

Presentation Topic: Informational Resources to Address and Rebut Adversarial Claims about Wind Projects

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Synopsis:

It is not uncommon for proposed wind projects to encounter localized opposition. People objecting to wind projects have ready access to adversarial information claiming a variety of negative consequences from wind energy facilities. The same issues and associated information sources continue to be circulated, even if they are not supported by sound scientific evidence. One similarity shared by many of the information sources offering so-called 'authoritative information' is a tendency to rely on inflammatory language, hyperbole, innuendo, and selective quotation and/or misquotation of other sources. Some resort to hints about conspiracy theories and government cover-ups when presented with large amounts of scientifically based information contrary to their positions. The recent development and popularity of social media and internet-based forums has only broadened the audience and appeal of citing fringe science and junk science sources as authoritative.

This presentation identifies some key assertions that commonly occur during wind project development, permitting and environmental review, and lists some reliable sources of scientifically based information that can be consulted to attempt to address these assertions, or at least to become familiar with technical information that can be incorporated into rebuttal positions.

The general categories of adversarial claims addressed in this presentation are:

- Sound (Wind Turbine Operational Noise)
- Medical Issues
- Physical Danger/Safety Risks
- Property Values
- Environmental Issues (Biological Impacts)

Background and Approach

Tetra Tech EC, Inc. received a request from program co-chair Rich Rayhill to conduct research for the above concept and compile lists of applicable information sources to address the issues.

Our results represent the product of a short-term, small-scale effort (i.e., a small group of generalist contributors with concurrent project responsibilities, rather than an integrated team of specialists dedicated to this work as a primary assignment) to provide some usable tools.

- We do not consider this to be the ultimate or all-inclusive set of information sources to address these issues, but it's a fair start to a sizable task. We have no doubt that there are additional valid sources that we have not identified yet for some or all of the issue categories. We also expect to see lots of new material, as well as tons of rehashed old material, addressing both sides of these topics in the future.

- We have not thoroughly investigated each source identified, and therefore are not claiming that we have confirmed the accuracy and validity of each item.
- We have not used the information contained in these sources to construct the ideal rebuttal argument for each issue or adversarial claim.

Some Useful General References and Sources

National Renewable Energy Laboratory. NREL Publications Database. <<http://www.nrel.gov/publications/>>

An Archive of Articles on Wind Energy, Electricity Feed Laws, & Other Topics Compiled by Paul Gipe – topics include Wind Power; Medium and Large Wind Turbines; General; Wind Statistics; Economic Calculations; Accidents & Safety; and Reviews. <http://www.wind-works.org/articles/large_turbines.html>

AWEA (American Wind Energy Association) Wind Energy Fact Sheets. <http://www.awea.org/la_pubs_factsheets.cfm>

Sound (Wind Turbine Operational Noise)

Issue/Claim:

Most often this issue relates to sound that is audible to the human ear, which is the type of noise that is regulated and measured under most federal, state, and local jurisdictions. However, lower frequency noise or infrasound overlaps with audible sound levels, and carries over into the medical category as well. We concentrated our reference search for Sound of the human auditory range. We have references also under Medical and vice versa.

Applicable Rebuttal Information Sources:

AWEA. 2010. Utility Scale Wind Energy and Sound. American Wind Energy Association fact sheet. <http://www.awea.org/documents/factsheets/Utility_Scale_Wind_Energy_Sound.pdf>

Lawrence Technological University. Primer for Addressing Wind Turbine Noise. Revised Oct. 2006. <<http://www.maine.gov/doc/mfs/windpower/pubs/pdf/AddressingWindTurbineNoise.pdf>>

"Wind Turbine Facilities Noise Issues" by Dr. Ramani Ramakrishnan for the Ontario Ministry of the Environment. <http://www.downloads.ene.gov.on.ca/envision/env_reg/er/documents/2008/Noise%20Report.pdf>

"Wind Turbine Acoustic Noise," A White Paper by Dr. Anthony Rodgers, James F. Manwell, and Sally Wright, at the University of Massachusetts at Amherst. January 2006. <http://www.ceere.org/rerl/publications/whitepapers/Wind_Turbine_Acoustic_Noise_Rev2006.pdf>

"Research into Aerodynamic Modulation of Wind Turbine Noise," University of Salford, UK, July 2007. <http://usir.salford.ac.uk/1554/1/Salford_Uni_Report_Turbine_Sound.pdf>

Bastach, M. 2009. "Wind Turbine Sound." CH2M HILL. Presented at State of the Art in Wind Siting seminar. October 20-21, Washington, D.C. <http://www.nationalwind.org/assets/blog/Bastach_WindTurbine_Final.pdf>

British Wind Energy Association. Noise from Wind Turbines—The Facts. Prepared with assistance from the Hayes McKenzie Partnership, Consultants in Acoustics, Southampton and Machynlleth. <<http://www.bwea.com/pdf/noise.pdf>>

Kaliski, K. 2009. "Calibrating Sound Propagation Models for Wind Power Projects." Resource Systems Group Inc. Presented at State of the Art in Wind Siting seminar. October 20-21, Washington, D.C.
<http://www.nationalwind.org/assets/blog/Kaliski_Wind_Siting_2009.pdf>

Punch, J., R. James, and D. Pabst. "Wind Turbine Noise: What Audiologists Should Know." 2010. Audiology Today, July/August.
<<http://www.windaction.org/documents/28110>>

Søndergaard, B. 2009. "Noise from Wind Turbines: What is new?" DELTA Danish Electronics, Light & Acoustics. Presented at State of the Art in Wind Siting seminar. October 20-21, Washington, D.C.
<http://www.nationalwind.org/assets/blog/Sondergaard_BsG_DELTA_c.pdf>

The Working Group on Wind Turbine Noise. 1996. The Assessment and Rating of Noise from Wind Farms. ETSU-R-97.
<<http://web.archive.nationalarchives.gov.uk/+http://www.berr.gov.uk/energy/sources/renewables/explained/wind/onshore-offshore/page21743.html>>

British Wind Energy Association. 2005. Low Frequency Noise and Wind Turbines. BWEA Briefing Sheet.
<<http://www.bwea.com/ref/lowfrequencynoise.html>>

Defra. 2003. A Review of Published Research on Low Frequency Noise and its Effects. Report for Defra by Dr Geoff Leventhall, Assisted by Dr Peter Pelmeare and Dr Stephen Benton.
<<http://www.defra.gov.uk/environment/noise/lowfrequency/pdf/lowfreqnoise.pdf>>

Medical Issues

Medical issues encompass a very broad spectrum of ailments, complaints and conditions, allegedly triggered by exposure to one or more elements related to wind farms, which deserve some introductory discussion here. Some of the elements of exposure most often cited include various forms of energy emitted from wind farms such as low frequency noise, infrasound, audible sound, shadow-flicker, and electric and magnetic fields (EMF) from electrical systems and equipment.

Infrasound is the most frequently cited source that causes medical issues. Here is a passage from Rodgers, Manwell, and Wright (2006) of the University of Massachusetts at Amherst that describes its effects:

The primary human response to perceived infrasound is annoyance, with resulting secondary effects. Annoyance levels typically depend on other characteristics of the infrasound, including intensity, variations with time, such as impulses, loudest sound, periodicity, etc. Infrasound has three annoyance mechanisms:

- A feeling of static pressure
- Periodic masking effects in medium and higher frequencies
- Rattling of doors, windows, etc. from strong low frequency components

Generalized categories of complaints with medical issues include sleep disturbance, induced annoyance, and increased stress. Some of the described physical and psychological symptoms associated with the above complaints include inner ear problems; vestibular stimulation, cardiac concerns such as arrhythmias, tachycardia, and palpitations; headaches; cognitive and mood disturbances; and acute hypertensive episodes. In the extreme, there are claims of triggering epileptic seizures in individuals with a photosensitivity to lights with a strobe effect.

Issue/Claim:

Wind Turbine Syndrome

Dr. Nina Pierpont of Malone, New York has gained widespread attention for claiming that wind energy facilities can cause a variety of adverse health effects, which she has termed "Wind Turbine Syndrome," for individuals living in proximity to wind turbines. Dr. Pierpont has published a book in 2009 by that same title, speaks often and authoritatively on her thesis, and her claims are described at her website: <<http://www.windturbinesyndrome.com/>>. From her website, the sales pitch for her book is as follows:

...explains in simple, layman's terms how turbine infrasound and low frequency noise (ILFN) create the seemingly incongruous constellation of symptoms she has christened Wind Turbine Syndrome. (Incongruous only to the non-clinician who does not understand Mother Nature's organs of balance, motion, and position sense.)

Also, here is a sample of the language used by one of her book's reviewers, Jon Boone, Ph.D., Maryland, USA:

Massive wind technology produces a relentless fusillade of pulsating sound, mechanical in pattern, audible to all and intolerable to many, particularly those sensitive to infrasound vibrations.

Post-book publishing,

...she has heard from people around the world who are discovering that **Wind Turbine Syndrome is not confined to living in the shadow of industrial wind turbines. It turns out people suffer identical symptoms from living close to natural gas compressor stations, industrial sewage pumping stations, and other power plants.** In each case, low frequency noise and infrasound appear to be the chief disease-causing culprit—basically, Wind Turbine Syndrome without the turbines."

Health Effects and Health-based Setbacks, Health Self-Surveys

The following source (The Society for Wind Vigilance), which claims to be about "Promoting Research for Authoritative Wind Turbine Guidelines" is a Canadian group critical of claims or studies by others that wind power sound from wind turbines does not pose a risk of hearing loss or any other adverse health effect in humans. "A Primer on Adverse Health Effects and Industrial Wind Turbines." March, 2010. Prepared by the Society for Wind Vigilance: <<http://www.windvigilance.com/page002.aspx>>

On its website, the Society for Wind Vigilance hosts a "self-survey" called "WindVOiCe[®]" to collect data from individuals claiming to suffer effects from wind turbines. This is the stated goal of WindVOiCe[®]:

WindVOiCe® is a community based, self reporting health survey that collects data about the adverse health effects being experienced by families living near industrial wind turbines. The WindVOiCe® health survey follows the principles of Health Canada's Canada Vigilance, which encourages all consumers in Canada to self report suspected adverse health effects from consumer and prescription products. Consumers do not have to prove the effect, only suspect it.

In addition to data about symptoms experienced, they also collect testimonials and comments. These are the types of data and subject information that the online-based survey collects from people:

- Age
- Gender
- Occupation
- Distance from turbine
- Time at property
- Health altered
- Headaches
- Palpitations
- Excessive tiredness
- Stress
- Anxiety
- Tinnitus
- Hearing problems
- Sleep disturbance
- Migraines
- Depression
- Other
- Approached doctor
- Altered quality of life

WindVOiCe® has posted results on-line at <http://www.windvigilance.com/downloads/health_survey_rev14%20final.pdf>

Noise & Health Effects of Large Wind Turbines

National Wind Watch is a US-based group that claims to 'Presents the Facts about Industrial Wind Power'. It hosts a multi-faceted website citing a multitude of health effects from wind turbines. Their website has much the same content and coverage as the Society for Wind Vigilance and can be viewed at

<<http://www.wind-watch.org/ww-noise-health.php>>

Applicable Rebuttal Information Sources:

The following sources provide information that contradicts claims that wind turbines have an adverse impact on some aspect of human health. They are listed in no particular order.

Renewable UK. 2010. Wind Turbine Syndrome (WTS): An independent review of the state of knowledge about the alleged health condition. Health and Safety Briefing. <http://www.bwea.com/pdf/publications/HS_WTS_review.pdf>

AWEA and CanWEA. 2009. Wind Turbine Sound and Health Effects: An Expert Panel Review. (This source includes extensive literature references.) <http://www.canwea.ca/pdf/talkwind/Wind_Turbine_Sound_and_Health_Effects-Executive_Summary.pdf>

Bastasch, M. 2010. AWEA/CanWEA Expert Sound Panel & Wind Turbine Sound Primer. <http://www.windpoweringamerica.gov/pdfs/workshops/2010_summit/bastasch_sound.pdf>

Bellhouse, G. 2004. Low Frequency Noise and Infrasound from Wind Turbine Generators: A Literature Review.

<<http://www.canwea.ca/pdf/talkwind/Low%20Frequency%20Noise%20and%20Infrasound%20from%20Wind%20Turbine%20Generators.pdf>>

Chief Medical Officer of Health (CMOH) of Ontario. 2010. The Potential Health Impact of Wind Turbines.

<http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf>

Chatham-Kent Public Health Unit, Ontario. 2008. The Health Impact of Wind Turbines: A Review of the Current White, Grey, and Published Literature. <<http://www.chatham-kent.ca/NR/rdonlyres/CA6E8804-D6FF-42A5-B93B-5229FA127875/7046/5a.pdf>>

Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects.¹ <<http://www.nap.edu/catalog/11935.html> http://www.cleanenergystates.org/Publications/NAS-NRC_wind_energy_final.pdf>

Danish Wind Industry Association. Updated June 2003. Shadow Casting from Wind Turbines.

<<http://www.windpower.org/en/tour/env/shadow/index.htm>>

"Electricity generation and health" in the peer-reviewed journal The Lancet. <<http://www.ncbi.nlm.nih.gov/pubmed/17876910>>

"Energy, Sustainable Development and Health." World Health Organization, June 2004.

<<http://www.canwea.ca/pdf/talkwind/WHO%20-%20Energy,%20sustainable%20development%20and%20health.pdf>>

Epilepsy Foundation. "Shedding Light on Photosensitivity, One of Epilepsy's Most Complex Conditions." By Giuseppe Erba, M.D.

<<http://www.epilepsyfoundation.org/about/photosensitivity/gerba.cfm>>

Harding, G., P. Harding, A. Wilkins. 2008. "Wind turbines, flicker, and photosensitive epilepsy: characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them." Neurosciences Institute, Aston University, Birmingham, United Kingdom. Published in *Epilepsia*, Jun; 49(6):1095-8. Epub 2008 Apr 4. <<http://www.ncbi.nlm.nih.gov/pubmed/18397297>>

Hayes McKenzie Partnership. 2006. The Measurement of Low Frequency Noise at Three UK Wind Farms.

<<http://www.berr.gov.uk/files/file31270.pdf>>

Howe Gastmeier Chapnik Engineering. 2007. Wind Turbines and Sound: Review and Best Practice Guidelines.

<http://www.canwea.ca/images/uploads/File/CanWEA_Wind_Turbine_Sound_Study_-_Final.pdf>

"Infrasound from Wind Turbines – Fact, Fiction or Deception?" by Geoff Leventhall in Vol. 34 No.2 (2006) of the peer-reviewed journal Canadian Acoustics.

<http://www.cleanenergycouncil.org.au/cec/technologies/wind/turbinefactsheets/mainColumnParagraphs/0/text_files/file1/06-06Leventhall-Infras-WT-CanAcoustics2.pdf>

¹ This source benefits from the authoritativeness and objectivity of the National Academy of Sciences/National Research Council, and includes a reference list of more than 600 citations

Lawrence Technological University. 2005. A Delphi Inquiry into the Importance of Wind Turbine Shadow Flicker.

<<http://www.ltu.edu/cm/attach/165D79C3-DD14-41EC-8A7F-CFA2D0C272DE/FlickerHandout.pdf>>

Minnesota Department of Health Environmental Health Division. 2009. Public Health Impacts of Wind Turbines. Prepared in response to a request from the Minnesota Department of Commerce-Office of Energy Security.

<<http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf>>

National Institute of Environmental Health Sciences (NIEHS). 1999. Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields.

National Institute of Environmental Health Sciences (NIEHS). 2002. EMF—Electric Magnetic Fields Associated with the Use of Electric Power—Questions and Answers. <<http://www.niehs.nih.gov/emfrapid>>

Physical Danger/Safety Risks

Generally refers to the risks related to fire, ice throw, blade throw, blade disintegration, tower failure and topple/fall, static electricity, and electrical shock that can result in physical harm to humans including death, as well as property damage.

Issue/Claim:

Physical failure events causing property damage and injury are the types of events that play on the public's fear of catastrophes; and are the ones that make the rounds on the internet and YouTube. While these sometimes spectacular events do occur, they are infrequent and rare; moreover, there are routine mitigation measures and safety procedures that reduce and eliminate risks. We found numerous references for good safety practices.

Applicable Rebuttal Information Sources:

"Emergency Management Guidelines for Wind Farms." 2007.

<http://www.cfa.vic.gov.au/documents/CFA_Guidelines_For_Wind_Farms.pdf>

Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects.² <<http://www.nap.edu/catalog/11935.html> http://www.cleanenergystates.org/Publications/NAS-NRC_wind_energy_final.pdf>

Gipe, P. 2004. A Summary of Fatal Accidents in Wind Energy. Adapted from the book Wind Power: Renewable Energy for Home, Farm, and Business. <<http://www.wind-works.org/articles/ASummaryofFatalAccidentsinWindEnergy.html>>

Garrad Hassan Canada Inc. 2007. Recommendations for Risk Assessments of Ice Throw and Blade Failure in Ontario. 38079/OR/01. <[http://www.canwea.ca/images/uploads/File/GH-RiskAssessment-38079or01a\(1\).pdf](http://www.canwea.ca/images/uploads/File/GH-RiskAssessment-38079or01a(1).pdf)>

GE Energy. 2006. Ice Shedding and Ice Throw – Risk and Mitigation. Greenville, SC.

<http://www.gepower.com/prod_serv/products/tech_docs/en/downloads/ger4262.pdf>

² This source benefits from the authoritativeness of the National Academy of Sciences/National research Council, and includes a reference list of more than 600 citations

Morgan, C., E. Bossanyi, H. Seifert. 1998. Assessment of Safety Risks Arising from Wind Turbine Icing. Paper presented at BOREAS, 31 March - 2 April 1998, in Hetta, Finland. <<http://www.renewwisconsin.org/wind/Toolbox-Fact%20Sheets/Assessment%20of%20risk%20due%20to%20ice.pdf>>

Morgan, C. and E. Bossanyi. 1996. Wind Turbine Icing and Public Safety—a Quantifiable Risk? <<http://www.easthavenwindfarm.com/filing/feb/ehwf-ml-reb4.pdf>>

Seifert, H., A. Westerhellweg, and J. Kröning. 2003. Risk Analysis of Ice Throw From Wind Turbines. Paper presented at BOREAS, 6, 9 to 11 April 2003, in Pyhä, Finland. <<http://web1.msue.msu.edu/cdnr/icethrowseifertb.pdf>>

VdS. 2008. Wind turbines: Fire protection guideline. <http://www.imia.com/downloads/external_papers/EP43_2009.pdf>

Caithness Windfarm Information Forum. Summary of Wind Turbine Accident data to 31 December 2010. <<http://www.caithnesswindfarms.co.uk/accidents.pdf>>

Freedman, J. and C. Alonge. 2009. "Icing and the Wind Resource." AWS Truewind LLC. Presented at State of the Art in Wind Siting seminar. October 20-21, Washington, D.C. <http://www.nationalwind.org/assets/blog/Jeff_Freedman.pdf>

Morgan, C. and E. Bossanyi. "Wind Turbine Icing and Public Safety – A Quantifiable Risk?" Garrad Hassan and Partners Limited. <www.easthavenwindfarm.com/filing/feb/ehwf-ml-reb4.pdf>

New York State Energy Research Development Authority. 2005. "Public Health and Safety." Report by Global Energy Concepts. <http://www.powernaturally.org/Programs/Wind/toolkit/18_publichealthandsafety.pdf>

Property Values

Issue/Claim:

Local residents often express concern over the potential for local property values to depreciate as a result of building and operating wind energy projects. This issue has come up during the siting and review of many wind power projects throughout the United States. Several variables are involved in determining property values, ranging from market conditions to land and structure conditions. Hence, it is difficult to isolate the potential impact of a single variable such as the presence of a local wind energy generation facility. We compiled a list of this rapidly changing study area. Of particular interest is the recent paper by Hoen, Wiser, et al. (2009), which uses a robust, data-rich approach to answering the question. In addition, we understand that many local and regional studies are currently underway, especially in the agricultural and public universities across the country.

Applicable Rebuttal Information Sources:

Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects.³ <<http://www.nap.edu/catalog/11935.html>
<http://www.cleanenergystates.org/Publications/NAS-NRC_wind_energy_final.pdf>

Delacy, P.B. 2005. A LULU of a case: Gauging Property Value Impacts in Rural Areas. Real Estate Issues: Fall 2004, Volume 29, No. 3. <http://www.allbusiness.com/business_planning/3586170-1.html>

Hoen, Ben. 2006. Impacts of Windmill Visibility on Property Values in Madison County, New York. Project report submitted to the faculty of the Bard Center for Environmental Policy. April 30, 2006. <http://www.nhsec.nh.gov/2008-04/documents/app_appendix_30b.pdf>

Hoen, B., R. Wiser, et al. 2009. The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis. Ernest Orlando Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division. <<http://eetd.lbl.gov/ea/ems/reports/lbnl-2829e.pdf>>

Poletti and Associates, Inc. 2005. A Real Estate Study of the Proposed Forward Wind Energy Center, Dodge and Fond Du Lac Counties, Wisconsin. Prepared for Invenergy Wind LLC. <http://psc.wi.gov/apps/erf_share/view/viewdoc.aspx?docid=35184>

Springfield-Sangamon County Regional Planning Commission. 2009. Effect of Wind Farms on Property Values. 2009, updated 2010. <http://www.co.sangamon.il.us/departments/regionalplanning/documents/Wind_Farms/InfoBrief%20WECS%20and%20Property Value%20Oct%202010%20Update_doc.pdf>

Sterzinger, G., Beck, F., and Kostiuk, D. 2003. The Effect of Wind Development on Local Property Values. Renewable Energy Policy Project. <http://www.repp.org/articles/static/1/binaries/wind_online_final.pdf>

Environmental Issues (Biological Impacts)

Issue/Claim:

Most often this refers to potential impacts to wildlife species that are managed as trust resources under various federal and state regulations, but some issues have been raised regarding domestic livestock and pets. For wildlife of all types, we were able to find ample literature and just a sampling is provided below. With the current changes in guidance regarding eagles and other avian species, there is more current information provided by other presenters in other sessions in this Siting Workshop; so we refer you to them for the latest wildlife references and information.

³ This source benefits from the authoritativeness of the National Academy of Sciences/National Research Council, and includes a reference list of more than 600 citations

With regard to domestic animals such as livestock and pets, there were limited references found as few studies have been. However there are lots of anecdotal stories of altered behavior. Here is one to share from the Society for Wind Vigilance website, self-survey:

Dogs & cats. 1 dog extremely antsy and whining & barking when vibration/noise levels are high. 2nd dog is just starting to show symptoms similar. –

<http://www.windvigilance.com/downloads/health_survey_rev14%20final.pdf>

Applicable Rebuttal Information Sources:

Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects.⁴ <<http://www.nap.edu/catalog/11935.html>>

<http://www.cleanenergystates.org/Publications/NAS-NRC_wind_energy_final.pdf>

Erickson, W., G. Johnson, and D. Young. 2005. A Summary and Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions. Prepared for the U.S. Forest Service.

<http://www.fs.fed.us/psw/publications/documents/psw_gtr191/Asilomar/pdfs/1029-1042.pdf>

Erickson, W., G. Johnson, D. Young, D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka. 2002. Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments. Technical report prepared by WEST, Inc., for Bonneville Power Administration, Portland, Oregon.

<http://www.bpa.gov/power/pgc/wind/avian_and_bat_study_12-2002.pdf>

Kunz, T., E. Arnett, et al. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal of Wildlife Management 71(8): 2449–2486.

<http://www.nationalwind.org/assets/publications/Nocturnal_MM_Final-JWM.pdf>

Manville, A. M. 2004. Prairie Grouse Leks and Wind Turbines: U.S. Fish and Wildlife Service Justification for a 5-mile Buffer from Leks; Additional Grassland Songbird Recommendations. U.S. Fish and Wildlife Service, Division of Migratory Bird Management. Arlington, Virginia. <<http://www.environment.ok.gov/documents/OKWindEnergy/PrairieGrouseLeksWindTurbines.pdf>>

The New York State Energy Research and Development Authority. 2009. Comparison of Reported Effects and Risks to Vertebrate Wildlife from Six Electricity Generation Types in the New York/New England Region. Albany, NY. Report 09-02, NYSERDA 9675. <<http://www.nyserdera.org/publications/Executive%20Summary%20Report.pdf>>

<<http://www.nyserdera.org/publications/Report%2009-02%20Wildlife%20report%20-%20web.pdf>>

NWCC (National Wind Coordinating Collaborative). 2010. Wind Turbine Interactions with Birds, Bats, and their Habitats: A Summary of Research Results and Priority Questions. Includes extensive references to additional literature.

<https://www.nationalwind.org/assets/publications/Birds_and_Bats_Fact_Sheet_.pdf>

<<http://www.nationalwind.org/publications/bbfactsheet.aspx>>

⁴ This source benefits from the authoritativeness of the National Academy of Sciences/National research Council, and includes a reference list of more than 600 citations.

NWCC (National Wind Coordinating Collaborative). 2008. Wind and Wildlife: Key Research Topics. Includes extensive references to additional literature. <http://www.nationalwind.org/assets/publications/NWCC_ResearchPriorities.pdf>

NWCC (National Wind Coordinating Collaborative). 2007. Critical Literature Review: Impact of Wind Energy and Related Human Activities on Grassland and Shrub-Steppe Birds. Includes extensive literature bibliography.
<<http://www.nationalwind.org/assets/publications/IMPACTOFWINDENERGYANDRELATEDHUMANACTIVITIESONGRASSLANDANDSHRUB-STEPPEBIRDS.pdf>>

NWCC (National Wind Coordinating Collaborative). 2007. Protocol for Investigating Displacement Effects of Wind Facilities on Grassland Songbirds. Prepared by Wallace Erickson and Dale Strickland, WEST Inc.; Jill Shaffer and Douglas Johnson, U.S. Geological Survey, Northern Prairie Wildlife Research Center. Includes references for literature cited.
<<http://www.nationalwind.org/assets/publications/SongbirdProtocolFinalJune07.pdf>>

National Renewable Energy Laboratory. Wind-Wildlife Impacts Literature Database (WILD). <<http://www.nrel.gov/wind/wild.html>>

Some Semi-Random But Useful Definitions

For this compilation and the elusive topics covered, it is only fitting to cite from a colloquial reference source like Wikipedia for some definitions about scientific methodologies and theories (website accessed February 22, 2011).

Fringe science is [scientific inquiry](#) in an established [field of study](#) that departs significantly from [mainstream](#) or [orthodox theories](#), and is classified in the "fringes" of a credible mainstream [academic discipline](#). Mainstream scientists typically regard fringe concepts as highly speculative or even strongly refuted.^[1] On the other hand, the [history of science](#) contains many instances of the eventual widespread acceptance of fringe sciences. This is because in theory a fringe science will still maintain scientific rigor, plausibility, and integrity, though it is usually highly disputed.

The term *fringe science* is sometimes loosely used to describe fields that are actually [pseudosciences](#), or fields which are referred to as *sciences*, but entirely lack scientific rigor or plausibility. Debunkers have coined the terms [pathological science](#), [voodoo science](#), and [cargo cult science](#) to suggest inquiry lacking in scientific integrity. [Junk science](#) is typically used politically to describe agenda-driven science. The general problem of where to properly draw a boundary between science and non-science, when the objective actually is objectivity, is called the [demarcation problem](#). Unfortunately, the objective of some debunkers is debunking, not encouraging real scientific objectivity. For this purpose, disparaging terms are often useful. They are almost always a clue that objectivity is not the main objective.

It is important to distinguish between *a science that has not yet been proven but follows the [scientific method](#)* and any science which *does not follow the scientific method*. This is the difference between fringe science and [pseudoscience](#). As above mentioned, some disciplines of fringe science have been or may, in the future, be proven to be actually true. Pseudoscience, however would only be proven true by a coincidence between opinion and fact, as the methods used are not logical proofs.