely through interaction with residential structures. Most importantly, Kelley found that the turbines radiated their peak sound power in the infrasonic range, typically between 1 and 10 Hz. An extensive investigation revealed that the reported annoyance was the result of a coupling of the turbine’s impulsive low-frequency acoustic energy into the structures of some of the surrounding homes, and that annoyance was “frequently confined to *within the home itself*” (p. 1). Despite these early findings that IWTs generate infrasonic levels that produce acoustic energy, vibrations, and resonances that affect people in

their homes, the wind industry has chosen to regard them as insignificant or only applicable to obsolete, downwind wind turbine designs.

The basis for discounting the research by Kelley and associates is predicated on the assumption that pressure changes of equal levels to wind turbines occur in natural environments and do not cause any similar complaints. The authors find that their own experiences with rapidly changing pressures have caused similar experiences. If these rather short-duration sensations were to continue over days, weeks, and months, as they do for people living near wind projects, they would likely find them to be unacceptable.

The primary argument of people who deny any effects is encapsulated by Leventhall^[9] in his *Child on a Swing* example:

“A child on a swing experiences infrasound at a level of around 110dB and frequency 0.5Hz, depending on the suspended length and the change in height during the swing” (p. 30).

The inference is that because children often swing on swings, there are no adverse sensations. That fails to acknowledge that the experience of swinging is one that elicits many visceral sensations that are pleasant to the child as long as the sensations stop when the swing stops. The example, however, misses one major point. The duration and motion of the swing provide a smooth, sinusoidal pressure change that has two high pressure points (at the top of each swing) that occur over a period of several seconds or so. This is a completely different experience to that of pressure pulses lasting 100 msec or less. If one considers a swing with a period of 3.5 sec, there is a pressure change at 1.75 sec, resulting in a frequency of 0.57 Hz. The pressure changes are approximately 120 dB peak-to-peak, or 110 dB rms. The overall G-weighted value in this example is -60 dB, with a smooth pressure change, resulting in a net 50 dBG for the child, versus the 75 dBG experienced as a pulse for a person living near a wind turbine (calculations provided by Malcolm Swinbanks, personal communication, 2010).

The assertion that wind turbine infrasound immissions, especially when received in the bedroom of a quiet home, must be at or above the threshold of hearing to cause adverse effects has been disproved, as noted above in the works of Kelley and colleagues in the 1980s.^[19, 20, 21] The significant finding of the Kelley studies is that when the intruding infrasound is dynamically modulated short-duration pulses (generally under 100 msec and as short as 4 msec), the thresholds of sound pressure levels (SPLs) for non-auditory perception are in the range of 60 to 70 dB. In the work by one of the authors of this paper (James, with Mr. Wade Bray, INCE, of Head Acoustics, GMBH), infrasound pulsations were measured from a GE 1.5-MW wind turbine

with a blade-pass frequency of 1 Hz that reached a level as high as 100 dB.^[22] The people living in the home 'felt' the pulsations when the crests of the pressure waves were as low as 60 dB at 1 Hz. During similar measurements, Swinbanks, who has reported that he is sensitive to infrasound pulsations, was present at the test site. His experience was that he could feel the pulsations outside the home at similar SPLs.

Subsequent to the papers by Kelley and colleagues, several other studies have also reported the thresholds for significant experiences at similar thresholds, all substantially below the threshold for audibility of steady pure tones. In many of those tests, the rms SPL of the dynamically modulated blade-pass tone and its harmonics has been as low as 40 dB when using narrow-band analysis with windows of 40 to 80 sec, providing the crest of the pressure waves are 10 to 15 dB higher than the rms levels. These studies include the works of Robert Rand, INCE, and Stephen Ambrose, Bd. Cert., INCE, in their study of homes of complainants in Falmouth, Massachusetts;^[23] Walker, Hessler, Hessler, and Schomer, in their work at the Shirley Wind project in Brown County, Wisconsin, for the Wisconsin Public Health Service;^[24] and most recently, Steven Cooper's study of the Cape Bridgewater project in Victoria, Australia.^[25] All of these studies report similar findings, namely that perception, generally non-auditory in character, begins when the rms SPLs of the modulating tones are as low as 40 dB rms, with increasing impacts as the rms levels rise to 50, 60, and to 70 dB and higher levels. In all these studies, the dynamic modulation of the blade-pass tones produce pressure peaks that are often 10 dB or more, sometimes much more, than the rms values.

In the opinion of the authors, a paper prepared by Swinbanks for the 2015 conference on wind energy in Glasgow, Scotland, shows the impact of dynamically modulated infrasound on a sensitive individual—himself—along with high-quality measurements of the environments in which he experienced the sensations.^[26] That paper shows that a highly respected acoustician and scientist with expertise in infra- and low-frequency sound also responds to this acoustic energy in a way that is similar to the many complaints from others, both in the location of his tests and at other wind energy projects around the world. In the paper, Swinbanks reports that he was able to differentiate the pulsations in the test data from at least six separate wind turbines in a project consisting of 46 1.5-MW GE models. He also reports that he was able to perceive the effects of the pulsations in his home's basement, approximately 3 km from the nearest operating wind turbine, with the SPLs of the blade-pass frequency and harmonics summing to about 55 dB rms. At closer locations, he measured positive-going pressure peaks of 87 dB with corresponding negative-going peaks of equal level. It is worth noting that at the Glasgow conference,

Swinbanks presented the paper as a poster session,^[27] as he was informed by the conference moderator that time restraints prevented him from presenting his paper to conference attendees.

In the 2012 investigation of infrasound at the Shirley Wind project, where local regulations require that the Nordex 2.5-MW turbines be sited at least 1,250 ft., or 381 m, from residences, Walker et al reported infrasound levels at one of the three test homes.^[24] WTN was not audible outside the residence where infrasound was greatest, supporting the position that infrasound is at the root of at least some of the complaints. The blade-pass frequency and harmonics were clearly evident from the measurements inside that one home, and the family had moved far away for a solution.

Following the Shirley Wind team study, several members of the community conducted a series of micro barometer measurements inside homes ranging from 1,280 ft. to approximately 6 mi. from the wind turbine towers. Infrasonic tones at blade-pass frequencies and harmonics were found at all test sites, including test sites at distances of several miles or more from towers under downwind conditions. Testimony to Wisconsin's Brown County Board of Health by people with homes more than 4 mi. from the nearest wind turbines reported AHEs during the times the turbines operated. In mid-October 2014, the Brown County Board of Health went on record declaring that wind turbines at the Shirley Wind site "...are a human health hazard."^[28] That action, which appears to be a precedent in the U.S., meant that Duke Energy's Shirley Wind utility were forced to prove to the Board that the utility was not the cause of the health complaints documented in the study and voiced by community residents. The outcome could result in a shut-down order, but no final decision had been made in that case at the time of this writing. Other examples of legally ordered turbine shutdowns include those in Massachusetts^{29, 30} and Portugal.³¹

We will return to the issue of perceptibility of infrasound later in this paper, as we describe the physiological bases for perceptibility.

Statement 2: There is nothing unique about wind turbine noise, as infrasound and low-frequency noise are commonly produced by the body and by many environmental sources.

To begin, when the spectral characteristics of IWT noise, as depicted in several papers,^[24, 32, 33] are compared to the spectra of subsonic jet transport planes,^[34] five different types of aircraft,^[35] and road traffic noise,^[36] it is clear that noise generated by wind turbines has a number of unique acoustical characteristics. These comparisons reveal dissimilarities in spectral and peak levels in both the higher and lower frequency regions, including the low-frequency and infrasonic range.

Leventhall^[37] was one of the first to describe how low-frequency noise is a special noise problem, particularly to sensitive people in their homes. He indicated that annoyance to low-frequency noise increases rapidly with level, often starting just above the threshold of audibility, and that about 2.5% of the population may be 12 dB more sensitive than the average person to low-frequency noise. He also noted that the World Health Organization (WHO) places a special emphasis on low-frequency noise as an environmental problem and source of sleep disturbance, even at low levels. The WHO^[38] acknowledges that a noise consisting of a large proportion of low-frequency components may considerably increase AHEs and should be limited to below 40 dBA. Cummings^[39] notes that sound levels of 40 dBA trigger high levels of community pushback.

Jung et al^[40] experimentally identified the characteristics of acoustic emissions from large upwind wind turbines, with emphasis on ILFN. The sound spectral density showed that the blade-passage frequency component is clearly dominant, revealing up to 6-7 harmonics that generally occupy the infrasonic frequency region of 1 to 10 Hz. They voiced a concern that the low-frequency noise of the 1.5-MW and 600-kW wind turbines in the frequency range over 30 Hz would very likely lead to psychological complaints from ordinary adults.

In responding to a bylaw to restrict wind turbine infrasound in the town of Plympton-Wyoming, Ontario, Leventhall^[41] declared that “Infrasound has become the Godzilla of acoustics” (p. 2). He concluded that science does not support the conditions in the bylaw, which was largely aimed at restricting blade-passing tones, because “There is no evidence that the very low level of blade passing tones affects humans, whilst there is evidence that it does not” (p. 7). Based on the kinds of evidence just discussed, we strongly disagree.

WTN has been described as having a character that makes it far more annoying and stressful than other sources of noise at the same A-weighted level, including traffic and industrial noise.^[42, 43, 44, 45] Harrison^[42] concluded that IWTs cause annoyance in about 20% of residents living within a distance considered acceptable by most regulatory authorities, and that for many of the 20%, the annoyance and sleep disturbance lead to AHEs. Thorne^[46] has pointed out that human perception of noise is based primarily on sound character rather than sound level, and that wind turbines are unique sound sources that exhibit special audible and inaudible modulated and tonal characteristics. He states that sound levels of 32 dBA Leq outside a residence and/or above an individual’s threshold of hearing inside the home are markers for serious AHEs, especially among susceptible individuals.

Structural and human responses to low-frequency noise, including noise from wind turbines, have been described by Hubbard.^[47] Hubbard and Shephard^[48] illustrated the special characteristics of WTN by explaining its sources, pathways, and receptors. Thorne^[46, 49] described wind turbines and *wind farms* as a unique source of sound and noise, like no other noise source or set of noise sources. The sounds are often of low amplitude and shifting in character, making it difficult for people who have never been exposed to such sounds to understand the problems of those who complain about the sounds. Shepherd et al^[50] have described WTN as having characteristics sufficiently different from other, more extensively studied, noise sources to justify the application of standards different from pre-existing noise standards.

The preponderance of evidence on this point leads to the conclusion that WTN has special acoustic characteristics that distinguish it from other industrial sounds. A primary feature is that it consists of measureable energy down to below 1 Hz.^[24, 51, 52] Its sound pressure level decreases rapidly with increasing frequency from about 0.5-5 Hz. It varies in amplitude over time,^[9, 49, 51, 53, 54, 55, 56, 57, 58] it tends to have an intermittent tonal quality,^[49, 52, 59] and its characteristics vary with distance and direction.^[52, 53] It can result in an impulsive sound,^[21, 40, 49, 60] even at long distances.^[52] According to Lee et al,^[53] the swishing sounds of turbines can be perceived from all directions, but at long distances from a turbine, low-frequency amplitude-modulated sounds can be heard only in particular directions and when the SPL is sufficiently high. This effect may make the WTN seem more impulsive at long distances despite an overall SPL that is relatively low.

Furthermore, ILFN from any source, including IWTs, is well known to penetrate walls and other barriers (e.g., Minnesota Department of Health^[55]); is typically more disruptive indoors than outdoors;^[46, 47, 61, 62, 63] and is not easily masked by atmospheric sounds, including road traffic and other sources of infrasound.^[63, 64, 65, 66] The perception of low-frequency noise depends on density level, modulations, bandwidth, purity of blade-pass tones and harmonics, discrete beating tones, or other time-varying properties, and can occur even at near-infrasonic frequencies if any of these factors is present; otherwise, it might pass unnoticed.^[57, 67, 68] James^[69] describes the infrasound occurring when wind turbine blades rotate past the tower as a short pressure pulse that consists of a well-defined array of tonal harmonics below 10 Hz. If the pressure peaks are received at the same time, they sum in a linear manner that significantly raises the overall SPL. Often, however, there are many wind turbines rotating at similar speeds, but not synchronized in time. This can lead to another form of modulation as the wind turbine infrasound is perceived as rising and falling, intermittent, or pulsating with variable intensity.

A common argument of wind industry proponents—one that is sometimes raised in legal proceedings—is that humans themselves generate infrasound by virtue of their own heartbeat and breathing, at levels that can be substantially higher than an external noise source such as wind turbines. In a rebuttal to a formal statement to this effect by the Association of Australian Acoustical Consultants (AAAC), Salt has provided a definitive explanation of why the two sources of infrasound (internal vs. external) cannot be equated. In a letter addressed to the AAAC,^[70] Salt stated:

“Stimulation of the ear occurs not directly by pressure (which is why deep sea divers can still hear) but by induced motions of the inner ear fluids, which in turn move sensory tissues and motion-sensitive cells....when low frequency and infrasound enters the ear via the stapes, it causes fluid movements throughout the entire ear between the stapes in the vestibule, through scala vestibuli and scala tympani to the compliant round window membrane at the base of scala tympani. It is these fluid movements that drive sensory tissue movements and cause stimulation. In contrast, pressure fluctuations generated by the body, such as by heartbeat and respiration, enter the ear via the cochlear aqueduct, not through the stapes. The cochlear aqueduct enters the ear adjacent to the round window membrane in the very basal part of scala tympani, so the fluid flows are localized in this tiny region of the ear. As the rest of the ear is bounded by a bony shell which is not compliant, fluid flows in the rest of the ear are substantially lower so that displacements of sensory tissues are negligible. Infrasound generated by the body, because it enters through the aqueduct, therefore does not cause stimulation of the ear.”

Statement 3: There is no evidence that wind turbine noise, audible or inaudible, is the cause of adverse health effects in people, and there are no physiological mechanisms to explain how inaudible acoustic energy can be harmful.

In fact, there is ample evidence that noise in general, and especially low-frequency noise, has long-term consequences for human health.^[71, 72] For example, long-term exposure to ordinary traffic noise has been associated in a dose-dependent manner with higher risk of myocardial infarction.^[73]

Two landmark reports embodying diametrically opposing perspectives with regard to the impact of WTN on health appeared almost concurrently in 2009. One was published as a book by Dr. Nina Pierpont,^[4] a Fellow of the American Academy of Pediatrics who holds an MD degree from Johns Hopkins University School of Medicine and a PhD degree in Population Biology from Princeton University. The other report was written by a panel of seven experts (three physicians, two acousticians, an audiologist, and an audiologist/hearing scientist) commissioned by the American Wind Energy Association and the Canadian Wind Energy Association. The latter report^[15] is commonly referred to as the AWEA/CanWEA report, or white paper. These

respective reports, more than any others, quickly became the rallying cry for so-called anti-wind and pro-wind advocacy groups in the media, in the public discourse, and in court proceedings.

In her book, Pierpont^[4] coined the term *Wind Turbine Syndrome* to describe a range of symptoms reported for 38 family members (adults and children) of 10 families who lived near wind turbines. Based on telephone interviews, she treated her observations and analyses as a case-series research design. She described the syndrome as consisting of 10 classes of symptoms (enumerated below), many of which she attributed to overstimulation of the vestibular system of the inner ear by ILFN. The wind industry, in its AWEA/CanWEA report and elsewhere, has vigorously criticized her study for being non-scientific and non-peer-reviewed. In fact, Pierpont's book was critically reviewed by far more than the usual number of reviewers for a peer-reviewed journal article. While it is true that case series are prone to selection bias, and can at best suggest hypotheses, many discoveries of new phenomena begin with a case study or case series. Furthermore, an increasing body of scientific evidence supports Pierpont's observations of a relationship between WTN and AHEs. More recent laboratory research, described later in this review, suggests that a variety of health symptoms may be due to ILFN stimulation of both vestibular and cochlear components of the inner ear.

Prior to Pierpont's book,^[4] Dr. Amanda Harry^[74] and Dr. Robyn Phipps and colleagues^[75, 76] had documented the occurrence of ill effects from IWTs by use of questionnaire-based surveys of the health complaints of people living near wind projects in Cornwall, England, and Palmerston North, New Zealand, respectively. These authors concluded that a substantial number of people living near wind turbines suffer from health problems and that the cause of the disturbances was the complexity of the noise and vibration. Harry^[74] observed that the symptoms were evident for people living within a mile from the wind development and recommended that no wind turbine should be sited closer than 1.5 mi. from the nearest residents. She noted that the guidelines used at the time to site wind turbines were developed when the turbines were 20% the size of the current ones. She concluded that annoyance from noise adversely affects human well-being, and that developers are wrong when they state that WTN is not a problem. Phipps et al^[75] noted that 45% of households living within 2 km of the wind farm and 20% of households living up to 8 km away reported hearing noise from the turbines. Phipps^[76] reported on the negative consequences of noise that were evident in her own survey and in the works of others, warning that residents do not readily habituate to the presence of WTN.

The AWEA/CanWEA report^[15] has been widely used by the wind industry as a basis for its denial of AHEs from IWTs. However, the report is the product of a hand-picked group of experts, at least some of whom were known to hold positions favorable to the report's sponsors.

it was never peer-reviewed, and it shows signs of bias, such as conclusions not supported by the research referenced in the report. That white paper concluded that sound from wind turbines, including sub-audible low-frequency sound, does not pose a risk of hearing loss or any other AHE in humans, whether those health effects are described as Wind Turbine Syndrome or otherwise. It also concluded that some people may be annoyed at the presence of sound from wind turbines, including its fluctuating nature, but described annoyance as unrelated to health. Although there is indeed no evidence that IWTs causes hearing loss, the report's conclusion that ILFN does not cause AHEs, and its dismissal of annoyance as a serious entity, have been heavily criticized as erroneous. Horner et al^[77] cite many specific examples of the AWEA/CanWEA report's failure to use proper documentation, concluding that it lacks scientific merit and that it is neither authoritative nor convincing. They criticized the report's conclusion that the issue of AHEs stemming from IWTs is settled and that no more research is required, a conclusion that is rarely voiced by scientists. Horner^[78] has characterized the report as offering nothing new in its treatment of annoyance, as annoyance has long been known to result from the stress effects of exposure to noise, and he criticized the report for downplaying the relationship between annoyance and health. Phillips^[79] has indicated that the report mischaracterized the research designs used by epidemiologists. Despite widespread denial by wind industry advocates of a causal relationship between IWTs and AHEs, the vast majority of peer-reviewed papers have shown that IWTs significantly disturb sleep in at least some residents at distances and noise levels that are typical where IWTs are installed. Furthermore, not a single well-designed scientific study has found WTN to be harmless.^[80, 81]

A panel of seven independent experts was commissioned by the Massachusetts Departments of Environmental Protection and Public Health to identify any documented or potential health impacts of risks that may be associated with exposure to IWTs and to facilitate a discussion of IWTs and public health based on scientific findings. The panel generated a report^[82] concluding that scientific evidence is lacking to show that WTN leads to AHEs and that a more comprehensive assessment of WTN in populated areas is needed for establishing and refining siting guidelines and for developing best practices. Closer investigation was recommended near homes where outdoor A- and C-weighted levels differ by more than 15 dB, a strategy for detecting the presence of ILFN (e.g., Kamperman & James^[83]). The Massachusetts report has been criticized as misrepresenting the evidence it cites, as well as underestimating evidence indicative of AHEs from IWTs.^[84, 85] Schomer and Pamidighantam^[86] have described the report as a critique of the literature relating to wind turbine acoustic emissions and health effects, and one with problems similar to those it criticizes.

Some laypersons have remarked disparagingly in the media on the factual evidence—including observations and scientific reports—that shows a relationship between IWTs and AHEs. Shahan,^[87] for example, confidently states: “To date, there is no scientific evidence that anything such as ‘Wind Turbine Syndrome’ actually exists.” A common argument of wind energy advocates is that studies show that wind turbines do not lead to AHEs, or that studies that draw such a conclusion are not sufficiently scientific to establish causation. Efforts to discredit those who take a skeptical view toward the wind industry commonly use terms such as *opponents*, *detractors*, *anti-wind activists*, or in the case of Shahan,^[87] “paid anti-wind ‘experts’ who have a long history of directly testifying against wind energy in various court cases.” Such critics casually ignore the fact that many of the industry experts, including consulting acousticians and physicians, routinely testify on behalf of the industry in such cases, sometimes for substantial fees, and those individuals are rarely described as paid pro-wind experts or activists.

Numerous researchers have reported the existence of a constellation of health symptoms, either directly mirroring or closely related to those described as Wind Turbine Syndrome by Pierpont,^[4] in persons living near IWTs. Significantly, the WHO^[38] states that there is sufficient evidence that nighttime noise, irrespective of its source, is related to self-reported sleep disturbance and other health problems, and that these effects can lead to a considerable burden of disease in the population.

Sleep disturbance has been identified as a major adverse impact of IWTs.^[4, 18, 45, 47, 54, 57, 58, 72, 74, 76, 77, 79, 80, 81, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107] Nighttime exposure to 40-dBA low-frequency noise has been shown to affect cortisol levels, a physiological indicator of stress. Those levels, following awakening, have been found to be associated with subjective reports of lower sleep quality and mood changes.^[108] Sleep is a biological necessity, and disturbed sleep is associated with a number of adverse health conditions. The WHO^[71] has concluded that there is available, good-quality evidence supporting a causal association between noise and sleep disruption. Sleep disturbance has important implications for public health and may be a particular problem in children.^[84, 94, 109]

Even if no other adverse effects were associated with WTN, sleep disturbance alone is a sufficient reason to site turbines at distances that do not disrupt sleep. Many rural communities have background, nighttime sound levels that do not exceed 25 dBA, and observable effects of nighttime, outdoor noise do not occur at levels of 30 dBA or lower.^[71] As outdoor sound levels increase, the risk of AHIEs increases, the most vulnerable populations being the first to show their effects. Vulnerable populations include elderly persons; children, especially those younger than age six; and people with pre-existing medical conditions, especially if sleep is affected.^[38, 71]

According to the WHO, there is ample evidence to link AHEs with prolonged exposure to outdoor sound levels of 40 dBA or higher. It is important to note that the WHO guidelines are based largely on industrial and transportation noise research, and not on wind turbine research. Because multiple studies (covered in this review) have indicated that WTN is significantly more annoying, has higher infra- and low-frequency sound energy, and is modulating, pulsatile, and sometimes tonal, it may impact health to a greater degree than other noises. This means that noise limits in the WHO guidelines may need to be adjusted downward when applied to WTN.

Additional factors increase the probability of sleep disruption due to WTN. The noise can be heard especially well in areas with low background noise levels, which usually occur at night. Also, lower nighttime wind speeds at ground level increase the nighttime contrast between WTN and background sound levels. Using test data taken during daytime wind conditions will result in a large underestimate of nighttime WTN levels, and thus underestimate the potential for sleep disruption.^[38, 58]

Researchers who have studied the impacts of ILFN in general and WTN specifically on health, including some who have reviewed and assessed the findings of other researchers, have attributed a variety of symptoms to ILFN exposure. Those symptoms have been variously described by different researchers, with varying degrees of overlap and detail. They are shown, in no particular order, in Table 1.

Clearly, in addition to annoyance, the most commonly experienced and least-contested health symptom suffered by people living near IWTs is sleep disturbance.^[110] Both the United Nations Committee against Torture (CAT) and the Physicians for Human Rights^[111] describe sleep deprivation as critical to human functioning. According to Physicians for Human Rights:

“Sleep deprivation ... causes significant cognitive impairments including deficits in memory, learning, logical reasoning, complex verbal processing, and decision-making; sleep appears to play an important role in processes such as memory and insight formation” (p. 22).

Table 1. Health symptoms described by different researchers as linked to exposure to infrasound and low-frequency noise, including exposure to industrial wind turbines.

Author (Year)	Reference	Symptomatology
Pierpont (2009)	4	Sleep disturbance; headache; Visceral Vibratory Vestibular Disturbance (VVVD); dizziness, vertigo, unsteadiness; tinnitus; ear pressure or pain; external auditory canal sensation; memory and concentration deficits; irritability and anger; and fatigue and loss of motivation
Leventhall (2003) Kasprzak (2014)	12 112	Vibration of bodily structures (chest vibration), annoyance (especially in homes), perceptions of unpleasantness (pressure on the eardrum, unpleasant perception within the chest area, and a general feeling of vibration), sleep disturbance (reduced wakefulness), stress, reduced performance on demanding verbal tasks, and negative biological effects that include quantitative measurements of EEG activity, blood pressure, respiration, hormone production, and heart rate
Havas & Colling (2011)	91	Difficulty sleeping, fatigue, depression, irritability, aggressiveness, cognitive dysfunction, chest pain/pressure, headaches, joint pain, skin irritations, nausea, dizziness, tinnitus, and stress
Horner (2013) Paller et al (2013)	78 113	Headaches, nausea, tinnitus, vertigo, and worsened sleep
Jeffery et al (2013)	92	Sleep disturbance; subjective complaints such as headaches, fatigue, temporary feelings of dizziness, and nausea; objective complaints such as vomiting, insomnia, and palpitations; annoyance; and reduced quality of life (QoL)
Jeffery et al (2014)	93	Negative impacts on the physical, mental and social well-being of people
Krogh et al (2012)	96	Annoyance (regarded as an adverse health effect associated with stress), sleep disturbance, headaches, difficulty concentrating, irritability, fatigue, and a variety of more-serious ailments
Minnesota Department of Health (2009)	55	Annoyance, reduced quality of life, sleeplessness, and headache
Howe Gastmeier Chapnik Limited (2010)	114	High levels of annoyance in a non-trivial percentage of persons, with annoyance associated with sound from wind turbines expected to contribute to stress-related health impacts in some persons

Author (Year)	Reference	Symptomatology
Nissenbaum (2013)	81	Sleep disturbances/sleep deprivation and the multiple illnesses that cascade from chronic sleep disturbance, which include cardiovascular diseases mediated by chronically increased levels of stress hormones, weight changes, and metabolic disturbances (including the continuum of impaired glucose tolerance through diabetes); psychological stresses that can result in cardiovascular disease, chronic depression, anger, and other psychiatric symptomatology; headaches, auditory and vestibular system disturbances; an increased requirement for and use of prescription medication; tinnitus; and vertigo
Nissenbaum et al (2012)	97	Increased sleep disruption, reduced mental health
Thorne (2013)	49	Sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic attack episodes
Pawlaczyk-Luszczyńska et al (2005)	115	Problems with vision, concentration, and continuous and selective attention (especially in persons who are highly sensitive to low-frequency noise)
Pedersen (2011)	99	Annoyance (both outdoors and indoors), statistically related to SPLs; sleep interruption, diabetes, and tinnitus (at one of three test sites); annoyance outdoors, significantly related to sleep interruption, tension, stress, irritability (at all three sites), headache (at two sites), and undue fatigue (at one site); annoyance indoors, significantly related to sleep interruption (at all three sites), and to diabetes, headache, undue fatigue, tension, stress, and irritability (at one of three sites)
Roberts & Roberts (2013)	102	Vibration or fatigue, annoyance or unpleasantness
Shepherd & Billington (2011)	103	Annoyance, which has been linked to increased levels of psychological distress, stress, difficulty falling asleep, and sleep interruption
Taylor (2013)	58	Annoyance, stress, sleep disturbance, interference with daily living, headache, irritability, difficulty concentrating, fatigue, dizziness, anxiety, and reduced QoL
Ambrose et al (2012)	61	Dizziness, irritability, headache, loss of appetite, fatigue, inability to concentrate, a need to leave the home, and a preference for being outdoors (during investigations of WTN by seasoned researchers, including acousticians)
Rand et al (2011)	116	
Thorne (2011)	46	Sleep disturbance, anxiety, stress, and headaches

Author (Year)	Reference	Symptomatology
Palmer (2013)	117	Negative impacts on sleep, job stability, social relationships, care giving, pursuit of hobbies, leisure, learning, and overall health (based on interviews of residents four years after living near operational wind turbines)
Castelo Branco & Alves-Pereira (2004)	118	Vibroacoustic disease, described as occurring only after extensive exposure to high levels of infrasound
Castelo Branco (1999)	119	

Other sources quoted by the Physicians for Human Rights^[111] note that:

“A review of the medical literature reveals numerous adverse cognitive effects of sleep deprivation including impaired language skills-communication, lack of innovation, inflexibility of thought processes, inappropriate attention to peripheral concerns or distractions, over-reliance on previous strategies, unwillingness to try out novel strategies, unreliable memory for when events occurred, change in mood including loss of empathy for colleagues, and inability to deal with surprise and the unexpected” (pp. 22-23).

Another line of reasoning is that there is a cause-effect relationship between AHEs and ILFN from wind turbines that mirrors that in motion sickness. Kennedy et al^[120] made acceleration recordings during 193 standard training mission scenarios for two moving-base flight trainers. The pilots, who were of comparable age and experience in both groups, were interviewed for motion sickness symptomatology and tested for ataxia after leaving the simulators. Motion sickness incidence was high for one of the simulators, but not for the second. Ataxia scores departed slightly from expected improvements following exposure in both simulators. Spectral analyses of the motion recordings showed significant amounts of energy in the *nauseogenic range* of 0.2 Hz. The authors concluded that simulator sickness in moving-base simulations may be, at least in part, a function of exposure to infrasonic frequencies that make people seasick. Later, von Gierke and Parker^[121] advanced the notion that motion sickness may involve an intermodal sensory conflict between visceral graviceptor signals and vestibular stimulation. Schomer and colleagues^[52, 86] have argued that similarities with motion sickness may explain some of the health symptoms suffered by individuals living near IWTs, given that the inner ear is capable of responding to accelerations of the kind that lead to seasickness. These accelerations correspond to frequencies in the infrasonic range, around and under 1 Hz. Schomer^[66] states that

some persons affected by WTN may be responding directly to acoustic factors, rather than to non-acoustic factors, as argued by Leventhall.^[14]

In a rare show of cooperation between the wind industry and independent acousticians, Pacific Hydro agreed to allow acoustician Steven Cooper, a consultant for The Acoustic Group,^[25] unlimited access to its Cape Bridgewater wind project in SW Victoria, which had been in operation for about six years. The company allowed Cooper to make noise measurements and independently investigate the noise complaints of six affected residents at three residences located 650-1,600 m from the nearest turbines while the company controlled the on-off cycling of turbine operation. Given Cooper's credentials as an acoustician, the study was described as an acoustical study, as opposed to a medical study. Noise levels were based on A-, G-, and Z-weighted measurements, as well as 1/3-octave band and narrow-band measurements. Participants vacated their homes at night when necessary for Cooper to perform his acoustic studies, and they provided detailed diary accounts of their observations during on-off cycles. Those accounts included severity ratings of perceptions of noise impacts, vibration impacts, and other disturbances, which were collectively labelled as *sensations*. The sensations included headache; pressure in the head, ears, or chest; ringing in the ears; heart racing; or a sensation of heaviness. Synchronization of the timing of the residents' experiences with turbine operational data revealed heightened sensations inside their dwellings during turbine operation. Sensations were not dependent on the ability to hear or see the turbines, as residents were not aware of any of the turbines' operational characteristics. Cooper found that *sensation*, and not *noise disturbance*, was the major disturbance identified. Furthermore, sensations were most related to several different operating conditions of the turbines: at start-up, when there was an increase or decrease in power output of about 20%, and when the turbines were operating at maximum power and the wind speed increased above 12 m/sec.

Based on narrow-band data, Cooper identified a unique *wind turbine signature* (WTS) in which there was an energy peak at the blade-pass frequency and first five harmonics. Shutdown testing confirmed that the WTS, which included an amplitude-modulated signal, was present when the turbines were operating, but not in a natural environment during a turbine shutdown. Participants rated sensations as proportionally more severe as increases occurred in the magnitude of the low-frequency amplitude-modulated signature. The identification of infrasound components was consistent with earlier observations of Kelley et al.^[19] Based on his findings, Cooper recommended that further studies be conducted to determine a threshold level of the WTS that protects against adverse impacts, and that the signature concept be used in medical studies by

identifying energy from the operation of wind turbines, as the A-weighted scale inside homes is of no assistance in such studies.

In consideration of the above findings and observations, it is reasonable to conclude that IWTs cause AHEs and other unwanted disturbances. We next examine the physiological mechanisms that may explain how inaudible infrasound can be harmful.

In a recent paper, Berger et al.^[122] concluded that ILFN levels are insufficient to induce AHEs, given the levels of ILFN typically produced by wind turbines, and that guidelines for audible noise are sufficient to protect human health. Their conclusions were based on measurements of indoor infrasound levels and low-frequency noise levels at distances >500 m that were similar to background levels. While we believe the design and major conclusions of their study to be faulty, their conclusions are consistent with the position taken by Leventhall and other wind energy advocates over the past decade.

In her original description of Wind Turbine Syndrome, Pierpont^[4] described a distinctive constellation of symptoms that she believed to be due to stimulation, or overstimulation, of the vestibular organs of balance as a consequence of ILFN from wind turbines. She termed these symptoms Visceral Vibratory Vestibular Disturbance (VVVD). In a follow-up report, Pierpont^[100] suggested that the observed symptoms of Wind Turbine Syndrome are due to air-borne or body-borne low-frequency sounds that directly stimulate the inner ear, both the cochlea, or hearing organ, and the vestibular organs of balance and motion detection. As discussed below, research by Salt and associates shows that responses in the cochlea suppress the perception of low-frequency sound but still send signals to the brain, signals whose function is, at present, mostly unknown. The physiologic response of the cochlea to WTN is also a trigger for tinnitus and the brain-cell-level reorganization that tinnitus represents. Although cochlear and vestibular organs are housed within the same bony (otic) capsule, evolutionary adaptations have led to selective activation of auditory or vestibular hair cells. In the presence of certain disorders of the inner ear, however, anatomical defects in the otic capsule can alter the functional separation of auditory and vestibular stimuli, resulting in pathological activation of vestibular reflexes in response to sound.^[123] The possibility that high-level ILFN can stimulate the vestibular organs lends credibility to Pierpont's suggestion and may explain the basis for symptoms that mimic other vestibular disorders. Physiologic responses from the otolith organs generate a wide range of brain responses, including dizziness and nausea, seasickness (even without bodily movement), fear and alerting responses such as startle and wakefulness, and difficulties with visually based problem-solving.^[100] One candidate for the other destination of cochlear input from the outer hair cells may be the interface between the insula and the medial surface of the transverse (Heschl's)

gyrus, where primary hearing is experienced but not recognized as sound; the latter involves adjacent secondary areas.^[124]

WTN can increase alerting responses that disturb sleep, even when people do not recall being awakened. This effect is one that clearly disturbs sleep and mental well-being out to 1,400 m (4,600 ft.) from turbines, with diminishing effects out to 3 km (3 mi.), as shown in a cross-sectional study by Nissenbaum et al.^[97]

Laboratory studies conducted by Salt and colleagues have provided evidence that clearly establishes the biological plausibility that infrasound can adversely affect health. That work shows that there are mechanisms in the inner ear that are capable of transducing infrasonic energy into a neural signal that can be transmitted to the brain, where the signals can lead to such symptoms as tinnitus, dizziness, pulsations, and sleep disturbance. Those studies by Salt and associates have involved laboratory experiments funded primarily by the National Institutes of Health and conducted mostly on guinea pigs, whose ears are very similar to human ears. Basically, electrodes were inserted into the inner ears to determine which structures respond to specific types of electroacoustic stimulation. Their findings help to explain why sound that is normally inaudible can result in the kinds of negative reactions reported by people who are exposed to wind turbine ILFN. Findings from their research indicate the following:

- (1) The inner hair cells (IHCs) of the inner ear, which are primarily responsible for transmitting signals to the brain that are interpreted as sound, are velocity-sensitive, and thus unresponsive to infrasound. The outer hair cells (OHCs), on the other hand, are displacement-sensitive and respond to infrasonic frequencies at levels well below those that are heard (i.e., interpreted as sound). This suggests that most IWTs produce an unheard stimulation of OHCs;^[56, 125, 126] specifically, at 5 Hz the OHCs can be stimulated at sound pressures 40 dB below those that stimulate the inner hair cells associated with conscious hearing.^[126]
- (2) Low frequencies, which are coded in the cochlear apex, require less low-frequency SPL to be amplitude modulated, when compared to higher frequencies, which are coded in the cochlear base. This means that amplitude modulation of audible sounds by wind turbine infrasound may be the basis for complaints of those living near wind turbines, including complaints such as annoyance or feelings of throbbing and rumbling sensations. It also means that infrasound from wind turbines need not be audible to annoy people, since infrasound can amplitude modulate sounds that are within the range of audibility.^[54]

- (3) There are several ways that infrasound could affect people, even though they cannot hear it: (a) causing amplitude modulation (pulsation) of heard sounds, (b) stimulating subconscious pathways, (c) causing endolymphatic hydrops, and (d) possibly potentiating, or exacerbating, noise-induced hearing loss.^[127]
- (4) Responses to infrasound reach the brain through pathways that do not involve conscious hearing but instead may produce sensations of fullness, pressure or tinnitus, or absence of sensation. Activation of subconscious pathways by infrasound could disturb sleep.^[128]
- (5) The presence of other, higher-pitched sounds (between 150-1,500 Hz) can suppress infrasound.^[129, 130, 131] Because the ear is maximally sensitive to infrasound when higher frequency sounds are absent, this means that WTN is most disturbing to persons inside their homes at night, when background sound levels are low and higher-pitched sounds are attenuated by walls and other physical structures.
- (6) A pathway exists, through the OHCs, for infrasound to reach the brain. There, parts of the brain other than auditory centers become active and the signals are perceived as something other than sound. This pathway to the brain, which also includes the vestibular mechanism of the inner ear, means that it is biologically plausible for infrasound to produce a variety of sensations, including pulsation, annoyance, stress, panic, ear pressure or fullness, unsteadiness, vertigo, nausea, tinnitus, general discomfort, memory loss, and disturbed sleep (with chronic sleep deprivation leading to blood pressure elevation and possibly changes in heart rate).

On the above grounds, Salt dismisses the common perception that *What we can't hear can't hurt us*, and has stated unequivocally that "Wind turbines can be hazardous to human health."^[132]

Interestingly, Oohashi et al,^[133] using non-invasive physiological measurements of brain responses, found evidence that sounds containing *high-frequency* components *above* the audible range, or ultrasound, significantly affect the brain activity of healthy human listeners. It should not be considered implausible, therefore, that infrasonic stimulation can also activate the brain.

Recent research supports the plausibility of such effects. Bauer et al,^[134] using functional magnetic resonance imaging (fMRI), found a significant response down to the 8 Hz, the lowest frequency presented, to be localized within the auditory cortex. Using magnetoencephalography (MEG), significant brain responses could be detected down to a frequency of 20 Hz. The authors hypothesized that a somatosensory excitation of the auditory cortex possibly contributes at these frequencies. In a somewhat related study, He and Krahé^[135] demonstrated a significant relationship between EEG reactions under different low-frequency noise exposures and

subjective annoyance. Noise sensitivity was also found to be an important factor in most of the observations. The authors of these two studies suggested that EEG, fMRI, and MEG may serve as effective physiological measures to explain negative reactions to low-frequency noise.

Kugler et al^[136] measured spontaneous otoacoustic emissions (SOAEs) before and after stimulation with perceptually unobtrusive low-frequency sound (30 Hz) and found significant changes to occur; these changes were positively correlated in frequency and level to pre-exposure status and lasted for about 2 min after stimulation. SOAEs are narrow-band acoustic signals that are spontaneously emitted by the inner ear in the absence of acoustic stimulation, and they can be recorded simply and non-invasively in the ear canal with a sensitive microphone. Otoacoustic emissions, first reported by physicist David Kemp,^[137] are a by-product of active biophysical amplification by OHCs in the cochlea, persisting in relatively stable form for years under normal physiological conditions. The main task of the OHCs is to detect and mechanically amplify sound waves. In acting as a cochlear amplifier, OHCs actively generate mechanical energy, which is fed back into the cochlear travelling wave to maximize the sensitivity and dynamic range of the mammalian ear. In humans, non-invasive recordings of different classes of sound-evoked otoacoustic emissions (EOAEs) allow indirect access to OHC function, but only SOAE measurements can probe the cochlea in its natural state. The presence of OAEs signals a healthy ear, and their absence or changes in their response patterns can signal pathological function. The significance of the work by Kugler et al is that it reveals OHC function to be affected by a brief exposure to very low-frequency sound that is largely imperceptible. It also reveals that measures of perception severely underestimate OHC sensitivity. The authors concluded that direct quantifications of inner ear active amplification, as measured in their study, are well suited for assessing the risk potential of low-frequency sounds. In the present context, the study provides further support for the notion that what we can't hear can potentially affect us.

Motion sickness has been mentioned in this article as being among the variety of symptoms suffered by individuals living near IWTs. Recalling the work of Kennedy et al,^[120] who found evidence of motion sickness in Navy pilots subjected to acceleration during flight simulation, Schomer et al^[138] stated that it is plausible that the ear responds similarly to accelerations of a moving vehicle and acoustic pressures at infrasonic frequencies under 1 Hz, in the nauseogenic range. They suggested that the AHEs experienced as a consequence of exposure to IWTs not only bear a striking resemblance to motion sickness, but that the condition may be induced by stimulation of the otolithic organs in the vestibular system of the inner ear. That type of stimulation is purportedly worse when a person is subjected to pressure changes in a closed

cavity, including inside one's home. Further, they describe the type of research needed to verify their hypothesis.

Michaud and colleagues have recently authored a series of papers^[139, 140, 141, 142, 143, 144, 145] describing a cross-sectional epidemiological study conducted under the sponsorship of Health Canada, in which they investigated the prevalence of health effects or health indicators among a sample of Canadians exposed to WTN. The studies employed both self-reported and objectively measured health outcomes. The final sample, drawn from communities in Ontario and Prince Edward Island where a sufficient number of dwellings were located near wind turbine installations, included 1,238 participants (606 males, 632 females) living between 0.25 and 11.2 km from operational turbines. One participant between the ages of 18-79 years was randomly selected from each household. The reported response rate was 78.9% and did not significantly vary across sampling strata or provinces. Modelled A- and C-weighted WTN levels reached 46 dBA and 63 dBC, respectively, and the two levels were found to be highly correlated, which suggested that C-weighted values offered no additional information beyond that offered by A-weighted values. Only minor differences across strata were reported for age, employment, and type and ownership of dwelling. WTN exposure was not found to be related to hair cortisol concentrations, blood pressure, resting heart rate, or any of several measured sleep parameters (i.e., sleep latency, sleep time, rate of awakenings, sleep efficiency). Self-reported results obtained through an in-person questionnaire did not provide support for an association between increasing WTN levels and self-reported sleep disturbance, use of sleep medication, or diagnosed sleep disorders. Similarly, no significant association was found between WTN levels and self-reported migraines, tinnitus, dizziness, diabetes, hypertension, perceived stress or any measure of QoL. However, they observed statistically significant exposure-response relationships between increasing WTN levels and the prevalence of long-term high levels of annoyance toward noise, shadow-flicker, visual impacts, blinking lights, and vibrations.

The authors of the present report, along with a number of professional colleagues with acoustical or medical expertise, have carefully analyzed the reports by Michaud and colleagues and have concluded that the research protocol of the Health Canada study reflects shortcomings that severely undercut the conclusions that were drawn in the various reports. To enumerate the major flaws in the Michaud et al reports:

- (1) They incorrectly concluded that AHEs were not found when sound levels were below 46 dBA by failing to benchmark their "surrogate control group" against the general population. Proper analysis, using a proper control group, would have resulted in high correlations of these symptoms with decreasing distances to, and increasing noise levels from, wind

turbines. In reports of the sound-exposure data, sound levels of 30-35 dBA were significantly associated with increases in the prevalence rates of symptoms. This indicates that the 40 dBA currently used as the permissible threshold in Ontario and other Canadian provinces is not protective of the public's health and welfare.

- (2) Key health symptoms were reported primarily for non-vulnerable populations, in that younger individuals and individuals who had left their homes were excluded from participation. Those exclusions invalidate the study as a reflection of health conditions in the general population.
- (3) Evidence provided by the World Health Organization^[38] showing that exposure to noise from vehicles, railways, and aircraft is linked to serious physiological and psychological health effects at sound levels of 40 dBA and higher, and that lower levels are needed to protect the more vulnerable members of the population, was ignored in the Health Canada study. The finding that AHEs did not occur below 46 dBA should have been a warning sign to the researchers that their study design, their analyses, or both, were flawed.

Statement 4: Setback distances of 1,000-1,500 ft. (approximately 0.3-0.5 km) are sufficiently safe to protect humans from harm, regardless of height or other physical characteristics of the IWTs.

Many zoning ordinances that regulate IWTs specify the height of the turbine tower from its base to blade tip, plus 10% to 100%, as a setback distance that sufficiently protects residents against a catastrophic event such as a tower failure, a falling blade, or ice throw. Some ordinances specify a distance of twice the base-to-blade tip height, roughly 900 ft., while others arbitrarily specify slightly longer distances such as 1,500 ft. or 0.5 km. Most of the reported health symptoms have been observed at distances much greater than these setback distances. One can deduce, therefore, that *setbacks intended to protect physical health from mechanical or other traumatic failure of a wind turbine component are not adequate to protect general health and well-being.*

While terrain, weather patterns, number and size of turbines, and the turbine array itself can influence the ILFN emitted from IWTs, the two major factors are turbine size and distance from the receiver. Distance is the only practical means of achieving acceptable sound levels, as controlling the noise through the erection of barriers or enclosures near the source or receiver are not feasible or effective. Because infrasound is involved, closing windows, insulating buildings (including residences), and sleeping in basements are not normally helpful in attenuating the noise, and there is less likelihood that the emissions will be masked by wind at ground level.^[60]

^[46] Noise levels must be measured by qualified personnel, and the sound level at the residence—or arguably at the property line—is the key element in protecting the health of residents.

To protect human health, a number of researchers have recommended specific distances, while others have recommended limitations on sound levels, irrespective of the distances needed to achieve those levels. Such recommendations are based on observed or reported complaints of AHEs. Though quite specific, the recommendations vary somewhat widely, as shown in Table 2.

The recommendations in Table 2 include boundaries of distance and noise levels of 0.5-2.5 mi. and 30-40 dB, respectively, that are believed by various professionals to protect human health. Although the use of maximum permissible noise levels appears to be the optimal approach for protecting the greatest number of people, the existence of multiple acoustic and environmental factors complicates our ability to recommend a single distance or noise level that protects most residents. Those factors are covered elsewhere in this review.

Table 2. Recommended minimum siting distances and maximum noise levels of industrial wind turbines, based on the protection of human health.

Author (Year)	Reference	Distance/Level
Pierpont (2009)	4	Distance of 1.25 mi, or 2 km
Kamperman & James (2008)	83	
Nissenbaum et al (2012)	97	Minimum distance of 0.87 mi, or 1.4 km, based on experimental conditions studied
Harry (2007)	74	Minimum distance of 1.5 km from nearest turbine
Frey & Hadden (2007)	90	2 km between family dwellings and IWTs of up to 2-MW installed capacity, with greater separation for a wind turbine greater than 2-MW installed capacity
Shepherd & Billington (2011)	103	4 km, to protect against amplitude-modulated turbine noise
Position of the National Institute of Public Health-National Institute of Hygiene on wind farms (2016)	147	A minimum distance of 2 km of wind farms from buildings
Cummings (2011)	39	Distance of ½ mi or greater; noise levels within 5-10 dB of existing background conditions; sound levels below 40 dBA, or even 30-35 dBA, as levels of 40 dBA or higher trigger large numbers of noise complaints
World Health Organization (2009)	38	Outdoor sound levels <40 dBA, with vulnerable populations expected to be most affected

Author (Year)	Reference	Distance/Level
Knopper et al (2014)	148	Sound levels <40 dBA, for non-participating receptors
Horner (2013)	78	Sound levels <30 dB
Harrison (2011)	42	Sound levels limited to 35 dBA at nighttime and 40 dBA during daytime hours; 5-dBA and 4-dBA penalties, respectively, imposed for the periodic or impulsive character of turbine noise and for uncertainty in noise prediction
Thorne (2013)	49	Sound levels <32 dB LAeq outside a residence

Statement 5: Annoyance is a nuisance, but it is not a health issue.

In the past few years, the position of the wind industry has changed from a blanket denial of any impact from noise to admitting that IWT noise is annoying to a substantial portion of exposed populations, and that annoyance from ILFN is a well-accepted phenomenon. While Bolin et al^[18] and Ellenbogen et al^[82] downplay the relationship between annoyance and WTN, the larger research community has documented that ILFN from wind turbines and other sources leads to annoyance.^[12, 14, 15, 19, 21, 37, 38, 40, 42, 46, 49, 55, 58, 59, 63, 64, 74, 78, 80, 81, 90, 92, 94, 98, 99, 102, 118, 146, 149, 150]

Several investigators have concluded that annoyance increases in a dose-response relationship as distance from turbines is reduced.^[44, 89, 146] A number of studies have concluded that noise annoyance appears to be worse when nearby residents have negative attitudes and when visual annoyance or intrusive sound characteristics are also involved.^[e.g., 44, 65, 112, 146, 151] However, the annoyance from visual stimulation and the annoyance from noise may be entirely independent. The two irritants do not have to be linked. The common factor is that as one moves closer to a wind turbine, it is perceived as both larger *and* louder. One recent study,^[152] which compared visual, audible noise, and combined visual-auditory representations of wind turbines, found noise sensitivity to correlate with both noise and visual annoyance. That study also demonstrated a reciprocal influence between auditory and visual stimuli, but in essentially a direction opposite that predicted by earlier studies of wind turbine visibility and noise. Interestingly, the study showed that a visual stimulus had a mitigating effect on noise annoyance, while an auditory stimulus had a disturbing effect on visual annoyance. This finding supports the idea that humans perceive the environment holistically and in context of all perceptual information. In suggesting that auditory and visual features are processed in close interaction, it forces us to question the idea that annoyance from WTN arises largely because the turbines are visible. Given our current

state of knowledge, it seems reasonable to accept that people can be annoyed by auditory and visual irritants independently, even though there may be interactions between them.

Annoyance occurs in residents living near wind turbines at lower sound levels than for transportation noise, industrial noise, or other sources.^[38, 42, 43, 58, 64, 93] Perception and annoyance have been found to be associated with both urbanized and rural terrains.^[149] Pedersen et al.^[146] in summarizing survey data on annoyance from wind turbines in the Netherlands and Sweden, found that 25% or more of all respondents were annoyed by levels of 40-45 dBA, while about 18-20% were very annoyed by those levels. A total of 18% found outdoor levels of 35-40 dBA to be rather annoying or very annoying outdoors and 8% found those levels to be rather or very annoying indoors. For outdoor levels of 40-45 dBA, 18% and 16% were rather or very annoyed outdoors and indoors, respectively. Because such surveys tend to emphasize *noise* from wind turbines, results often reflect levels of annoyance that relate more directly to audible sounds, as opposed to infrasound.

While few would argue that noise from wind turbines annoys a substantial percentage of nearby residents, there is disagreement over whether it leads to AHEs. Colby et al.^[15] stated that:

“...there is no evidence for direct physiological effects from either infrasound or low frequency sound at the levels generated from wind turbines, indoors or outside” (p. 3-8).

They reasoned, therefore, that annoyance is not a pathological entity. Their basic contention was that although wind turbines produce infrasound, it is not harmful because people can't hear it. They contended that while some people may be annoyed by the sound from wind turbines — presumably audible sound—annoyance is primarily due to the fluctuating nature of the noise and personal attitudes. In their view, it is a psychological reaction, as opposed to a direct physiological reaction to sound. As noted above, however, several investigations^[44, 89, 146] have found a dose-response relationship to exist between measured or estimated sound levels and annoyance. IWT noise emissions have been found to be a mediator between exposure and sleep disturbance and psychological distress,^[89] and to be directly associated with stress.^[e.g., 104]

The documented health symptoms from exposure to wind turbines are often stress-related and exacerbated by sleep disorders; they appear to be mediated through both direct and indirect pathways, and the result can be serious harm to human health.^[92] There is an association between WTN, stress, and well-being, and this association is a potential hindrance to psycho-physiological restitution.^[58, 98] The WHO has described annoyance as a critical health effect, in that in some people it is associated with stress, sleep disturbance, and interference with daily living.^[38] A range of symptoms, often described as stress responses, have been associated with

WTN in people living in the vicinity of wind projects. As Pierpont^[4] and others have noted, these symptoms include headache, irritability, difficulty concentrating, fatigue, dizziness, anxiety, and sleep disturbance. Regardless of whether the perceived impacts of noise from wind projects are physiological or psychological in nature, they are considered to cause AHEs through sleep disturbance, reducing the quality of life and serving as a source of annoyance that sometimes leads to stress-related symptoms.^[71] The potential of environmental noises to induce stress reactions is well known. These reactions are dependent on how the noises are interpreted in the central nervous system; medical effects such as increased blood pressure, for example, are known to result from prolonged noise exposure.^[153]

Generally, models that explain the relationship between noise and health fall into two broad

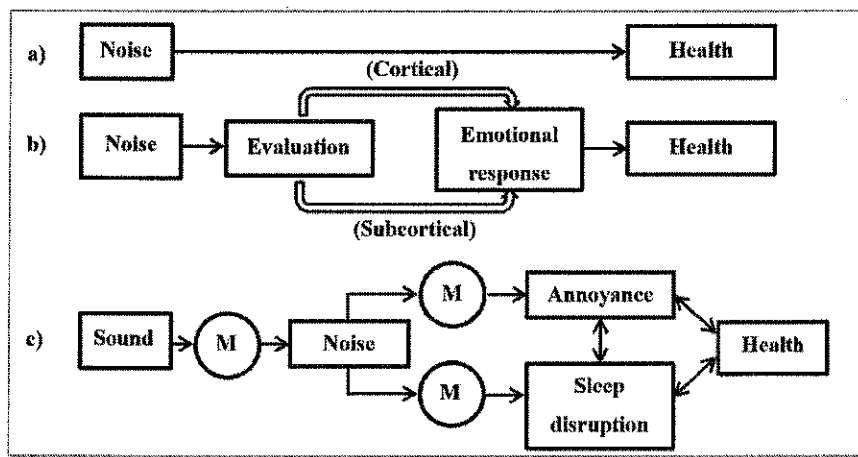


Figure 1. Three models representing the relationship between noise and health: the biomedical model (a) stipulating a direct causal relationship and indirect models (b and c) containing moderators and mediators (Adapted from original source and used with permission of first author, Daniel Shepherd).^[50]

categories, based on pathways that are *direct* or *indirect*. Figure 1, which is a modification of a figure from Shepherd et al,^[50] depicts three models, one direct and two indirect, that have been described in the contemporary literature. The first (Fig. 1a) represents a direct pathological relationship between

an environmental parameter (e.g., noise level) and a target organ that affects health. For example, in this model, noise can affect both cognition and sleep, and thus directly impact health. An alternative approach (Fig. 1b) distinguishes between direct health effects and psychosomatic illness. This approach suggests that any physiological illness coinciding with the onset of WTN may be caused by a negative psychological response to the noise, and not the noise *per se*. Any anxiety or anger resulting from the presence of WTN induces stress and strain that, if maintained, can eventually lead to AHEs. Another explanation that involves an indirect pathway from sound to health effects is one that is consistent with the WHO's definition of health.^[38] That model (Fig. 1c) recognizes the role of environmental moderators, or mediators, in the determination of whether a sound is (unwanted) noise, and, if so, whether or not the noise

negatively impacts health. Mediators include factors such as degree of urbanization, house type, and sound level, and psychological and demographic moderators such as age, gender, education, employment status, attitudes to wind energy, noise sensitivity, and whether the individual receives a monetary return from the turbines. In this model, sleep disruption plays a major role in producing AHEs, with annoyance and sleep disruption being intervening factors between noise and AHEs for some people.

Authors of a recent study,^[154] which focused on the province of Ontario, acknowledge both the link between annoyance and health and the possibility that wind projects can exacerbate psychosocial health problems through social processes such as intra-community conflict. They list socially mediated health concerns, distribution of financial benefits, lack of meaningful engagement, and failure to treat landscape concerns seriously, as the core stumbling blocks to a community's acceptance of wind energy development.

Statement 6: Noise cannot account for all of the complaints of people living in the vicinity of wind turbines; there must be another, unknown reason for the complaints.

Havas & Colling^[91] have observed that wind turbines generate electromagnetic waves in the form of poor power quality (*dirty electricity*) and ground current, and speculate that these waves can adversely affect those who are electrically hypersensitive. McCallum et al^[155] performed magnetic field (EMF) measurements in the proximity of 15 Vestas 1.8-MW wind turbines, two substations, various buried and overhead collector and transmission lines, and nearby homes in the vicinity of Goderich, Ontario, during high-wind, low-wind, and shut-off operational stages. They concluded that there is nothing unique to wind farms with respect to EMF emissions, finding that magnetic field levels in the vicinity of wind turbines were lower than those produced by many common household electrical devices and that levels were well within any existing regulatory guidelines with respect to human health.

Although at least a few of the health symptoms mentioned above have been self-reported by individuals who are exposed to electromagnetism, clinical trials to date suggest the link between health complaints and exposure to electromagnetism to be a purely psychological one, or a nocebo effect, in that self-described sufferers of electromagnetic hypersensitivity are unable to distinguish between exposure and non-exposure to electromagnetic fields.^[156] Another review paper^[157] found no convincing scientific evidence that symptoms are caused by electromagnetic fields. However, one cannot rule out that the design of the experiments upon which the review papers drew their conclusion may have missed some unique characteristic that could account for the anecdotal evidence. (See our earlier statements describing how failure to identify infrasound

pulsations as a causal factor for perception at pressure levels below those needed for audibility have led some to conclude that IWT infrasound causes no harm.) When faced with health complaints from families who live near IWTs, especially when there are repeated instances of symptoms that wax and wane with alternating sequences of exposure and non-exposure, and especially when those families have taken the drastic step of abandoning their homes, it is unreasonable to argue that noise is not the cause of the complaints. Even if other factors such as electromagnetic waves are the root cause of a given complaint, it is still the placement of turbines too close to those residents that is the most likely cause of the problem.

Unfortunately, not as much is known about the effects of electromagnetism as is known about ILFN. At this point in time, therefore, it is reasonable to conclude that more people who live near wind turbines are negatively affected by ILFN than by hypersensitivity to dirty electricity or ground current, as measurable levels of ILFN from wind turbines are highly associated with individual complaints. When Stigwood et al^[57] studied and analyzed complaints at over 75 wind developments in the U.K., they found that identifying the problems was straightforward, occurrence was common (i.e., some residents reported problems in all developments), all developments generated excess amplitude modulation (AM), and AM was the cause of the vast majority of the complaints. These findings have recently been reinforced by Cooper's work^[25] in Australia.

Statement 7: Infrasound from wind turbines is sufficiently correlated to the A-weighted sound emissions to allow an A-weighted model to be used to predict how much infrasound is present in homes.

This statement is not typically stated explicitly, but it is one that is inherent in the positions commonly taken by wind energy advocates and regulatory bodies through their interpretations and acceptance of research on WTN, which is based largely on A-weighted levels. As noted in many previous papers, including one of our own,^[101] the continued use of the A-weighting scale in sound level meters is a major basis for misunderstandings that have led to acrimony between advocates and opponents of locating wind turbines in residential areas. The dBA scale was devised as a means to incorporate into measurements of environmental and industrial SPLs the inverse of the minimum audibility curve^[158] at the 40-phon level. It is typically used, though, to specify the levels of noises that are more intense, where the audibility curve becomes considerably flattened, obviating somewhat the need for A-weighting. Use of the A-weighted scale is mandated or recommended in various national and international standards for measurements that are compared to damage-risk criteria for hearing loss and other health effects resulting from occupational or environmental noise exposure. It drastically reduces sound-level

readings in the lower frequencies, beginning at 1,000 Hz, and reduces sounds at 20 Hz by 50 dB. For WTN, the A-weighting scale is especially inappropriate because of its devaluation of the effects of ILFN. Many authors have commented on its inadequacy. For example, Pederson and Persson Waye^[159] state:

“There is... support both from experimental and field studies that intrusive sound characteristics not fully described by the equivalent A-weighted sound pressure level contribute to annoyance with wind turbine noise” (p. 4).

A number of researchers have recommended comparing C-weighted measurements to A-weighted measurements when considering the impact of sound from wind turbines.^[10, 12, 37, 61, 67, 75, 76, 83, 101] According to these sources, the presence of infra- and low-frequency sound is generally indicated when the difference between levels on the two scales differs by 10-20 dB. When such differences are observed, the use of third-octave or linear-scale measurements is typically recommended (for example, see Shepherd et al^[50]). Other weighting scales have been suggested for wind turbine applications, but at present, linear-scale or narrow-band measurements, used in conjunction with a conventional sound level meter (with low-frequency microphone) and micro barometer, offer the best potential for accurately and completely describing the soundscape in the vicinity of IWTs.

As noted above, Cooper^[25] has suggested that A-weighted levels, measured inside homes, are not likely to be useful indicators of AHEs. That report concluded that A-weighted levels are not a valid index of protection from AHEs and recommended the further exploration of a newly developed *wind turbine signature* scale, based on the discovery of its capability to quantify the amplitude-modulated peak energy in the infrasonic frequency region. That scale was shown to be directly linked to a variety of adverse bodily sensations when nearby turbines were operating or undergoing transitions in operation.

Although A-weighted sound level measurements have been the *sine qua non* for specifying environmental and occupational noise levels for many decades, we must recognize the inherent inadequacies of applying the A-weighting scale to quantifying noise emitted by IWTs. Bray^[160] goes even further by noting that people, and not electronic devices, are the ultimate analysts of data that affect their responses to sound, making the point that people's responses should be given the credence they deserve, and not be devalued when physical measurements fail to confirm them.

Statement 8: Wind Turbine Syndrome has not been accepted as a diagnostic entity by the medical profession, so medical professionals cannot diagnose or treat it.

Currently, Wind Turbine Syndrome is not included in the International Classification of Diseases (ICD) coding system, which is used globally for purposes of establishing categories for diagnosing diseases and other health conditions, and as a basis for reimbursing medical providers for diagnostic and treatment services. Yet, of the 10 symptom sets comprising Pierpont's Wind Turbine Syndrome,^[4] at least seven are included as a category or subcategory in the newly revised (ICD-10) coding system. The fact that the syndrome itself is not included may be due to its relatively recent discovery, but is more likely due to the fact that the syndrome consists of symptoms that are highly variable from person to person and affect a minority of the exposed population.

Especially in legal proceedings, it is important to distinguish between the terms *differential diagnosis* and *causation assessment*. It is the latter that is most often the subject of such proceedings. Attorneys and expert witnesses often get the terms confused. Differential diagnosis refers to the identification of disorder(s) that may account for a particular complaint or symptom complex. It rarely deals with the external cause of the disorder. Causation assessment, on the other hand, typically requires an evaluation of whether potential causative agents have irritating properties; a determination of the approximate amount of exposure, or dose, of that agent, and the timing between exposure (and non-exposure) and the occurrence of symptoms; and an assessment of whether alternative potential causes of the disorder can be ruled out. These latter steps are not necessarily considered part of the diagnosis.

Notwithstanding the fact that Pierpont herself is a practicing pediatrician, a couple of recent developments would appear to increase the prospect that medical personnel will soon be able to establish Wind Turbine Syndrome, by that or a similar label, as a clinical entity caused by exposure to WTN. Dr. Robert McMurtry, a physician who is a special advisor to the Canadian Royal Commission on the Future of Health Care, and a long-time advocate for more effective public involvement in healthcare policy, recently published a set of highly specific criteria for establishing such a link. McMurtry^[161] originally proposed a case definition that identifies first-, second-, and third-order criteria, as well as specified circumstances and symptoms that must be established before AHEs can be attributed to wind turbine exposure. According to those criteria, probable AHEs are present when:

- (1) All four of the following first-order criteria are met: (a) The individual resides within 5 km of IWTs, (b) Health status is altered following the start-up of or initial exposure to, and during

the operation of, IWTs (a latent period of up to 6 months may be allowed), (c) Amelioration of symptoms occurs when more than 5 km from the environs of IWTs, and (d) Recurrence of symptoms occurs upon return to the environs of IWTs within 5 km.

- (2) At least three of the following second-order criteria are met (occurring or worsening after the initiation of operation of IWTs): (a) Compromised quality of life, (b) Continuing sleep disruption, difficulty initiating sleep, and/or difficulty with sleep disruption, (c) Annoyance producing increased levels of stress and/or psychological distress, and (d) A preference to leave the residence temporarily or permanently for sleep restoration or well-being.
- (3) At least three specified symptoms occur or worsen following the initiation of IWTs, those symptoms referred to as third-order criteria that fall within the following categories: (a) Otological and vestibular disorders, (b) Cognitive disorders, (c) Cardiovascular disorders, (d) Psychological disorders, (e) Regulatory disorders, or (f) Systemic disorders.

To be confirmed as AHEs from WTN exposure, McMurtry indicated that consideration should be given to other stressors present in the community, that sleep studies be carried out if at all possible, and that a licensed physician be able to rule out alternate explanations for AHEs. These alternate explanations include substantial barometric changes from prevailing winds, a stressful home environment, and psychological and/or mood disorders, all of which can normally be ruled out when symptoms subside or disappear when the individual leaves the vicinity of the wind turbines. Apart from these three factors, he indicates that there are very few, if any, other health conditions that can mimic those caused by exposure to wind turbines and at the same time meet the three orders of criteria outlined in his case definition. More recently, McMurtry and Krogh^[162] published a revised case definition, in which the third-order criteria—which are commonly present—are not considered essential elements. In both papers, the authors acknowledged that the identification of IWTs as the cause of adverse health symptoms is a complex emerging issue that requires further study to validate the criteria. They proposed key elements that ought to be included in any model used to assess the validity of the case-definition criteria.

McCunney and colleagues^[163] have challenged those case definitions as having poor specificity, leading to a substantial potential for false-positive assessments and missed diagnoses. A potential fallacy in this challenge is that the authors unnecessarily conflate the concept of case definition for medical practitioners with that of an epidemiologic research plan. The case definitions presented by McMurtry^[161] and McMurtry and Krogh^[162] represent guidelines for medical doctors whose individual patients are experiencing new or unusual symptoms. It is erroneous to purport that a physician's mental process can be encapsulated into a set of equations, especially

during the earliest stages of developing a case definition. The criticisms of these early case definitions should not deter physicians from attempting to evaluate and treat patients who report AHEs after living in the vicinity of IWTs. This area may indeed benefit from further study. Our view, however, is that such criteria provide an adequate starting point for guiding medical practitioners.

Dr. Steven Rauch, an otolaryngologist at the Massachusetts Eye and Ear Infirmary and a professor at Harvard Medical School, recently declared that he believes Wind Turbine Syndrome to be a real phenomenon.^[164] As reported by numerous websites and newspapers, multiple patients have sought treatment from him for AHEs stemming from consistent exposure to IWTs. Rauch compares the syndrome to migraine headaches and believes that people who suffer from migraines are among the most sensitive to the effects of WTN, and he has stated that the wind industry aims to suppress the notion of Wind Turbine Syndrome by blaming the victim.

Given these developments, it is possible that the medical profession may someday embrace Wind Turbine Syndrome—by that or another name—as a clinical entity. This prospect is encouraging, as such acceptance by the profession will facilitate efforts to protect individuals from the harmful health effects of exposure to IWTs. Even though it may be some time before such a diagnostic label is formally acknowledged as an ICD code, it is currently possible for physicians to identify many of the specific symptoms associated with wind turbine exposure and to bill for diagnosing and treating those symptoms, with or without regard for their underlying cause. Paradoxically, it is apparently the case that the most effective treatment for AHEs associated with WTN exposure is non-medical in nature; it is to recommend that patients physically remove themselves from the vicinity of IWTs.

Statement 9: Peer-reviewed epidemiological literature is the only acceptable basis for proving a causative relationship between wind turbine noise and adverse health effects.

This issue runs as a thread through virtually all the other issues addressed in this paper, as it relates to the kind of scientific evidence frequently called for, especially in legal settings, to prove that IWTs are the cause of AHEs. While personal physicians of complainants in legal cases are often considered the only expert witnesses qualified to establish *specific causation*, others can testify to *general causation*, which is the methodology by which scientists determine whether or not an agent is responsible for producing a particular disorder. In general, this requires evaluation of the scientific and medical literature to identify documented instances of health-related conditions arising from exposure to specific agents and, when available, the dose-response relationships between agents and their effects. This process is highly similar to that of

causation assessment, as explained above, and it does not necessarily require the input of a complainant's personal physician, although such input may be helpful. In legal cases involving WTN, it is critical that expert witnesses in acoustics and health be able to reconcile their positions with the reports and standards of the WHO,^[165] the International Organization of Standards (ISO),^[166] and the American National Standards Institute/Acoustical Society of America (ANSI/ASA)^[167] that have linked low-frequency noise to symptoms of the type involved in complaints. These acoustical documents and research reports are seldom, if ever, included in literature reviews used by the industry to deny potential health risks. If challenged on the validity of the available evidence, acousticians need to be knowledgeable of the relevant acoustical standards and make sure that they are understood by all parties. In reality, the wind industry's almost universal refusal to cooperate with researchers has made it virtually impossible to conduct proper acoustical or epidemiological studies. The industry has been largely unwilling, or claims it is unable, to shut down or modify operations of its turbines for experimental purposes. To date, such a situation has rarely occurred, most notably in the case of the Cape Bridgewater study.^[25]

The veracity of Statement 9 is strongly challenged by the classic address by Sir Austin Bradford Hill,^[168] Professor Emeritus of Medical Statistics, University of London, to the newly founded Section of Occupational Medicine of the Royal Society of Medicine. In his essay, Hill shared his thinking about association and causal evidence surrounding environmental disease. He posited nine elements that are critical in establishing causation:

- (1) *strength* (strength of observed relationships),
- (2) *consistency* (consistency, or repeatability, of relationships, based on observations by different persons, in different places, under different circumstances, and at different times),
- (3) *specificity* (causation is indicated if the association is limited to specific individuals and to particular sites and types of disease and there are no associations with other factors),
- (4) *temporality* (there is a clear temporal relationship between outcomes and periods of exposure and non-exposure),
- (5) *biological gradient* (a dose-response relationship exists),
- (6) *plausibility* (causation is more likely when certain outcomes are biologically plausible, or possible, a caveat being that plausibility depends on the biologic knowledge of the day; this element is best expressed in the statement: "When you have eliminated the impossible, whatever remains, however improbable, must be the truth" (p. 10),

- (7) *coherence* (the cause-and-effect interpretation of data should not seriously conflict with generally known facts of the natural history and biology of the disease),
- (8) *experiment* (experimentation or semi-experimental evidence, even if only occasional, can reveal the strongest kind of evidence for causation), and
- (9) *analogy* (the recognition that similar cause-effect relationships have occurred under similar conditions).

Hill states:

“What I do not believe (is) ...that we can usefully lay down some hard-and-fast rules of evidence that must be obeyed before we can accept cause and effect. None of my nine viewpoints can bring indisputable evidence for or against the cause-and-effect hypothesis and none can be required as a *sine qua non*. What they can do, with greater or less strength, is to help us to make up our minds on the fundamental question – is there any other way of explaining the set of facts before us, is there any other answer equally, or more, likely than cause and effect?... No formal tests of significance can answer those questions. Such tests can, and should, remind us of the effects that the play of chance can create, and they will instruct us in the likely magnitude of those effects. Beyond that they contribute nothing to the ‘proof’ of our hypothesis” (p. 299).

Hill makes this final observation in his essay:

“All scientific work is incomplete – whether it be observational or experimental. All scientific work is liable to be upset or modified by advancing knowledge. That does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time” (p. 300).

Extrapolating from Hill’s essay, the totality of our knowledge gained from the available evidence must be considered when examining the link between WTN and AHEs. Fortunately, in addition to experimentation, this evidence includes simple tools that are useful, particularly if we are willing to recognize their collective value. Those tools begin, but do not end, with adverse health reporting.

Dr. Carl Phillips, a specialist in epidemiology and science-based policy making, and a former professor of public health, has stated:^[169]

“In cases of emerging and unpredictable disease risk, adverse event reports are the cornerstone of public health research. Since it is obviously not possible to study every possible exposure-disease combination using more formalized study methods, just in case an association is stumbled on, collecting reports of disease cases apparently attributable to a particular exposure is the critical first step” (p. 304).

He gives familiar examples of hazards revealed by adverse event reporting, including infectious disease outbreaks and side effects from pharmaceuticals. He points out that:

“Pharmaceutical regulators rely heavily on clearinghouses they create for adverse event reporting about drug side effects (and often become actively concerned and even implement policy interventions based on tens of reports)” (p. 304).

Phillips indicates that the case of wind turbines and health fits the same pattern. He describes adverse event reporting as a special type of case study—sometimes denigrated as anecdotes—that generally reports on the rapid onset of a disease that appears to be related to a particular exposure. He advocates self-reporting of adverse events as a highly useful approach in studying the health effects of wind turbines. In addition, he advocates the use of case-crossover experiments as useful and well-accepted sources of epidemiologic information, stating that they are intuitively recognized by both experts and laypersons seeking to assess whether an exposure is causing specifiable outcomes.

Other forms of evidence, all considered scientific, have been or can be used to determine the impacts of WTN on health. These include case studies, case-series studies, and other pre-experimental, quasi-experimental, true experimental, correlational analysis, and single-subject designs. Single-subject designs, like the case-crossover design used by epidemiologists, can also be applied across multiple individuals to reveal relationships between specific interventions and changes in outcomes in individuals or groups. In both designs, subjects serve as their own controls while crossing over from one treatment to another (A vs. B) during the course of the experimental trial. Both are flexible designs and useful in studying events that are infrequent or sporadic. Numerous individuals living near IWTs have experienced health symptoms that have waxed and waned during repeated cycles of exposure (A) and non-exposure (B), which indicates that the wind industry has unwittingly engaged individuals and families worldwide in a series of quasi-empirical studies for many years, without obtaining informed consent from un-enrolled subjects, typically by downplaying any concerns about potential health impacts. The outcomes from these experiments offer some of the strongest evidence available that there is a causative link between WTN and AHEs in some individuals.

According to the WHO,^[170] epidemiology is “the study of the distribution and determinants of health-related states or events (including disease), and the application of this study to the control of diseases and other health problems. Although the randomized clinical trial (RCT) is generally considered the *gold standard* of designs for establishing causation, various methods can be used to carry out epidemiological investigations: surveillance and descriptive studies can be used to study distribution; analytical studies are used to study determinants.” Epidemiology uses a

systematic approach to study the differences in disease distribution in subgroups and allows for the study of causal and preventive factors.^[171] Descriptive epidemiological studies describe the occurrence of outcomes, and analytical studies reveal associative linkages between exposure and outcomes. Descriptive studies include primarily case reports and case-series studies. Analytic designs include experimental studies such as community trials and randomized controlled clinical trials, and observational studies, in which observations can be made retrospectively, concurrently, or prospectively. Observational studies include those in which either grouped (i.e., ecologic) or individual data are collected, the latter normally favored by the scientific community. Those designs involving individual data include cross-sectional, cohort, case-control, and case-crossover studies. Although epidemiological studies rely on statistical analyses of relationships between exposure to specific agents and AHEs in relatively large samples of the population, they are not aimed at revealing the cause of a disease or disorder in specific individuals. A cogent summary of research designs used in *evidence-based medicine* can be found online.^[172]

Cross-sectional studies survey exposures and disease status at a single point in time in a cross-section of the population. They measure prevalence, not incidence, of a disease process, and have the disadvantage of difficulty in establishing the temporal sequence of exposure and effect. Also, rare and quickly emerging events may be difficult to detect. Their major advantage is that data can be collected at the same time on all participants, which means the study can be completed in a relatively short time. Notably, several cross-sectional investigations of the effects of WTN exposure have been reported.^[44, 97, 98, 99, 104, 149] These studies serve as major contributions to the scientific literature on the subject.

Cohort studies involve an observational design in which a sample of the population is followed to discover new events.^[75] They compare individuals with a known risk factor or exposure with others without the risk factor or exposure and aim to determine whether there is a difference in the risk, or incidence, of a disease over time. They tend to be the strongest observational design, especially when the data are collected prospectively, as opposed to retrospectively. Compared to the cross-sectional design, cohort studies tend to require more time, which partially explains the paucity of such studies involving wind turbine exposure.

Case-control designs compare exposures in diseased cases vs. healthy controls from the same general population. Specific disease states must be known prior to initiation, and exposure data must be collected retrospectively. This design can be applied to cases of IWT exposure, despite the fact that it requires the cooperation of affected and unaffected segments of the same population, a circumstance made difficult by attempts on the part of energy companies to

maintain confidentiality and privacy as a means to facilitate wind turbine development in areas involving both participants and non-participants.

In case-crossover studies, which are a special type of case-control design, the *case* and *control* components reside in the same individual. This design is especially useful in investigating triggers of a disease process within an individual. In the behavioral sciences, it is commonly referred to as a *single-subject design*, as already described. The case component signifies the hazard period, which is the time period before the disease or event onset (e.g., exposure to IWTs), and the control component signifies a specified time interval other than the hazard period, namely the non-exposure interval. As already mentioned, wind companies themselves have unwittingly subjected residents to the basic conditions of this design, and results clearly suggest that exposure to WTN leads to a variety of health complaints in some individuals and families. Phillips^[79] argues that:

“A case-crossover study is one of the most compelling sources of epidemiologic data. It consists of observing whether someone’s outcomes change as their exposure status changes. This is often not possible because the outcomes only happen a single time as a result of long-term exposure (e.g., cancer) or the exposure cannot be changed. But the observed effects of turbine exposure lend themselves perfectly to such studies because the exposure is transient and the effects, while not instantaneous in their manifestation or dissipation, are generally transient over a period of days or weeks at most. Thus, unlike a case of a lifelong exposure or non-transient disease, where we can only make one observation about disease and outcome per person, the effects of turbines allow multiple observations by the same person, including experimental interventions” (p. 305-306).

Turning to experimental designs, the clinical trial is considered the ideal design to test hypotheses of causation. In a clinical trial, the investigator has control of the exposure to an extent similar to a laboratory experiment. The subjects generally are randomly assigned to one of at least two groups, an experimental and a control group. The experimental group receives the treatment (i.e., exposure in the case of wind turbines) and the control group does not; instead, it usually is subjected to a condition that simulates a generic treatment of some type, and the purpose and procedures of the control condition are explained only after the experiment ends.

A fully developed clinical trial of residents who live near wind turbines has never been conducted, and the reasons are fairly clear if we consider the circumstances surrounding such a trial. In a rigorous trial done to establish the link between AHEs and WTN, the investigator would randomly assign hundreds of people selected from the general population—including adults and children, elderly adults, and chronically ill adults—to either an experimental or a control group. Randomization would control for pre-experimental biases toward or against wind

energy, as well as for other factors that could confound the outcome. The experimental group would be required to spend a significant period (day and night for weeks or months) in homes located between approximately 1,000 ft. and several miles from the nearest wind turbine. The control group would be required to take up residence several miles or more away from the nearest wind turbine, where they would presumably be free from any effects due to extraneous noise or infrasound. Homeowners who leave their homes, as well as research participants occupying those homes, would have to adjust to new residences and modify their work and school activities, eating patterns, and overall lifestyles. Participants in both groups and at least some of the homeowners who vacate their homes for the experiment would have to be reimbursed for their participation, as well as for the costs incurred as a result of their participation, and the research staff would also have to be paid. To maintain some control across sites, the average age and health status within each group should be equivalent, and data would have to be gathered regarding such factors as turbine size, wind speed and other weather conditions, length of time the turbines were operating, terrain, the exact distance of each participating family from the nearest turbines, and actual noise levels present outside and inside the homes. Scientifically rigorous methods for measuring low-frequency noise and infrasound would have to be agreed upon and used. Although self-report via a survey technique could be part of the experimental design, medical examinations and physiological measurements, including sleep studies, should also be incorporated into the research protocol.

While possible, it is not practical to expect such a study design, in its ideal form, to be implemented. Aside from the difficulty of recruiting and enrolling enough families in enough geographic areas to form statistically strong samples, legitimate ethical questions should be raised regarding the exposure of individuals, especially children and other vulnerable individuals, to potentially hazardous conditions. One might conjecture, however, that consent to participate in such a study could be gained from fully informed adults because the effects of WTN are widely believed to be reversible when a period of non-exposure follows a period of exposure.

Statement 10: The nocebo effect, a manifestation of psychological expectations, explains why people complain of adverse health effects when living near wind turbines.

This statement is the core position of some of the most outspoken critics of the view that IWTs cause AHEs. Any discussion of this statement should begin with an acknowledgment that human behavior and beliefs are highly variable and are often driven by psychological and emotional influences, and not just by observations, logic, intellectual knowledge, or cognitive thought processes. It is not surprising, therefore, that some have adopted the view that negative reactions

to wind turbines are based primarily or solely on psychological expectations. Our analysis of the limited literature on the topic leads us to state unequivocally that it is lacking in scientific rigor. Even if the results were as described, the existing studies and observations do not support a conclusion that psychological forces are the only or even primary explanation for most of the negative reactions toward IWTs. Here, we will critically review four papers, all supporting a psychological explanation for the negative reactions.

Chapman et al^[173] tested four hypotheses relevant to psychogenic explanations of the variable timing and distribution of health and noise complaints about wind farms in Australia. They obtained records from the wind companies of complaints about noise or degraded health from residents living near 51 wind projects operating between 1993 and 2013 and corroborated those records with complaints documented by three government public agencies, news media records, and court affidavits. Complaints were expressed as proportions of estimated populations residing within 5 km of a wind project. The authors concluded that historical and geographical variations in complaints were consistent with psychogenic hypotheses expressing health problems as “communicated diseases,” with nocebo effects likely to play an important role in the etiology of complaints.

Nocebo effects are commonly described as being the opposite of placebo effects. While the *placebo effect* usually refers to a positive reaction to an inert substance—the placebo—the *nocebo effect* refers to a negative reaction to an inert substance—the nocebo. Both effects are psychogenic, but known to exert powerful influences on human physiology, behavior, and attitudes. Essentially, Chapman and his supporters believe that psychogenic reasons are the basis for health complaints about wind turbines, which they believe to be harmless.

Our major criticism of the work of Chapman et al is that wind companies typically engage in practices that discourage local residents to complain. These companies require participating residents to sign contracts before turbines are constructed and before the residents can receive compensation for leasing their land, and they often request non-participating residents to sign contracts prior to initiating a project. Those contracts, which are binding, often include gag clauses that effectively limit resident complaints. The contracts have often stipulated not only that residents refrain from voicing negative views of the wind project, but also that they support the development of future projects. Such conditions create an atmosphere in which it is highly unlikely that the records of wind companies, governments, courts, or the media will sufficiently reflect all of the complaints that residents have and would voice under less-restrictive circumstances. We argue that the only way to gather accurate data on such complaints is through a survey of either an adequate sample of residents living near multiple wind projects or all such

residents, where residents are free of restrictions by the wind companies. Such data would allow a valid determination of the proportion of residents who experience adverse effects. Whether that proportion is large or small, we could all act on the basis of factual evidence, as opposed to incomplete observations.

Another shortcoming of the study by Chapman et al,^[173] which is less well documented but a factor observed in legal cases in which the present authors have been involved, is that residents near IWT projects tend to be delayed in their responses to AHEs. Many of them believe their health problems to be linked to other causes before suspecting that the turbines are the cause. Some or most of these individuals were supporters of wind projects prior to experiencing such problems, as Phipps et al^[75] noted in New Zealand. The delay factor would mean that the types of records used by Chapman et al would not likely reflect the reactions of many affected residents.

Crichton and colleagues conducted two laboratory investigations, each of which has bolstered the argument that negative reactions to audible and inaudible WTN can be explained by psychological expectations. Crichton et al^[174] conducted what they described as a sham-controlled double-blind provocation study, in which participants were exposed to 10 min of infrasound and 10 min of sham infrasound. Fifty-four participants were randomized to high- or low-expectancy groups and presented with audio-visual information, using material from the Internet that was designed to invoke either high or low expectations that exposure to infrasound causes specified symptoms. High-expectancy participants reported significant increases, from pre-exposure baseline assessment, in the number and intensity of symptoms experienced during exposure to both infrasound and sham infrasound. There were no symptomatic changes in the low-expectancy group. Healthy volunteers, when given information about the expected physiological effect of infrasound, reported symptoms that aligned with that information, during exposure to both infrasound and sham infrasound. According to the authors, results suggest that psychological expectations are sufficient to explain the link between wind turbine exposure and health complaints.

Punch^[175] has criticized that study as methodologically weak, on the following grounds:

- (1) Subjects were never exposed to infrasound that adequately represented that to which residents near wind turbine projects are subjected. It is extremely unlikely that the employed studio woofer was capable of producing a 5-Hz stimulus; the authors did not describe or show a graph of the output spectrum. Even if a true infrasound stimulus was produced by their equipment, 40 dB (presumably SPL) was not sufficient to represent the level of

infrasound commonly produced by IWTs. Even if a sufficient stimulus had been produced to represent wind turbine infrasound, a 10-min exposure would have been meaningless in representing the duration of exposure that is likely necessary to produce any substantial health symptoms.

- (2) In effect, subjects were exposed to two sham conditions. If they had been exposed to infrasound that adequately mimicked infrasound from IWTs (preferably actual IWT infrasound), subjects in both the high- and low-expectancy groups would have had a physical stimulus (in the infrasound condition) that could have overridden, or at least moderated, their psychological reactions.
- (3) The design limited the study's external validity, the ability to generalize the results to other populations and situations. Most of the individuals who have reported AHEs from WTN, some of whom have abandoned their homes, are not people who were adequately warned of potential health effects prior to their exposures. In fact, most of them were likely told by the wind company to expect no harmful effects. Again, many individuals who report AHEs were advocates of wind energy prior to being exposed. Because the major premise underlying the study is that people complain of WTN based primarily on expectancies that align with prior information, the study is based on a false premise. Also, the recruitment of university students does not represent the type of subjects who are apt to complain about WTN. This population is probably the least vulnerable to the effects of WTN in that few, if any, were very young, very old, likely to have chronic health conditions, or disabled. Also, they are more likely to exhibit a response bias because they are less likely than prospective residents of a wind project to believe that they might be harmed by participating in an experiment. Furthermore, the extensive use of pretesting introduced reactive or interactive effects that could have affected post-test behaviors and ratings. Finally, the use of a laboratory setting and short exposure times, as opposed to a real-life setting in which wind turbine blades are turning at night and the subjects are inside a home, introduced situational effects that limit the ability to generalize the data. The authors admit this shortcoming in their statement:
 "... exposure to infrasound in a listening room purpose (sic) built for sound experiments may not be directly comparable to exposure to infrasound from a wind farm" (p. 4).

- (4) This was an experiment whose outcomes could have been predicted, given the conditions employed. Aside from the fact that the outcome had virtually nothing to do with the real-world conditions of exposure to infrasound from wind turbines, none of the factors that influence how expectations can affect perceptions through top-down, or cognitive- based, processing, as opposed to bottom-up, or stimulus-based, processing, were controlled or even

discussed. (Interested readers should refer to Williams^[176] for examples of the effects of top-down processing and for a discussion of how such experiments might be improved.)

In a second laboratory study by Crichton and colleagues,^[177] similar in design to the first, the authors investigated whether positive expectations can produce a reduction in symptoms and improvements in reported health. Sixty participants were randomized to either positive or negative expectations and subsequently exposed to audible wind turbine sound and infrasound. According to the authors,

“Participants were ... exposed to infrasound (9Hz, 50.4dB) and audible wind farm sound (43dB), which had been recorded 1 km from a wind farm, during two 7-minute listening sessions. Both groups were made aware they were listening to the sound of a wind farm, and were being exposed to sound containing both audible and sub audible components and that the sound was at the same level during both sessions” (p. 2).

Prior to exposure, negative-expectation participants watched a DVD incorporating TV footage about health effects said to be caused by infrasound produced by wind turbines. In contrast, positive-expectation participants viewed a DVD that:

“...framed wind turbine sound as containing infrasound, sub audible sound created by natural phenomena such as ocean waves and the wind, which had been reported to have positive effects and therapeutic benefits on health” (p. 2).

The authors described the results as indicating that during exposure to audible wind turbine sound and infrasound, symptoms and mood were strongly influenced by subject expectations. Negative-expectation participants experienced a significant increase in symptoms and a significant deterioration in mood, while positive-expectation participants reported a significant decrease in symptoms and a significant improvement in mood. The authors concluded that if expectations about infrasound are framed in more neutral or benign ways, then it is likely that reports of symptoms or negative effects could be nullified.

That second investigation by Crichton and colleagues has some of the same methodological weaknesses as the first, particularly with respect to the use of what was described as experimental infrasound. Again, recordings of WTN were used, and no description of the recording instrumentation was provided, leading us to assume that the instrumentation may have been incapable of accurately reproducing infrasound, and thus its true effects. All participants were informed of the purpose of the study, which was:

“...to investigate the effect of sound below the threshold of human hearing (infrasound) on the experience of physical sensations and mood” (p. 2).

Preferably, the purpose should have been divulged only after the data were gathered because the description of sounds as those that humans cannot hear would presumably have established a mind-set, or bias, in both groups that the sound would have little impact. That preconception could have confounded any reactions to the different DVD messages. Another criticism of the study is that wind companies frame their turbines in the best possible light, so positive expectations have already been established in the minds of most wind-project participants and non-participants. Despite neutral or positive framing that has sometimes included assurance that the turbine sounds would be no louder than that of a refrigerator (see, for example, Chen & Narins^[178]), the consequences of living near IWTs are catastrophic for some residents.

Tonin et al^[179] repeated the experimental work of Crichton and her colleagues by using specially modified headphones to produce infrasound, as opposed to the loudspeaker system used in the previous studies, and exposed participants to 23 min of infrasound, as opposed to the 10-min exposures in the Crichton studies. Similar results were reported, suggesting that the simulated infrasound had no statistically significant effect on the symptoms reported by volunteers, while the prior expectations the volunteers had about the effect of infrasound had a statistically significant influence on the symptoms reported, thereby supporting the nocebo effect hypothesis. Some of the same criticisms of the Crichton et al study^[174] levelled by Punch^[175] also apply to the Tonin et al study, as participants were not being stimulated by sufficient durations or peak levels of infrasound exposure to which residents living near IWTs are exposed, and participants were effectively exposed to two sham conditions, denying them any opportunity to experience realistic infrasonic stimuli that could have overridden or moderated their psychological reactions based on expectancy.

In a related study, Taylor et al^[180] assessed the effect of negatively oriented personality (NOP) traits (Neuroticism, Negative Affectivity and Frustration Intolerance) on the relationship between both actual and perceived noise on “medically unexplained non-specific symptoms (NSS)” (p. 338), presumably their euphemism for Pierpont’s Wind Turbine Syndrome.^[4] Households within 500 m of 8 0.6-kW micro turbine installations and within 1 km of 4 5-kW small wind turbines in two U.K. cities were surveyed, and 138 questionnaires were completed and returned for analysis. Turbine noise level for each household was also calculated. There was no evidence for an effect of calculated noise on NSS. A statistically significant relationship was found between perceived noise and NSS for individuals high in NOP traits.

That study is similar in concept to those performed by Crichton and colleagues,^[174, 177] with virtually the same conclusion—that the link between wind turbines and AHEs has a psychological origin. The study can be criticized on several grounds:

(1) Only smaller wind turbines were investigated; there is virtually no literature demonstrating that such turbines produce noise levels of any consequence to humans. The fact that no relationship was found between “calculated actual noise” from the turbines and participants’ attitudes toward wind turbines was thus predictable because the noise levels were either too low to affect attitudes differentially or were completely inaudible.

(2) The authors state:

“Actual noise turbine level for each household was also calculated” (p. 338).

Calculated levels (from noise maps) are not necessarily actual levels, so this procedure was, at a minimum, mischaracterized.

(3) It should not be surprising to find that individuals with negatively oriented personalities respond negatively to WTN, as they would likely respond negatively to almost any stimulus. However, the findings, as acknowledged by the authors, resulted from reports of participants’ retrospective perceptions of noise from turbines and symptoms at the same point in time, possibly resulting in common-method variance and retrospective bias. Also, although the authors reported a statistically significant relationship between NSS and negatively oriented personality, the reported variance explained by those relationships was quite low. That finding suggests that a meaningful (i.e., clinical) significance was not established, in which case one might reasonably question whether symptom reporting in the study was actually linked to negative personality type.

(4) Among other possible confounders, individual differences are likely to have complicated the authors’ analyses (see Williams^[176] for an explanation).

To conclude this section, we believe that while psychological expectations conceivably can influence perceptions of the effects of WTN on health status, no scientific studies have yet convincingly shown that psychological forces are the major driver of such perceptions. Based on the bulk of literature covered in this review, those drivers are the physical stimuli themselves and the internal physiological reactions they induce.

Statement 11: Only relatively few people, if any, are adversely impacted by wind turbine noise, and the majority have no complaints.

As indicated earlier, most of the studies that have documented specified percentages of the population adversely affected by WTN have been those focusing on annoyance, as opposed to health. While the exact percentage of people whose health is affected by WTN has not been accurately determined, countless reports worldwide suggest that the acoustic energy emitted by

IWTs is harmful to the health of substantial numbers of people. As already noted, Phipps et al^[75] found that 45% of households living as far away as 4 km from a wind project and 20% of households living up to 8 km away reported hearing turbine noise. Those figures take into account only the audible noise, of course, and not the inaudible infrasound, and they do not account for any documented adverse impacts.

Estimates of the percentage of people adversely affected by WTN should not be based solely on questionnaire surveys of populations known to be experiencing health problems, due to selection bias. Such surveys can be helpful in arriving at rough estimates of AHEs, however, but only if those surveys also report estimates of the total population from which the affected sample is drawn. The main value of surveys that include only affected individuals (e.g., Harry^[74]; Pierpont^[4]; The Acoustic Group^[25]) is that they strongly suggest that substantial numbers of people living near wind turbines suffer health symptoms. For example, Harry^[74] reported that 81% of her 42 survey respondents had health complaints, 76% had visited a doctor regarding those complaints, and 73% reported a reduced quality of life. In a somewhat more representative survey of residents living within 15 km of a wind turbine project—most of whom lived within 3 km—Phipps^[76] found that 42 of 614 households who responded to a questionnaire (6.8%) reported occasional sleep disturbance, another 21 (3.4%) reported frequent sleep disturbance, and an additional 5 (0.8%) reported sleep disturbance most of the time due to WTN. Eleven percent of households, therefore, reported suffering at least occasional sleep disruption due to the wind turbines. Fifteen percent of respondents to that survey reported that they had suffered at least occasional reductions in their quality of life since the turbines became operational.

Despite the lack of definitive scientific evidence, we cannot ignore the numerous accounts of such effects reported worldwide on the Internet, in legal proceedings, and in news accounts. Krogh et al^[96] have reviewed studies that document such incidents, many of which have involved the abandonment of homes. In a 2010 report commissioned by the Ontario Ministry of the Environment, the engineering firm of Howe Gastmeier Chapnik Limited,^[112] despite its general conclusion that Ontario IWTs do not pose a risk to human health, stated:

“The audible sound from wind turbines, at the levels experienced at typical receptor distances in Ontario, is nonetheless expected to result in a non-trivial percentage of persons being highly annoyed research has shown that annoyance associated with sound from wind turbines can be expected to contribute to stress related health impacts in some persons” (p. 39).

In conclusion, we should recall that Phillips^[169] advocates self-reporting of adverse events as a critical element in the study of the health effects of wind turbines. As stated earlier, he has noted

the importance of case-crossover experiments as useful and well-accepted sources of epidemiologic information. Numerous households around the world have been subjected to this type of quasi-experiment by the wind industry. It is unfortunate that an accurate count of these incidents has never been tallied formally and scientifically. Although that task must be left to future research, we should regard complaints of AHEs from individuals living near wind turbine installations seriously, when they occur, and the wind industry must act responsibly by siting its turbines at distances from residents that protect health and quality of life.

It is widely accepted that the industry has warned that tighter siting restrictions will destroy its prospects for growth. Such growth, however, should not continue in areas where there are probable and potential risks to human health. There are regions of the U.S. and other countries where turbines can operate safely, presumably without such risks. Some examples of those sites are illustrated in Figure 2.

Statement 12: There is no evidence in the literature to support a causative link between wind turbine noise and adverse health effects.

The above review has been aimed specifically at addressing this point, which is often cited as factual by wind industry advocates in the literature and in legal proceedings. Namely, there is an abundant literature, much of it peer-reviewed and authored by highly reputable researchers, indicating that audible and inaudible noise emitted by IWTs adversely impacts the health and well-being of substantial numbers of people who are regularly exposed to wind turbines. It is clear that the literature reviews and papers claiming no AHEs fail to include important studies, international standards, guidance from the WHO, and research conducted on wind turbine noise and other sources of infra- and low-frequency sound. Whether this is through oversight or calculation, only reports that cite scientifically credible references should be considered legitimate sources of information. Our review has shown that it is unacceptable simply to state that the literature contains little or no evidence of a causal link between WTN and AHEs. At a minimum, those effects have been shown to be regularly correlated to living in proximity to IWTs, and there is sufficient evidence that those effects are highly associated with objective measurements of audible noise and infrasound.

Although sleep disturbance and its associated impacts on health and quality of life appear to be the most salient consequences of IWT noise, varying health effects that are unrelated to sleep have also been widely and consistently reported by different investigators. While not everyone who is exposed to IWTs suffers AHEs, it is incumbent on governmental officials and the wind industry to take seriously the health implications of their decisions to locate wind turbines near

residential and other populations, especially vulnerable populations, that are or likely to be negatively affected.

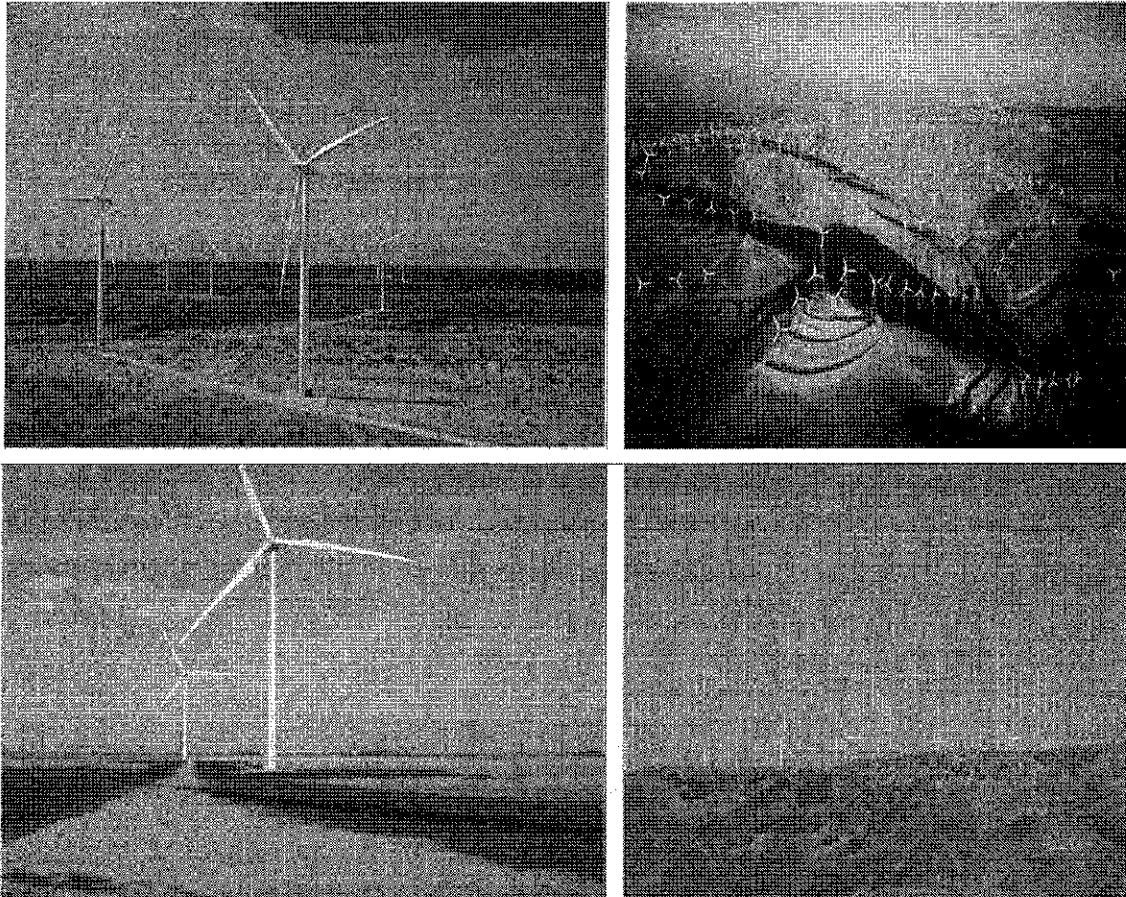


Figure 2. Photographic images of sites illustrating onshore landscapes where industrial wind turbines expose humans to minimal health risks due to large setback distances. Note that homes are not seen in the photos. (Source: https://images.search.yahoo.com/search/images?p=wind+turbine+images+california&fr=tightropeth&imgurl=http%3A%2F%2Fwww.freefoto.com%2Fimages%2F39%2F01%2F39_01_1---Wind-Turbine-Generators--Palm-Springs--California_web.jpg#id=36&iurl=http%3A%2F%2Fmedia-cdn.tripadvisor.com%2Fmedia%2Fphoto-%2F01%2F70%2Ff9%2Fbb%2Ftehachepi-area-california.jpg&action=close).

Conclusion

We have discussed in this paper various elements of acoustics, sound perception, sound measurement, and psychological reactions, and the role these factors play in support of the view that a general-causative link exists between human health and ILFN emitted by IWTs. The available evidence warrants the following conclusions:

- (1) Large wind turbines generate infrasound, which is not normally experienced as sound by most human listeners. Some people, however, experience it in the form of pathological

symptoms such as headache, dizziness, nausea, or motion sickness, which appear to be caused by the excitation of resonances inside closed structures and the human body itself.

- (2) WTN has unique acoustic characteristics when compared to other environmental noises. These characteristics include low-amplitude, amplitude-modulated, intermittent occurrences of tones that mirror the peak energy of the blade-pass frequency and the first several harmonics. The coupling mechanisms in the inner ear prevent internally generated sound, but not externally generated sound, from being perceived, which means that perception of wind turbine infrasound is far more disturbing than infrasound generated within the human body.
- (3) There is voluminous evidence, ranging from anecdotal accounts from around the world to peer-reviewed scientific research, that audible and inaudible low-frequency noise and infrasound from IWTs lead to complaints ranging from annoyance to AHEs in a substantial percentage of the population. Although sleep disturbance is the most common problem cited, a variety of other health problems has been reported by numerous reputable sources. Recent research is largely consistent with Pierpont's original description of Wind Turbine Syndrome. Research on humans and lower animals has shown that it is biologically plausible that inner ear mechanisms, in conjunction with the brain, can process acoustic energy in ways that result in pathological perceptions that are not interpreted as sound. Both balance and hearing mechanisms appear to be involved in evoking these perceptions. The findings that infrasonic stimuli can amplitude modulate higher frequencies in the audible region, and that infrasound may be more perceptible when higher frequencies are absent, are especially compelling in suggesting that what we can't hear can hurt us.
- (4) To prevent AHEs, scientists have recommended that distances separating turbines and residences be 0.5-2.5 mi., and 1.25 mi. (2 km) or more has been commonly recommended. Clearly, the short siting distances used by the industry for physical safety do not protect against AHEs. Alternatively, researchers have recommended sound levels typically ranging from 30-40 dBA for safeguarding health, which is consistent with the recommendation of nighttime noise levels by the WHO.
- (5) Annoyance is a health issue for many people living near IWTs, which is consistent with both the WHO's definition of health and contemporary models of the relationships among annoyance, stress, and health.
- (6) The scientific evidence regarding factors other than amplitude-modulated ILFN as an explanation for most of the health complaints near IWTs, including electromagnetic fields (dirty electricity), is weak; the preponderance of research suggests that ILFN is the most viable explanation for such complaints.

- (7) The A-weighted decibel scale, which effectively excludes infrasound and substantial amounts of low-frequency noise, is inadequate to predict the level of outdoor or indoor infrasound, to reveal correlations to infrasound, or to show a definitive relationship with AHEs. Achievement of these goals requires the development of new measurement methods.
- (8) Even though Wind Turbine Syndrome is not currently included in the ICD coding system, that system includes most of the acknowledged symptoms of the syndrome. Medical professionals, therefore, have the necessary tools to evaluate and treat it, and that process has already begun on a limited scale.
- (9) While some epidemiologically solid research has been done in the area of IWTs and AHEs, evidence from other sources cannot be ignored. Hill noted the nature of such sources in 1965, and Phillips, in 2011, described the importance of other kinds of evidence, including adverse event reports, in establishing a causative relationship. One of the strongest types of evidence is the case-crossover experimental design, which the wind industry has unwittingly imposed for years on multiple families, many of whom have abandoned their homes to escape IWT noise exposure.
- (10) While psychological expectations and the power of suggestion conceivably can influence perceptions of the effects of WTN on health status, no scientifically valid studies have yet convincingly shown that psychological forces are the major driver of such perceptions.
- (11) Accurate estimates of the percentage of people who are affected by IWTs exist only for annoyance, not AHEs. Multiple reports, however, emphasize the relationships that exist between annoyance, stress, health, and quality of life, and indicate that a non-trivial percentage of people who live near IWTs experience AHEs. Those reports are consistent with thousands of reports worldwide. Although it seems reasonable to conclude that noise from IWTs does not cause AHEs in the majority of exposed populations, and that accurate estimates of AHEs are yet to be established, it is also clear that considerable numbers of people are affected and that they deserve to be heard and protected from adverse health impacts.
- (12) The available literature, which includes research reported by scientists and other reputable professionals in peer-reviewed journals, government documents, print and web-based media, and in scientific and professional papers presented at society meetings, is sufficient to establish a general causal link between a variety of commonly observed AHEs and noise emitted by IWTs.

Based on all the evidence presented, our fundamental view is that the controversy surrounding AHEs should not be polarized into two groups consisting of either *pro-wind* or *anti-wind*

factions, but rather one in which there is room for a third, *pro-health*, perspective. Essentially, the pro-wind view is that IWTs should be installed wherever feasible, that definitive scientific research is lacking to indicate that turbines cause AHEs, and that if you can't hear it, you can't feel it. The anti-wind view is that IWTs should not be installed anywhere because wind is not an economically viable source of renewable energy, that all government subsidies and development efforts should end, and that what we can't hear can hurt us. A pro-health view is that there is enough anecdotal and scientific evidence to indicate that ILFN from IWTs causes annoyance, sleep disturbance, stress, and a variety of other AHEs to warrant siting the turbines at distances sufficient to avoid such harmful effects, which, without proper siting, occur in a substantial percentage of the population. That view holds that what we can't hear can hurt some of us, and that the precautionary principle must be followed in siting IWTs if such health risks are to be avoided. Industrial-scale wind turbines should not be located near people's homes, educational and recreational facilities, and workplaces. It is our belief that the bulk of the available evidence justifies a pro-health perspective. It is unacceptable to consider people living near wind turbines as collateral damage while this debate continues.

Further scientific investigations of the dose-response relationship between IWT noise and specific health effects in exposed individuals are sorely needed. However, people should be protected by conservative siting guidelines that recognize the concerns raised in this review. Hopefully, such research can and will be planned and executed by independent researchers with the full cooperation of the wind industry. The major objective of such research should be to reveal directions for the industry in balancing the energy needs of society with the need to protect public health.

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References

- ¹ Caithness Windfarm Information Forum. Summary of wind turbine accident data to 30 June 2016. Available from: <http://www.caithnesswindfarms.co.uk/AccidentStatistics.htm>. [Last accessed on 2016 July 5].
- ² Hedges C, Sacco, J. *Days of Destruction, Days of Revolt*. New York: Nation Books; 2012.
- ³ Krogh C, Horner B, Morris J, May M, Papadopoulos G, Watts AC. Trading off human health: wind turbine noise and government policy. Presentation at 5th International Meeting on Wind Turbine Noise, August 2013. Available from: <http://waubrafoundation.org.au/wp-content/uploads/2014/02/Wind-Turbine-Noise-Conference-2013-Policy-paper.pdf>. [Last accessed on 2016 July 5].
- ⁴ Pierpont N. *Wind turbine syndrome: a report on a natural experiment*. Santa Fe (NM): K-Selected Books, 2009.
- ⁵ Horner B. Open Letter Audit: National Health and Medical Research Council Public Statement (2010) and Rapid Review (2010). Available from: http://docs.wind-watch.org/Horner_NHMRC-references-audit_July-31-2012.pdf. [Last accessed on 2016 July 5].
- ⁶ Office of Management and Budget: Final Information Quality Bulletin for Peer Review, December 16, 2004. Available from: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB4QFjAA&url=http%3A%2F%2Fwww.cio.noaa.gov%2Fservices_programs%2Fpdfs%2FOMB_Peer_Review_Bulletin_m05-03.pdf&ei=zxo8VI2PLEvesASY64LQBA&usg=AFQjCNHRv2lLaSO_W6HyH05x9E90yQynDQ&sig2=jewV1g8YLe-Yrqz3IZ6rxg&bvm=bv.77161500,d.cGE&cad=rja. [Last accessed on 2016 July 20].
- ⁷ Achenbach J. Why do many reasonable people doubt science? *National Geographic*, 2015. Available from: <http://ngm.nationalgeographic.com/2015/03/science-doubters/achenbach-text>. [Last accessed on 2016 July 5].
- ⁸ Leventhall G. How the "mythology" of infrasound and low frequency noise related to wind turbines might have developed. Presentation at First International Meeting on Wind Turbine Noise: Perspectives for Control, October 2005. Available from: https://www.researchgate.net/publication/237542296_First_International_Meeting_on_Wind_Turbine_Noise_Perspectives_for_Control_Berlin_17th_and_18th_October_2005_How_the_mythology_of_infrasound_and_low_frequency_noise_related_to_wind_turbines_might_have_developed. [Last accessed on 2016 July 5].
- ⁹ Leventhall G. Infrasound from wind turbines—fact, fiction or deception. *Canadian Acoustics* 2006; 34:29-36.
- ¹⁰ James RR. Wind turbine infra and low-frequency sound: warning signs that were not heard. *Bulletin of Science, Technology & Society* 2012;32:108-127.

-
- ¹¹ Schwartz S. Linking noise and vibration to Sick Building Syndrome in office buildings. Air & Waste Management Association. March 2008:26-28. Available from: <http://pubs.awma.org/gsearch/em/2008/3/schwartz.pdf>. [Last accessed on 2016 July 5].
- ¹² Leventhall G. A review of published research on low frequency noise and its effects, May 2003. Available from: <http://docs.wind-watch.org/leventhall-defra-lowfreqnoise.pdf>. [Last accessed on 2016 July 20].
- ¹³ Broner N. The effects of low frequency noise on people—a review. *Journal of Sound and Vibration* 1978;58:483-500.
- ¹⁴ Leventhall G. Concerns about infrasound from wind turbines. *Acoustics Today* 2013;9:30-38.
- ¹⁵ Colby WD, Dobie R, Leventhall G, Lipscomb DM, McCunney RJ, Seilo MT, et al. Wind turbine sound and health effects: an expert panel review. Report prepared for Prepared for American Wind Energy Association and Canadian Wind Energy Association, December 2009. Available from: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAA&url=http%3A%2F%2Fcanwea.ca%2Fpdf%2Ftalkwind%2FWind_Turbine_Sound_and_Health_Effects.pdf&ei=Ja5TVIvDJ4WjyATUq4HQBA&usg=AFQjCNGYQ3-rkSZtsOVpuyhzeGsk2o4lQ&sig2=kZ_liEZ8jzUkFsT4bE7dbg&bvm=bv.78677474,d.aW. [Last accessed on 2016 July 5].
- ¹⁶ Møller H, Pedersen CS. Low-frequency noise from large wind turbines. *Journal of the Acoustical Society of America* 2011;129:3727-3744.
- ¹⁷ Evans T, Cooper J, Lenchine V. Infrasound levels near windfarms and in other environments. Environment Protection Authority, South Australia, January 2013. Available from: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&cad=rja&uact=8&ved=0CD8QFjAG&url=http%3A%2F%2Fwww.epa.sa.gov.au%2Fxstd_files%2FNoise%2FReport%2Finfrasound.pdf&ei=wIJeU_n_AfOFyQG26YCoDQ&usg=AFQjCNG-V01kqE5hz7j0Jajwv8nFac0C4A&sig2=fj0z4hblVm_TOTTKxs-0nA&bvm=bv.65397613,d.aWc. [Last accessed on 2016 July 20].
- ¹⁸ Bolin K, Bluhm G, Eriksson G, Nilsson ME. Infrasound and low frequency noise from wind turbines: exposure and health effects. *Environmental Research Letters* 2011;6:1-12.
- ¹⁹ Kelley ND, Hemphill RR, McKenna ME. A methodology for assessment of wind turbine noise generation. *Journal of Solar Energy Engineering* 1982;104:112-120.
- ²⁰ Kelley ND, McKenna HE, Hemphill RR, Etter CL, Garrelts RL, Linn NC. Acoustic noise associated with the MOD-1 wind turbine: its source, impact, and control. Report prepared for the U. S. Department of Energy, Contract No. DE-AC02-83CH-10093, February 1985. Available from: <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAA&url=http%3A%2F%2Fwww.nrel.gov%2Fdocs%2Flegosti%2Fold%2F1166.pdf&ei=uK9TVIL3L82P7AajolHQDQ&usg=AFQjCNGgDEPZV0hd1gkxw4hGcqWROWkufQ&si>

g2=abXK4ET8bDhYWbdG7UsKaA&bvm=bv.78677474,d.ZGU. [Last accessed on 2016 July 20].

- ²¹ Kelley ND. A proposed metric for assessing the potential of community annoyance from wind turbine low-frequency noise emissions. Presentation at Windpower'87 Conference and Exposition, November 1987. Available from: <http://www.nrel.gov/docs/legosti/old/3261.pdf>. [Last accessed on 2016 July 20].
- ²² Bray W, James R. Dynamic measurements of wind turbine acoustic signals, employing sound quality engineering methods considering the time and frequency sensitivities of human perception. Presentation at Noise-Con 2011 conference, July 2011. Available from: <http://waubrafoundation.org.au/wp-content/uploads/2013/07/Bray-James-11-07-25-Dynamic-measurement-of-wind-turbine-noise.pdf>. [Last accessed on 2016 July 20].
- ²³ Rand RW, Ambrose SE, Krogh CME. Occupational health and industrial wind turbines: a case study. *Bulletin of Science, Technology & Society* 2011;31:329-362.
- ²⁴ Walker B, Hessler GF, Hessler DM, Rand R, Schomer PD. A cooperative measurement survey and analysis of low frequency and infrasound at the Shirley Wind Farm in Brown County, Wisconsin. Report Number 122412-1, December 24, 2012. Available from: <https://docs.wind-watch.org/Shirley-LFN-infrasound.pdf>. [Last accessed on 2016 July 5].
- ²⁵ The Acoustic Group. The results of an acoustic program: Cape Bridgewater Wind Farm. Report prepared for Energy Pacific (Vic), Melbourne, Vic 3000, January 2015. Available from: <http://www.pacifichydro.com.au/english/our-communities/communities/cape-bridgewater-acoustic-study-report/?language=en>. [Last accessed on 2016 July 20].
- ²⁶ Swinbanks M. Direct experience of low-frequency noise and infrasound within a windfarm community. Paper prepared for presentation at 6th International Meeting on Wind Turbine Noise, April 2015. Available from: <https://docs.wind-watch.org/WTN2015-Swinbanks.pdf>. [Last accessed on 2016 July 5].
- ²⁷ Swinbanks M. Direct experience of low frequency noise and infrasound within a windfarm community. Presentation at 6th International Meeting on Wind Turbine Noise, April 2015. Available from: <http://docs.wind-watch.org/WTN2015-Swinbanks-poster.pdf>. [Last accessed on 2016, July 20].
- ²⁸ Artz K. Health threat from Wisconsin wind farm affirmed, October 29, 2014. Available from: <http://news.heartland.org/newspaper-article/2014/10/28/health-threat-wisconsin-wind-farm-affirmed>. [Last accessed on 2016 July 20].
- ²⁹ Abel D. State wants turbine shut over noise. *Boston Globe*, May 16, 2012. Available from: <https://www.bostonglobe.com/metro/2012/05/15/massachusetts-officials-recommend-falmouth-shut-down-turbines/mCPNKvUoq1IrdPCIRygmWN/story.html>. [Last accessed on 2016 September 10.]

-
- ³⁰ Anon, Kingston wind turbine shut down indefinitely; financial problems reported to the Town, June 19, 2016. Available from: http://www.windaction.org/posts/45258-kingston-wind-turbines-shut-down-indefinitely#.V8x_tDXIS-E. [Last accessed on 2016 September 4.]
- ³¹ Castelo Branco NAA, Alves-Pereira M, Pimenta AM, Ferreira JR. Low frequency noise-induced pathology: contributions provided by the Portuguese wind turbine case. Presentation at EuroNoise 2015 conference. Available from: <http://docs.wind-watch.org/Eurnoise2015-000602.pdf>. [Last accessed on 2016 September 11.]
- ³² Leloudas G, Zhu WJ, Sørensen JN, Shen WZ, Hjort S. Prediction and reduction of noise from a 2.3 MW wind turbine. *Journal of Physics: Conference Series* 75, 2007. Available from: <http://iopscience.iop.org/article/10.1088/1742-6596/75/1/012083/pdf>. [Last accessed on 2016 July 20].
- ³³ Rogers AL. Wind turbine noise, infrasound and noise perception. January 18, 2006. Available from: http://www.google.com/url?sa=t&source=web&cd=1&ved=0CBoQFjAA&url=http%3A%2F%2Fwww.windpoweringamerica.gov%2Fpdfs%2Fworkshops%2Fmwwg_turbine_noise.pdf&rct=j&q=frequency%20spectrum%20wind%20turbine%20noise&ei=u_fLTdu9OunRiALiotmUCA&usg=AFQjCNFWWT5fFWS6aO3XYIpvqkevckXbmw&sig2=1C0uNL4d19vHkmbvE4V8Lg&ad=rja. [Last accessed on 2016 July 20].
- ³⁴ Powell CA, Preisser JS. NASA's subsonic jet transport noise reduction research. Available from: <http://hdl.handle.net/2060/20040086700>. [Last accessed on 2016 July 8].
- ³⁵ Hubbard HH, Maglieri DJ. A brief review of air transport noise. *Journal of Sound and Vibration* 1975;43:159-172.
- ³⁶ Cermak GW, Cornillon PC. Multidimensional analyses about judgments about traffic noise. *Journal of the Acoustical Society of America* 1976;59:1412-1420.
- ³⁷ Leventhall HG. Low frequency noise and annoyance. *Noise & Health* 2004;6:59-72.
- ³⁸ World Health Organization. Night Noise Guidelines for Europe. World Health Organization, 2009. Available from: http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf. [Last accessed on 2016 July 20].
- ³⁹ Cummings, J. Looking for wind industry leadership in reducing noise impacts. February 23, 2011. Available from: <http://www.renewableenergyworld.com/renew/news/article/2011/02/looking-for-wind-industry-leadership-in-reducing-noise-impacts>. [Last accessed on 2016 July 20].
- ⁴⁰ Jung SS, Cheung W-S, Cheong C, Shin S-H. Experimental identification of the acoustic emission characteristics of large wind turbines, with emphasis on infrasound and low frequency noise. *Journal of the Korean Physical Society* 2008;53:1897-1905.
- ⁴¹ Leventhall G. On the overlap region between wind turbine infrasound and infrasound from other sources and its relation to criteria. Presentation at 6th International Conference on Wind

Turbine Noise, April 2015. Available (for purchase) from:
<http://www.proceedings.com/26771.html>. [Last accessed on 2016 July 15.]

- ⁴² Harrison JP. Wind turbine noise. *Bulletin of Science, Technology & Society* 2011;31:256-261.
- ⁴³ Janssen SA, Vos H, Eisses AR, Pedersen E. Predicting annoyance by wind turbine noise. Presentation at 2010 Internoise conference, June 2010. Available from: http://docs.wind-watch.org/Janssen_Predicting-annoyance.pdf. [Last accessed on 2016 July 20].
- ⁴⁴ Pedersen E, Persson Waye KP. Perception and annoyance due to wind turbine noise—a dose-response relationship. *Journal of the Acoustical Society of America* 2004;116:3460-3470.
- ⁴⁵ Van Renterghem T, Bockstael A, De Weirt V, Botteldooren D. Annoyance, detection and recognition of wind turbine noise. *Science of the Total Environment* 2013;456-7:333-345.
- ⁴⁶ Thorne B. The problems with “noise numbers” for wind farm noise assessment. *Bulletin of Science, Technology & Society* 2011;31:262-290.
- ⁴⁷ Hubbard HH. Noise induced house vibrations and human perception. *Noise Control Engineering Journal* 1982;19:49-55.
- ⁴⁸ Hubbard HH, Shepherd KP. Wind turbine acoustics. NASA Technical Paper 3057. December 1990. Available from: <http://hdl.handle.net/2060/19910007366>. [Last accessed on 2016 July 8].
- ⁴⁹ Thorne B. Wind farm noise and human perception: a review. April 2013. Available from: http://www.google.com/url?sa=t&ret=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0CC8QFjAB&url=http%3A%2F%2Fdocs.wind-watch.org%2FNMS-Wind-Farm-Noise-Human-Perception-April-2013.pdf&ei=vcprU_3KOZCFyQG-p4HYBA&usq=AFQjCNGJS5ylvcUMNXbqiy7IML7kMd_H7w&sig2=Ls0JpH4uFoSdfxYnlhz6Vg&bvm=bv.66330100,d.aWc. [Last accessed on 2016 July 8].
- ⁵⁰ Shepherd D, Hanning C, Thorne B. Noise: windfarms. In: Jorgensen SE, editor. *Encyclopedia of Environmental Management*. New York: Taylor & Francis Online; 2012. pp. 1-17.
- ⁵¹ Schomer P. Can wind turbine sound that is below the threshold of hearing be heard? Presentation at ICA 2013 Conference, June 2013. Available from: http://www.ica2013montreal.org/Proceedings/mss/040063_1.pdf. [Last accessed on 2016 July 20].
- ⁵² Schomer PD, Erdreich J, Boyle J, Pamidighantam P. A proposed theory to explain some adverse physiological effects of the infrasonic emissions at some wind farm sites. Presentation at 5th International Conference on Wind Turbine Noise, August 2013. Available from: <http://docs.wind-watch.org/Schomer-et-al-physiologic-effects-infrasound-wind.pdf>. [Last accessed on 2016 July 20].
- ⁵³ Lee S, Lee S, Lee, S. Numerical modeling of wind turbine aerodynamic noise in the time domain. *Journal of the Acoustical Society of America* 2013;133:94-100.

-
- ⁵⁴ Lichtenhan JT, Salt AN. Amplitude modulation of audible sounds by non-audible sounds: understanding the effects of wind turbine noise. Presentation at 2013 ICA conference, June 2013. *Journal of the Acoustical Society of America* 2013;133:3419. Available from: <http://oto2.wustl.edu/cochlea/LichtenhanAMASA.pdf>. [Last accessed on 2016 July 20].
- ⁵⁵ Minnesota Department of Health. Public health impacts of wind turbines. May 22, 2009. Available from: <http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf>. [Last accessed on 2016 July 20].
- ⁵⁶ Salt AN. Does the infrasound from wind turbines affect the inner ear? Presentation at Association for Research in Otolaryngology conference, February 2011. Available from: https://c.yimcdn.com/sites/aro.site-ym.com/resource/resmgr/Abstract_Archives/2011_Abstract_Book.pdf. Pp. 137-138. [Last accessed on 2016 July 20].
- ⁵⁷ Stigwood M, Large S, Stigwood D. Audible amplitude modulation: results of field measurements and investigations compared to psycho-acoustical assessment and theoretical research. Presentation in Denver, Colorado, August 2013. Available from: http://www.masenv.co.uk/uploads/WTN13_Stigwood_Presentation.pdf. [Last accessed on 2016 July 20].
- ⁵⁸ Taylor S. Report on the health impacts of wind farms: Shetland 2013 Summary. July 15, 2013. Available from: http://www.shb.scot.nhs.uk/board/publichealth/documents/Summary_Report_on_Health_Impacts_Wind_Farms.pdf. [Last accessed on 2016 July 20].
- ⁵⁹ Bray WR. Measurement and sound quality issues concerning low-frequency noise. Presentation at Noise-Con 2007 conference (Abstract). Available from: http://www.head-acoustics.de/downloads/messen/Noise-Con_2007_Measurement_and_SQ_WBray.pdf. [Last accessed on 2016 July 20].
- ⁶⁰ van den Berg GP. Effects on the wind profile at night on wind turbine sound. *Journal of Sound and Vibration* 2004;277:955-970.
- ⁶¹ Ambrose SE, Rand RW, Krogh ME. Wind turbine acoustic investigation: infrasound and low-frequency noise – a case study. *Bulletin of Science, Technology & Society* 2012;32:128-141.
- ⁶² Vasudevan RN, Gordon CG. Experimental study of annoyance due to low frequency environmental noise. *Applied Acoustics* 1977;10:57-69.
- ⁶³ Frey BJ, Hadden PJ. Wind turbines and proximity to homes: the impact of wind turbine noise on health. January 2012. Available from: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0CC8QFjAB&url=http%3A%2F%2Fdocs.wind-watch.org%2FFrey_Hadden_WT_noise_health_01Jan2012.pdf&ei=op9eU4aJCsJK2wXeyIDQCA&usq=AFQjCNHGxv6iq3RAc_CXS0KtVqKxdedzNw&sig2=hMEop9T4B7eFyX97B_36Fw&bvm=bv.65397613,d.b2U. [Last accessed on 2016 July 20].

-
- ⁶⁴ Farboud A, Crunkhorn R, Trinidad A. Wind turbine syndrome: fact or fiction? *Journal of Laryngology & Otology* 2013;127:222-226.
- ⁶⁵ Pedersen E, van den Berg F. Why is wind turbine noise poorly masked by road traffic noise? Internoise 2010 conference, June 2010. Available from: <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0CCQqFjAB&url=http%3A%2F%2Fwww.diva-portal.org%2Fsmash%2Fget%2Fdiva2%3A332207%2FFULLTEXT01.pdf&ei=sLJTVJeaNNCWyATQkIGoBA&usg=AFQjCNEyiBjgIjpCsq3ShXZAMUPdSP4rzQ&sig2=n3ZJBFNLUzT4dMjib-gghw&bvm=bv.78677474,d.aWw>. [Last accessed on 2016 July 20].
- ⁶⁶ Schomer PD. Comments on recently published article, "Concerns about infrasound from wind turbines." *Acoustics Today* 2013;9:7-9.
- ⁶⁷ Moorhouse A, Waddington D, Adams M. Proposed criteria for the assessment of low frequency noise disturbance. Report (NANR45) prepared for DEFRA, February 2005. Available from: <http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/quality/noise/research/lowfrequency/documents/nanr45-criteria.pdf>. [Last accessed on 2016 July 20].
- ⁶⁸ Swinbanks MA. Numerical simulation of infrasound perception, with reference to prior reported laboratory effects. Presentation at 2012 Internoise conference, August 2012. Available from: <http://docs.wind-watch.org/Internoise2012-Swinbanks.pdf>. [Last accessed on 2016 July 20].
- ⁶⁹ James RR. Untitled. ND. Available from: <http://www.windturbinesyndrome.com/wp-content/uploads/2014/07/How-Blade-pass-causes-infrasound-pulsations.pdf>. [Last accessed on 2016 July 8].
- ⁷⁰ Salt AN. Letter to Chairman of Association of Australian Acoustical Consultants. September 18, 2013. Available from: <https://s3.amazonaws.com/windaction/attachments/1998/Warpenius.pdf>. [Last accessed on 2016 September 5].
- ⁷¹ Berglund B, Lindvall T, Schwela DH (eds.), Guidelines for Community Noise. World Health Organization, April 1999. Available from: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB8QFjAAahUKEwjsqc_CnJPHAhXEi5IKHeJxANk&url=http%3A%2F%2Fwhqlibdoc.who.int%2Fhq%2F1999%2Fa68672.pdf&ei=RK3Cvez3A8SXygTi44HIDQ&usg=AFQjCNHq0SRjmXAXPKGPvQC88NtlGaJJBQ&bvm=bv.99261572,d.aWw&cad=rja. [Last accessed on 2016 July 20].
- ⁷² Ising H, Kruppa B. Health effects caused by noise: evidence in the literature from the past 25 years. *Noise & Health* 2004;6:5-13.
- ⁷³ Sørensen M, Andersen ZJ, Nordsborg RB, Jensen SS, Lillilund KG, Beelen R., et al. Road traffic noise and incident myocardial infarction: a prospective cohort study. *PLoS ONE* 2012;7(6):1-7.

-
- ⁷⁴ Harry A. Wind turbines, noise and health. February 2007. Available from: http://docs.wind-watch.org/wtnoise_health_2007_a_harry.pdf. [Last accessed on 2016 July 20].
- ⁷⁵ Phipps R, Amati M, McCoard S, Fisher R. Visual and noise effects reported by residents living close to Manawatu Wind Farms: preliminary survey results. ND. Available from: <http://docs.wind-watch.org/hipps-visualnoiseeffects.pdf>. [Last accessed on 2016 July 8].
- ⁷⁶ Phipps R. Evidence of Dr. Robyn Phipps, in the matter of Moturimu Wind Farm application, Palmerston North. March 2007. Available from: <http://docs.wind-watch.org/hipps-moturimutestimony.pdf>. [Last accessed on 2016 July 20].
- ⁷⁷ Horner B, James RR, Jeffery RD, McMurtry RY, Nissenbaum MA, White DL. Wind energy industry acknowledgement of adverse health effects: part 1 conclusion and executive summary. January 2010. Available from: http://co.wasco.or.us/planning/Energy/BOCC/New_Comments/after_2-15/swaim1_SWV_Critique_CANAWEA.pdf. [Last accessed on 2016 July 20].
- ⁷⁸ Horner B. Open letter to Prime Minister of Canada and others to request formally that representatives of CanWEA, the Government of Canada, Health Canada, and the Government of Ontario provide Canadians immediate and full disclosure of the health effects “conclusively demonstrated” from exposure to wind turbine noise. March 21, 2013. Available from: <https://mothersagainstturbines.files.wordpress.com/2013/09/request-stop-health-canada-experiment-on-canadians-march-21-2013.pdf>. [Last accessed on 2016 July 20].
- ⁷⁹ Phillips CV. An analysis of the epidemiology and related evidence on the health effects of wind turbines on local residents. Public Service Commission of Wisconsin, Docket no. 1-AC-231. July 3, 2010. Available from: <http://docs.wind-watch.org/Phillips-wind-turbines-and-health.pdf>. [Last accessed on 2016 July 8].
- ⁸⁰ Hanning C. Wind turbine noise, sleep and health. July 2010. Available from: http://www.acousticecology.org/wind/winddocs/health/Hanning%202010_Wind%20turbine%20noise%20sleep%20and%20health%20November%202010.pdf. [Last accessed on 2016 July 20].
- ⁸¹ Nissenbaum MA. Industrial wind turbines, human variability, and adverse health effects. NOCOEM Reporter, *New England College of Occupational and Environmental Medicine*. Fall 2013;2(38). Available from: http://www.necoem.org/documents/V2_38e.pdf. [Last accessed on 2016 July 20].
- ⁸² Ellenbogen JM, Grace S, Heiger-Bernays WJ, Manwell JF, Mills DA, Sullivan KA, et al. Wind Turbine Health Impact Study. Report prepared for Massachusetts Department of Environmental Protection. January 2012. Available from: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCMQFjAA&url=http%3A%2F%2Fwww.mass.gov%2Feea%2Fdocs%2Fdep%2Fenergy%2Fwind%2Fturbine-impact-study.pdf&ei=wSw0VMjCDoz_yQTRpILoAQ&usg=AFQjCNEdk-4087qFICDXRnPB2mXjV5MU1Q&bvm=bv.76943099,d.aWw. [Last accessed on 2016 July 20].

-
- ⁸³ Kamperman GW, James RR. The “how to” guide to criteria for siting wind turbines to prevent health risks from sound. October 28, 2008. Available from: <http://www.windturbinesyndrome.com/wp-content/uploads/2008/11/kamperman-james-10-28-08.pdf>. [Last accessed on 2016 July 20].
- ⁸⁴ Hanning C. Comments on wind turbine health impact study: report of independent expert panel. ND. Available from: <http://docs.wind-watch.org/MassDEP-wind-health-1-Hanning.pdf>. [Last accessed on 2016 July 26].
- ⁸⁵ Hartman RS. Statement of Dr. Raymond S. Hartman presented to the zoning board of Charlestown, Rhode Island, Critique of the Massachusetts Department of Environmental Planning (DEP) “Wind Turbine Health Impact Study, Report of Independent Expert Panel.” January 2012. Available from: <https://www.wind-watch.org/docviewer.php?doc=Hartman-Mass-DEP-study-RI-130605.pdf>. [Last accessed on 2016 July 20].
- ⁸⁶ Schomer P, Pamidighantam P. A critical analysis of Wind Turbine Health Impact Study: report of independent expert panel. Presentation at 166th meeting of Acoustical Society of America, December 2013. Available from: <http://scitation.aip.org/deliver/fulltext/asa/journal/poma/20/1/1.4870639.pdf?itemId=/content/asa/journal/poma/20/1/10.1121/1.4870639&mimeType=pdf&containerItemId=content/asa/journal/poma>. [Last accessed on 2016 July 20].
- ⁸⁷ Shahan, Z. Wind Turbine Syndrome... not! Available from: <http://cleantechnica.com/2012/12/27/wind-turbine-syndrome-not/>. December 27, 2012. [Last accessed on 2016 July 20].
- ⁸⁸ Hanning CD, Evans A. Wind turbine noise. *British Medical Journal* 2012;344:1-2.
- ⁸⁹ Bakker RH, Pedersen E, van den Berg GP, Stewart RE, Lok W, Bouma J. Impact of wind turbine sound on annoyance, self-reported sleep disturbance and psychological distress. *Science of the Total Environment* 2012;425:42–51.
- ⁹⁰ Frey BJ, Hadden PJ. Noise radiation from wind turbines installed near homes: effects on health. February 2007. Available from: <http://waubrafoundation.org.au/wp-content/uploads/2014/06/Frey-Hadden-Noise-Radiation-fro-Wind-Turbines-Installed-Near-Homes.pdf>. [Last accessed on 2016 July 20].
- ⁹¹ Havas M, Colling D. Wind turbines make waves: why some residents near wind turbines become ill. *Bulletin of Science, Technology & Society* 2011;31:414–426.
- ⁹² Jeffery RD, Krogh C, Horner B. Adverse health effects of industrial wind turbines. *Canadian Family Physician* 2013;59:473-475.
- ⁹³ Jeffery RD, Krogh CME, Horner B. Industrial wind turbines and adverse health effects. *Canadian Journal of Rural Medicine* 2014;19:21-26.
- ⁹⁴ Krogh C. Risk of harm to children and industrial wind turbines: health and social-economic impacts in Canada, Health Canada Wind Turbine Noise and Health Study. December 27, 2012.

Available from:

http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB0QFjAA&url=http%3A%2F%2Fwepat.files.wordpress.com%2F2013%2F05%2Fhealth-canada_risks-to-children-december-27-2012-final.pdf&ei=Lp2tU862N4W2yAT6kYDwDQ&usg=AFQjCNGeq2a21hWue4rFj3f4817L8nvQ5g&sig2=fTWlBMrlj6KwvfzeNnVtQQ&bvm=bv.69837884,d.aWw. [Last accessed on 2016 July 20].

- ⁹⁵ Krogh CME, Gillis L, Kouwen N, Aramini J. WindVOiCe, a self-reporting survey: adverse health effects, industrial wind turbines, and the need for vigilance monitoring. *Bulletin of Science, Technology & Society* 2011;31:334-335.
- ⁹⁶ Krogh CME, Jeffery RD, Aramini J, Horner B. Wind turbines can harm humans: a case study. Presentation at 2012 Internoise conference, August 2012. Available from: [http://docs.wind-watch.org/Krogh et al. - Wind Turbines - Risk of Harm.pdf](http://docs.wind-watch.org/Krogh%20et%20al.%20-%20Wind%20Turbines%20-%20Risk%20of%20Harm.pdf). [Last accessed on 2016 July 20].
- ⁹⁷ Nissenbaum MA, Aramini JJ, Hanning CD. Effects of industrial wind turbine noise on sleep and health. *Noise & Health*, 2012;14:237-243.
- ⁹⁸ Pedersen, E. Effects of wind turbine noise on humans. Presentation at Third International Meeting on Wind Turbine Noise, June 2009. Available from: <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAA&url=http%3A%2F%2Fwww.diva-portal.org%2Fsmash%2Fget%2Fdiva2%3A240110%2FFULLTEXT01.pdf&ei=crJTVOWIFpP3yQTomYCIBw&usg=AFQjCNGWc9olvAaMXMa-Ih7gi3yK9DAHUA&sig2=UBo9Smw5E7w3xJFYx01hbg&bvm=bv.78677474,d.aWw>. [Last accessed on 2016 July 20].
- ⁹⁹ Pedersen E. Health aspects associated with wind turbine noise—results from three field studies. *Noise Control Engineering Journal* 2011;59:47-53.
- ¹⁰⁰ Pierpont N. Wind Turbine Syndrome and the brain. Keynote address at First International Symposium on the Global Wind Industry and Adverse Health Effects: Loss of Social Justice?, November 15, 2010. Available from: <http://www.windturbinesyndrome.com/img/WTSbrain-color.pdf>. [Last accessed on 2016 July 20].
- ¹⁰¹ Punch J, James R, Pabst D. Wind turbine noise: what audiologists should know. *Audiology Today* 2010:20-31.
- ¹⁰² Roberts JD, Roberts MA. Wind turbines: is there a human health risk? *Journal of Environmental Health* 2013;75: 8-13, 16-17.
- ¹⁰³ Shepherd D, Billington R. Mitigating the acoustic impacts of modern technologies: acoustic, health, and psychosocial factors informing wind farm placement. *Bulletin of Science, Technology & Society* 2011;31:389-398.
- ¹⁰⁴ Shepherd D, McBride D, Welch D, Dirks KN, Hill EM. Evaluating the impact of wind turbine noise on health-related quality of life. *Noise & Health* 2011;13:333-339.

-
- ¹⁰⁵ Timmerman NS. Wind turbine noise. *Acoustics Today* 2013;9:22-29.
- ¹⁰⁶ Abbasi M, Monnazzam MR, Zakerian SA, Yousefzadeh A. Effect of wind turbine noise on workers' sleep disorder: a case study of Manjil Wind Farm in Northern Iran. *Fluctuation and Noise Letters* 2015;14(2):1-15.
- ¹⁰⁷ Abbasi M, Monazzam MR, Akbarzadeh A, Zakerian SA, Ebrahimi MH. Impact of wind turbine sound on general health, sleep disturbance and annoyance of workers: a pilot-study in Manjil wind farm, Iran. *Journal of Environmental Health Science & Engineering* 2015;13:71-79.
- ¹⁰⁸ Persson Waye KP, Clow A, Edwards S, Hucklebridge F, Rylander R. Effects of low frequency noise on the cortisol response to awakening and subjective sleep quality. *Life Sciences* 2003;72:863-875.
- ¹⁰⁹ Bronzaft AL. The noise from wind turbines: potential adverse impacts on children's wellbeing. *Bulletin of Science, Technology & Society* 2011;31:291-295.
- ¹¹⁰ Fiumicelli D. Wind farm noise dose response. *Acoustics Bulletin* November/December 2011:26-35.
- ¹¹¹ Physicians for Human Rights. Leave no marks: enhanced interrogation techniques and the risk of criminality. August 2007. Available from: https://s3.amazonaws.com/PHR_Reports/leave-no-marks.pdf. [Last accessed on 2016 July 20].
- ¹¹² Kasprzak C. The influence of infrasound noise from wind turbines on EEG signal patterns in humans. *Acoustic and Biomedical Engineering* 2014;125:A-20-A23.
- ¹¹³ Paller C, Bigelow P, Majowicz S, Law J, Christidis T. Wind turbine noise, sleep quality, and symptoms of inner ear problems. Presentation at Symposia of the Ontario Research Chairs in Public Policy. ND. Available from: http://docs.wind-watch.org/Paller_Poster_15Oct2013.pdf. [Last accessed on 2016 July 20].
- ¹¹⁴ Howe Gastmeier Chapnik Limited. Low frequency noise and infrasound associated with wind turbine generator systems: a literature review. December 10, 2010. Ontario Ministry of the Environment RFP No. OSS-078696. Available from: <https://dr6j45jk9xcmk.cloudfront.net/documents/1160/88-noise-and-wind-turbine-generator-systems-en.pdf>. [Last accessed on 2016 July 20].
- ¹¹⁵ Pawlaczyk-Luszczyńska M, Dudarewicz A, Waszkowska M, Szymczak W, Śliwińska-Kowalska M. The impact of low frequency noise on human mental performance. *International Journal of Occupational Medicine and Health* 2005;18(2):185-198.
- ¹¹⁶ Rand RW, Ambrose SE, Krogh ME. Occupational health and industrial wind turbines: a case study. *Bulletin of Science, Technology & Society* 2011;31:359-362.
- ¹¹⁷ Palmer W. Wind turbine sound prediction – the consequence of getting it wrong. Presentation at ICA 2013 meeting of Acoustical Society of America, June 2013. Available from: <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0CDUQFjAC&u>

rl=http%3A%2F%2Fs3.amazonaws.com%2Fwindaction%2Fattachments%2F1791%2FPMA040066_Palmer.pdf&ei=E12RUsyLFIS2rQHp-oDYAQ&usg=AFQjCNGQ45VRuryLV19x2-T81J8z3qdukQ&bvm=bv.56988011,d.aWM. [Last accessed on 2016 July 20].

¹¹⁸ Castelo Branco NAA, Alves-Pereira M. Vibroacoustic disease. *Noise & Health* 2004;6(23):3–20.

¹¹⁹ Castelo Branco NA. The clinical stages of vibroacoustic disease. *Aviation, Space, and Environmental Medicine* 1999;70(3, Pt 2):A32-39.

¹²⁰ Kennedy RS, Allgood GO, Van Hoy BW, Lilienthal MG. Motion sickness symptoms and postural changes following flights in motion-based flight trainers. *Journal of Low Frequency Noise and Vibration* 1987;6(4):147-153.

¹²¹ von Gierke HE, Parker DE. Differences in otolith and abdominal viscera graviceptor dynamics: implications for motion sickness and perceived body position. *Aviation, Space, and Environmental Medicine* 1994;65:747-751.

¹²² Berger RG, Ashtiani P, Ollson CA, Whitfield Aslund M, McCallum LC, Leventhall G, et al. Health-based audible noise guidelines account for infrasound and low-frequency noise produced by wind turbines. *Frontiers in Public Health* 2015;3:1-14.

¹²³ Carey J, Amin N. Evolutionary changes in the cochlea and labyrinth: solving the problem of sound transmission to the balance organs of the inner ear. *The Anatomical Record Part A*, 2006;288A:482-90.

¹²⁴ Persinger MA. Infrasound, human health, and adaptation: an integrative overview of recondite hazards in a complex environment. *Natural Hazards* 2013;70:501-525.

¹²⁵ Salt AN. Infrasound: your ears “hear” it but they don't tell your brain. Presentation at Symposium on Adverse Health Effects of Industrial Wind Turbines. Available from: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCcQFjAA&url=http%3A%2F%2Ffoto2.wustl.edu%2Fcochlea%2FWTPicton_salt_final.pdf&ei=H1hqU7XUA4iyyATMpoGoBQ&usg=AFQjCNHzz_0mBFhOP1GKgv4b0ncCC_iW7g&sig2=UxKESjK4Yr-lulkP7o2xmQ&bvm=bv.66111022,d.aWc. [Last accessed on 2016 July 20].

¹²⁶ Salt AA, Hullar TE. Responses of the ear to low-frequency sounds, infrasound and wind turbines. *Hearing Research* 2010;268:12-21.

¹²⁷ Salt AN, Lichtenhan JT. How does wind turbine noise affect people? *Acoustics Today* 2014;10:20-28.

¹²⁸ Salt AN, Kaltenbach JA. Infrasound from wind turbines could affect humans. *Bulletin of Science, Technology & Society* 2011;31:296-302.

¹²⁹ Salt AN, Lichtenhan JT. Responses of the inner ear to infrasound. Presentation at Fourth International Meeting on Wind Turbine Noise, April 2011. Available from: <http://oto2.wustl.edu/cochlea/saltlichtenhan.pdf>. [Last accessed on 2016 July 20].

-
- ¹³⁰ Salt AN, Lichtenhan JT. Perception-based protection from low-frequency sounds may not be enough. Presentation at 2012 Internoise conference, August 2012. Available from: <http://oto2.wustl.edu/cochlea/saltlichtenhaninternoise2012.pdf>. [Last accessed on 2016 July 20].
- ¹³¹ Salt AN, Lichtenhan JT, Gill RM, Hartsock JJ. Large endolymphatic potentials from low-frequency and infrasonic tones in the guinea pig. *Journal of the Acoustical Society of America* 2013;133:1561-1571.
- ¹³² Salt AN. Wind Turbines can be hazardous to human health. Available from: http://www.google.com/url?sa=t&ret=j&q=&esrc=s&source=web&cd=1&ved=0CCcQFjAA&url=http%3A%2F%2Foto2.wustl.edu%2Fcochlea%2Fwind.html&ei=PSl6U-flMledqAbWIYLIaw&usq=AFQjCNE7m2g3uKmdL4OgN4es_-gymFbe-g&sig2=a8SmsvCVRQ2lb_TC4Idjfw&bvm=bv.66917471,d.b2k&cad=rja. [Last accessed on 2016 July 20].
- ¹³³ Oohashi T, Nishina E, Honda M, Yonekura Y, Fuwamoto Y, Kawai N., et al. Inaudible high-frequency sounds affect brain activity: hypersonic effect. *Journal of Neurophysiology* 2000; 83:3548-3558.
- ¹³⁴ Bauer M, Sander-Thömmes T, Ihlenfeld A, Kühn S, Kühler R, Koch C. Investigation of perception at infrasound frequencies by functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG). Presentation at 22nd International Congress on Sound and Vibration. Available from: https://stopthesethings.files.wordpress.com/2015/07/full_paper_koch-v2-1.pdf. [Last accessed on 2016 July 14.]
- ¹³⁵ He M, Krahé D. EEG reaction under low frequency noise exposure. Presentation at 22nd International Congress on Sound and Vibration. Available from: <http://waubrafoundation.org.au/wp-content/uploads/2016/02/He-Krahe-EEG-Reaction-Under-Low-Frequency-Noise-Exposure.pdf>. [Last accessed on 2016 July 15.]
- ¹³⁶ Kugler K, Wiegerebe L, Grothe B, Kössl M, Gürkov R, Krause E, et al. Low-frequency sound affects active micromechanics in the human inner ear. *Royal Society Open Science* October 2014. Available from: <http://dx.doi.org/10.1098/rsos.140166>. [Last accessed on 2016 July 20].
- ¹³⁷ Kemp DT. Stimulated acoustic emissions from within the human auditory system. *Journal of the Acoustical Society of America* 1978;64:1386-1391.
- ¹³⁸ Schomer PD, Erdreich J, Pamidighantam PK, Boyle JH. A theory to explain some physiological effects of the infrasonic emissions at some wind farm sites. *Journal of the Acoustical Society of America* 2015;137:1356-1365.
- ¹³⁹ Michaud DS, Feder K, Keith SE, Voicescu SA, Marro L, Than J, et al. Effects of wind turbine noise on self-reported and objective measures of sleep. *Sleep* 2016;39(1):97-109.
- ¹⁴⁰ Michaud D. Health and well-being related to wind turbine noise exposure: Summary of results. *Journal of the Acoustical Society of America* 2015;137:2368.

-
- ¹⁴¹ Michaud DS, Feder K, Keith SE, Voicescu SA, Marro L, Than J, et al. Exposure to wind turbine noise: perceptual responses and reported health effects. *Journal of the Acoustical Society of America* 2016;139:1443-1454.
- ¹⁴² Michaud DS, Keith SE, Feder K, Voicescu SA, Marro L, Than J, et al. Personal and situational variables associated with wind turbine noise annoyance *Journal of the Acoustical Society of America* 2016;139:1455-1466.
- ¹⁴³ Michaud DS, Feder K, Keith SE, Voicescu SA, Marro L, Than J, et al. Self-reported and measured stress related responses associated with exposure to wind turbine noise. *Journal of the Acoustical Society of America* 2016;139:1467-1479.
- ¹⁴⁴ Voicescu SA, Michaud DS, Feder K, Marro L, Than J, Guay M, et al. Estimating annoyance to calculated wind turbine shadow flicker is improved when variables associated with wind turbine noise exposure are considered. *Journal of the Acoustical Society of America* 2016;139:1480-1492.
- ¹⁴⁵ Michaud DS. An evaluation of how nightly variations in wind turbine noise levels influence wrist actigraphy measured sleep patterns. *Journal of the Acoustical Society of America* 2016;139:2150.
- ¹⁴⁶ Pedersen E, van den Berg F, Bakker R, Bouma J. Response to noise from modern wind farms in The Netherlands. *Journal of the Acoustical Society of America* 2009;126:634-643.
- ¹⁴⁷ Position of the National Institute of Public Health – National Institute of Hygiene on wind farms. March 8, 2016. Available from: <http://en.friends-against-wind.org/health/position-of-the-polish-public-health-institute-on-wind-farms>. [Last accessed on 2016 July 14.]
- ¹⁴⁸ Knopper LD, Ollson CA, McCallum LC, Whitfield Aslund ML, Berger RG, Souweine K, McDaniel M. Wind turbines and human health. *Frontiers in Public Health* 2014;19.
- ¹⁴⁹ Pedersen E, Persson Waye KP. Wind turbine noise, annoyance and self-reported health and wellbeing in different living environments. *Occupational and Environmental Medicine* 2007;64(7):480-486.
- ¹⁵⁰ Tempest W. Loudness and annoyance due to low frequency sound. *Acustica* 1973;29: 205-209.
- ¹⁵¹ Bastasch M, van Dam J, Søndergaard B, Rogers A. Wind turbine noise: an overview. *Canadian Acoustics* 2006;34:7-15.
- ¹⁵² Ruotolo F, Senese VP, Ruggiero G, Maffei L, Masullo M, Iachin T. Individual reactions to a multisensory immersive virtual environment: the impact of a wind farm on individuals. *Cognitive Processing* 2012; Suppl 1, S319-23.
- ¹⁵³ Rylander R. Physiological aspects of noise-induced stress and annoyance. *Journal of Sound and Vibration* 2004;277:471-478.

-
- ¹⁵⁴ Fast S, Mabee W, Baxter J, Christidis T, Driver L, Hill S, et al. Lessons learned from Ontario wind energy disputes. *Nature Energy* 2016. Available from: <http://www.nature.com/articles/nenergy201528>. [Last accessed on 2016 July 18.]
- ¹⁵⁵ McCallum LC, Whitfield Aslund ML, Knopper LD, Ferguson GM, Ollson CA. Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern? *Environmental Health* 2014;13:1-6.
- ¹⁵⁶ Rössli M. Radiofrequency electromagnetic field exposure and non-specific symptoms of ill health: a systematic review. *Environmental Research* 2008;107(2):277-287.
- ¹⁵⁷ Rubin GJ, Das Munshi J, Wessely S. Electromagnetic hypersensitivity: a systematic review of provocation studies. *Psychosomatic Medicine* 2005;67(2):224-232.
- ¹⁵⁸ Fletcher H, Munson WA. Loudness, its definition, measurement and calculation. *Journal of the Acoustical Society of America* 1933;5:82-108.
- ¹⁵⁹ Pedersen E, Persson Wayne KP. Wind turbines—low level noise sources interfering with restoration? *Environmental Research Letters* 2008;3:1-5.
- ¹⁶⁰ Bray W. Relevance and applicability of the soundscape concept to physiological or behavioral effects caused by noise at very low frequencies which may not be audible. Presentation at 164th meeting of Acoustical Society of America, October 2012. Available from: http://acoustics.org/pressroom/httpdocs/164th/Bray_2aNS6.html. [Last accessed on 2016 July 20].
- ¹⁶¹ McMurtry RY. Toward a case definition of adverse health effects in the environs of industrial wind turbines: facilitating a clinical diagnosis. *Bulletin of Science, Technology & Society* 2011; 31:316-320.
- ¹⁶² McMurtry RY, Krogh CME. Diagnostic criteria for adverse health effects in the environs of wind turbines. *Journal of the Royal Society of Medicine Open* 2014;5:1-5.
- ¹⁶³ McCunney RJ, Morfeld P, Colby WD, Mundt KA. Wind turbines and health: An examination of a proposed case definition. *Noise & Health* 2015;17:175-181.
- ¹⁶⁴ Halperin A. Big wind is better than big oil, but just as bad at P.R. June 15, 2014. Available from: <https://newrepublic.com/article/118138/big-wind-needs-address-wind-turbine-syndrome>. [Last accessed on 2016 July 20].
- ¹⁶⁵ Berglund B, Hassmen P, Soames Job RF. Sources and effects of low-frequency noise. *Journal of the Acoustical Society of America* 1996;99:2985-3002.
- ¹⁶⁶ ISO 1996-1:2016. Acoustics—Description, measurement and assessment of environmental noise—Part 1: Basic quantities and assessment procedures. Available from: http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=59765. [Last accessed on 2016 July 11].

-
- ¹⁶⁷ ANSI/ASA S12.9—2005/Part 4 (R2015). Quantities and procedures for description and measurement of environment sound—Part 4: Noise assessment and prediction of long-term community response. Available from: [http://webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2fASA+S12.9-2005%2fPart+4+\(R2015\)](http://webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2fASA+S12.9-2005%2fPart+4+(R2015)). [Last accessed on 2016 July 11].
- ¹⁶⁸ Hill AB. The environment and disease: association or causation? *Proceedings of the Royal Society of Medicine* 1965;58:295-300.
- ¹⁶⁹ Phillips CV. Properly interpreting the epidemiologic evidence about the health effects of industrial wind turbines on nearby residents. *Bulletin of Science, Technology & Society* 2011;31:303-315.
- ¹⁷⁰ World Health Organization Health topics: epidemiology. Available from: <http://www.who.int/topics/epidemiology/en/>. [Last accessed on 2016 July 20].
- ¹⁷¹ Songer T. Basic epidemiology: study designs in epidemiologic research. Available from: <http://www.google.com/url?sa=t&ret=j&q=&esrc=s&source=web&cd=2&ved=0CCsQFjAB&url=http%3A%2F%2Fwww.pitt.edu%2F~super7%2F19011-20001%2F19101.ppt&ei=LRibU4PAPMyiATpioGwDQ&usg=AFQjCNG5R1wNMj3ipEws4rzLaG7kHvH0CQ&sig2=T1hDZwtlnN7BGvsvpClfgQ&bvm=bv.68911936,d.aWw&cad=rja>. [Last accessed on 2016 July 20].
- ¹⁷² University of Ottawa. Society, the individual and medicine: study designs. Available from: http://www.med.uottawa.ca/sim/data/Study_Designs_e.htm. [Last accessed on 2016 July 20].
- ¹⁷³ Chapman S, St. George A, Waller K, Cakic V. The pattern of complaints about Australian wind farms does not match the establishment and distribution of turbines: support for the psychogenic, 'Communicated Disease' hypothesis. *PLoS ONE* 2013;8(10). Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3797792/>. [Last accessed on 2016 July 20].
- ¹⁷⁴ Crichton F, Dodd G, Schmid G, Gamble G, Petrie KJ. Can expectations produce symptoms from infrasound associated with wind turbines? *Health Psychology* 2013;33:360-364.
- ¹⁷⁵ Punch J. Review of Crichton et al. (Can expectations produce symptoms from infrasound associated with wind turbines?). March 28, 2013. Available from: <http://www.wind-watch.org/documents/review-of-crichton-et-al-can-expectations-produce-symptoms-from-infrasound-associated-with-wind-turbines/>. [Last accessed on 2016 July 20].
- ¹⁷⁶ Williams T. The effects of expectations on perception: experimental design issues and further evidence. Working paper series, Federal Reserve Bank of Boston, No. 07-14. Available from: <http://www.bostonfed.org/economic/wp/wp2007/wp0714.pdf>. [Last accessed on 2016 July 20].
- ¹⁷⁷ Crichton F, Dodd G, Schmid G, Gamble G, Cundy T, Petrie KJ. The power of positive and negative expectations to influence reported symptoms and mood during exposure to wind farm sound. *Health Psychology* 2013; 33:1588-1592.

-
- ¹⁷⁸ Chen HA, Narins P. Wind turbines and ghost stories: the effects of infrasound on the human auditory system. *Acoustics Today* 2012;8:51-56.
- ¹⁷⁹ Tonin R, Brett J, Colagiuri B. The effect of infrasound and negative expectations to adverse pathological symptoms from wind farms. *Journal of Low Frequency Noise, Vibration and Active Control* 2016;35(1);77-90.
- ¹⁸⁰ Taylor J, Eastwick C, Wilson R, Lawrence C. The influence of negative oriented personality traits on the effects of wind turbine noise. *Personality and Individual Differences* 2013;54:338-343.

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