Harm from Wind Turbines *

What has been known for decades

University of Waterloo Seminar

May 7, 2014

Carmen Krogh, BScPharm

* Case Nos.: 10-121/10-122 Erickson v. Director, Ministry of the Environment Environmental Review Tribunal, Decision, p 207

Audio clarifications: May 9 2014

- Please note the audio clarifications related to:
  - Slide 40: Modern upwind wind turbines are typically utilized where the rotor is in the front of the unit rather than behind the unit. [1]
  - Slide 43: the distance cited is 1 km rather than 1 meter. [2]
    - 1. Formerly slide 39
    - 2. Formerly slide 42

40 to 45 Minutes

- Setting the stage
- Snapshot of some of the evidence
- Wrap-up
  - *All slides referenced*
  - *Not exhaustive: errors/omissions unintended*
  - *Emphasis sometimes added to original quotes highlighting key points*

Personal disclosure

- Education / research: no funding, no per diems
  - Sometimes travel / accommodation provided
- Member of the Board: the Society for Wind Vigilance
  - International federation of physicians, acousticians, other professionals
  - Members are volunteers / independent
  - Peer reviewed and published
- Objective - to site wind turbines to prevent harm

Published: author/co-author

Peer reviewed [9]

- Roy D. Jeffery, Carmen M.E. Krogh, and Brett Horner, Industrial wind turbines and adverse health effects Can J Rural Med 2014;19(1) http://www.cma.ca/multimedia/staticContent/HTML/N0/l2/cjrm/vol-19/issue-1/pdf/pg21.pdf
- Roy D. Jeffery, Carmen Krogh, and Brett Horner, Adverse health effects of industrial wind turbines Can Fam Physician 2013; 59: 473-475 (Commentary) http://www.cfp.ca/content/59/5/473.full
- Roy D. Jeffery MD FCFP, Carmen Krogh, Brett Horner CMA, Adverse health effects of industrial wind turbines, Letter to editor, Vol 59: September • septembre 2013, Canadian Family Physician • Le Médecin de famille canadien
- Carmen M.E. Krogh, Industrial Wind Turbine Development and Loss of Social Justice? Bulletin of Science Technology & Society 2011 31: 321, DOI: 10.1177/0270467611412550, http://bst.sagepub.com/content/31/4/321
- Carmen M.E. Krogh, Lorrie Gillis, Nicholas Kouwen, and Jeffery Aramini, 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, DOI: 10.1177/0270467611412551. http://bst.sagepub.com/content/31/4/334
- Brett Horner, Roy D. Jeffery and Carmen M. E. Krogh, Literature Reviews on Wind Turbines and Health: Are They Enough? Bulletin of Science Technology & Society 2011 31: 399. DOI: 10.1177/0270467611421849 http://bst.sagepub.com/content/31/5/399
- Stephen E. Ambrose, Robert W. Rand and Carmen M. E. Krogh, Wind Turbine Acoustic Investigation: Infrasound and Low-Frequency Noise--A Case Study, Bulletin of Science Technology & Society published online 17 August 2012 DOI: 10.1177/0270467612455734, http://bst.sagepub.com/content/early/2012/07/30/0270467612455734
- Robert W. Rand, Stephen E. Ambrose, and Carmen M. E. Krogh, Occupational Health and Industrial Wind Turbines: A Case Study, Bulletin of Science Technology & Society 2011 31: 359DOI: 10.1177/0270467611417849. http://bst.sagepub.com/content/31/5/359
- Birds and Bird Habitat: What Are the Risks From Industrial Wind Turbine Exposure? Terry Sprague, M. Elizabeth Harrington, and Carmen M. E. Krogh, DOI: 10.1177/0270467611417844 http://bst.sagepub.com/content/31/5/377

Published: author / co-author

Conference papers [7]

- Wind Turbine Facilities' Perception: A Case Study from Canada Peter N. Cole MD, MHSc, FRCP(C) and Carmen Krogh, BScPharm 5th International Conference on Wind Turbine Noise Denver 28 – 30 August 2013 (published in proceedings but not presented)
- Audit report: literature reviews on wind turbine noise and health Brett Horner, Carmen ME Krogh, Roy D Jeffery Paper presented at the Wind Turbine Noise conference 2013, August 28 to 30, Denver, Colorado, USA
- Trading off human health: Wind turbine noise and government policy Carmen ME Krogh, Joan Morris, Murray May, George Papadopoulos, Brett Horner Paper presented at the Wind Turbine Noise conference 2013, August 28 to 30, Denver, Colorado, USA
- Carmen ME Krogh, Roy D Jeffery, Jeff Aramini, Brett Horner, Wind turbines can harm humans: a case study, Paper presented at Inter-noise 2012, New York City, NY
- Carmen ME Krogh, Roy D Jeffery, Jeff Aramini, Brett Horner, Wind turbine noise perception, pathways and effects: a case study Paper presented at Inter-noise 2012, New York City, NY
- Carmen ME Krogh, Roy D Jeffery, Jeff Aramini, Brett Horner, Annoyance can represent a serious degradation of health: wind turbine noise a case study, Paper presented at Inter-noise 2012, New York City, NY
- Stephen E. Ambrose, Robert W. Rand and Carmen M. E. Krogh, Falmouth, Massachusetts wind turbine infrasound and low frequency noise measurements, Invited paper presented at Inter-noise 2012m New York City, NY

Setting the stage

Definitions

Symptoms

Direct and indirect pathways

Government policy

1948 Definition of health

CONSTITUTION OF THE WORLD HEALTH ORGANIZATION[1]

THE STATES Parties to this Constitution declare, in conformity with the Charter of the United Nations, that the following principles are basic to the happiness, harmonious relations and security of all peoples:

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.

Acknowledgement: annoyance

- Annoyance is acknowledged to be an adverse health effect. [1,2,3,4,5]

- 1. Health Canada, Community Noise Annoyance, Its Your Health, (2005, September)
- 2. Michaud, D. S., Keith, S. E., & McMurchy, D., “Noise Annoyance in Canada”, Noise Health, 7, 39-47. (2005)
- 3. Pedersen, E., & Persson Waye, K., “Wind Turbine Noise, Annoyance and Self-Reported Health and Well Being in Different Living Environments”, Occupational and Environmental Medicine, 64, 480-486, (2007) doi:10.1136/oem.2006.031039
- 4. Suter, A. H., Noise and Its Effects, Washington, DC: Administrative Conference of theUnited States, (1991)
- 5. New South Wales. Parliament. Legislative Council. General Purpose Standing Committee No. 5, Rural Wind Farms (2009, December)

Definition: sound versus noise

- World Health Organization defines noise as “unwanted sound” [1]
- Sound meters can assess sound; however, humans assess “noise”
- Humans are being considered as “objective measuring instruments (New Experts), whose reports and descriptions must be taken seriously and quantified by technical measurements.” [2]

References: sound versus noise

1. Berglund, B., Lindvall, T., & Schwela, D. H., *Guidelines for Community Noise*, Geneva, Switzerland: World Health Organization, (1999)

2. Bray Wade, Acoustical Society of America 164th Meeting, Kansas City, MO 22 - 26 October, 2012, 2aNS6, Relevance and applicability of the Soundscape concept to physiological or behavioural effects caused by noise at very low frequencies which may not be audible.

   www.acoustics.org/press/164th/Bray_2aNS6.html

2009 Commonly reported symptoms

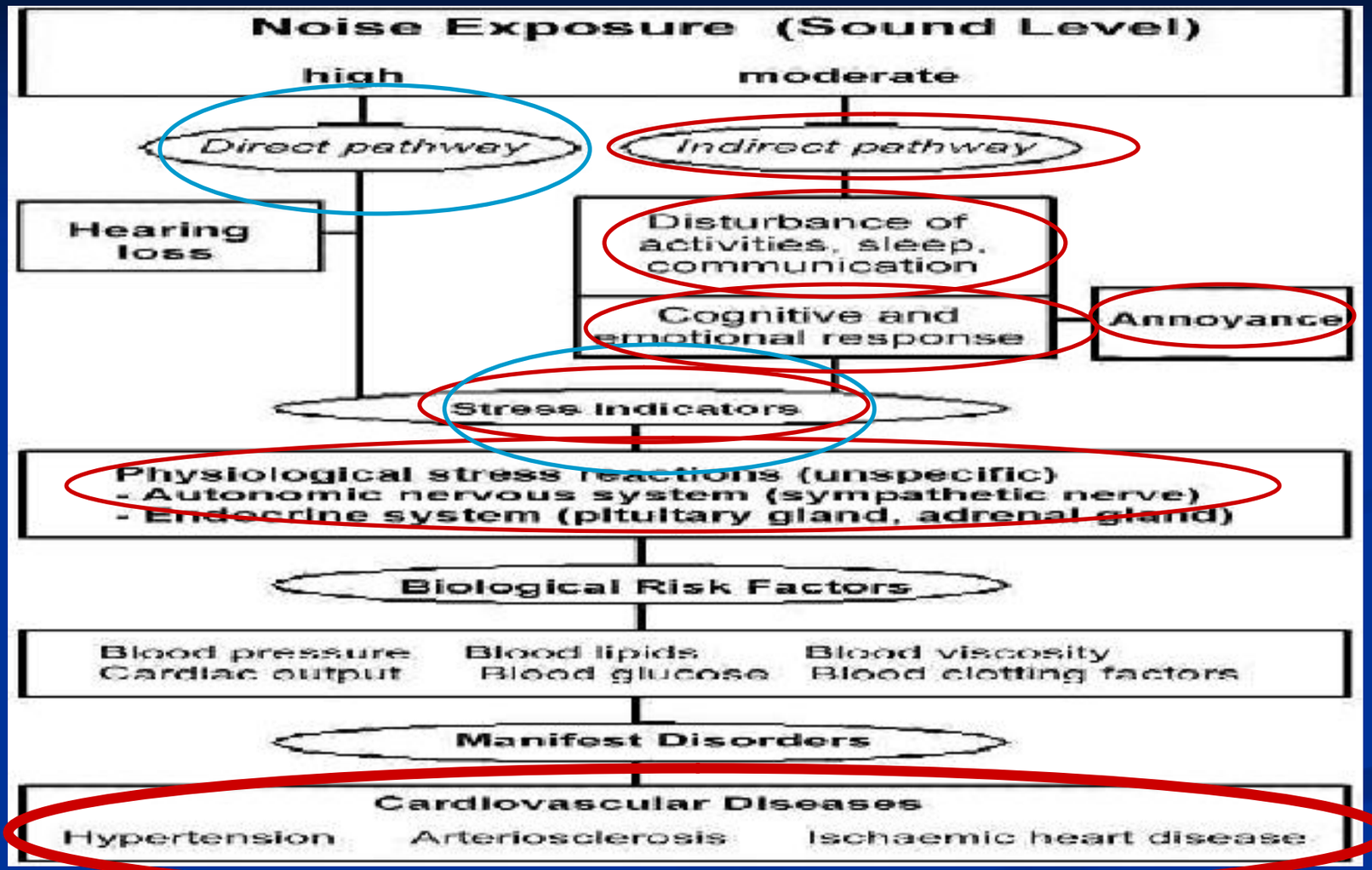
- Dr. Nina Pierpont documented symptoms reported by individuals exposed to wind turbines which include: sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering when awake or asleep.

- Pierpont, N., *Wind Turbine Syndrome: A Report on a Natural Experiment*, Santa Fe, NM: K-Selected Books, (2009)

Commonly reported symptoms

	"I am happy to accept these symptoms… what Pierpont describes is effects of annoyance by noise – a stress effect …"
	"… well-known stress effects of exposure to noise…"
	"… Wind Turbine Syndrome is the result of stress from annoyance by audible noise from wind turbines…"

Noise: direct and indirect pathways



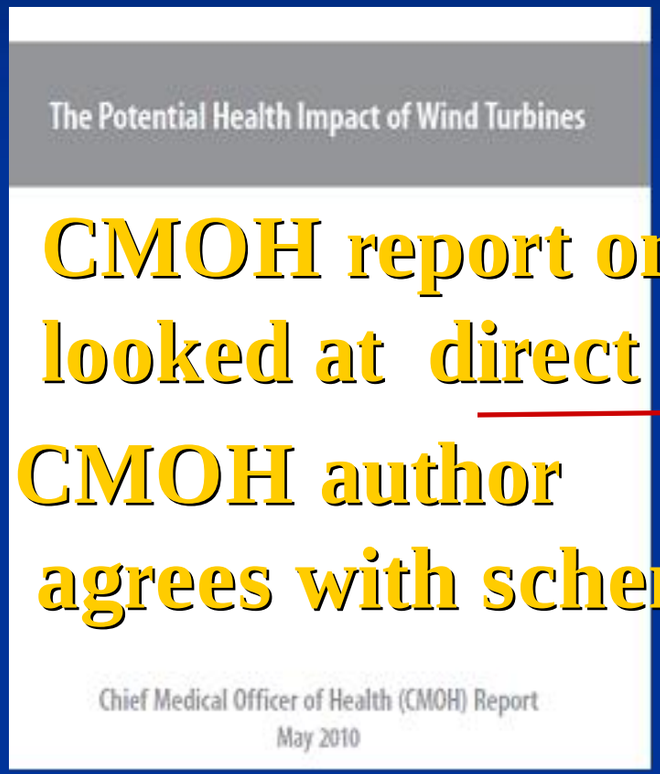
- World Health Organization, Night Noise Guidelines for Europe, 2009

2010 ON Chief Medical Officer of Health

- "While some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, the scientific evidence available to date does not demonstrate a **direct** causal link between wind turbine noise and adverse health effects."

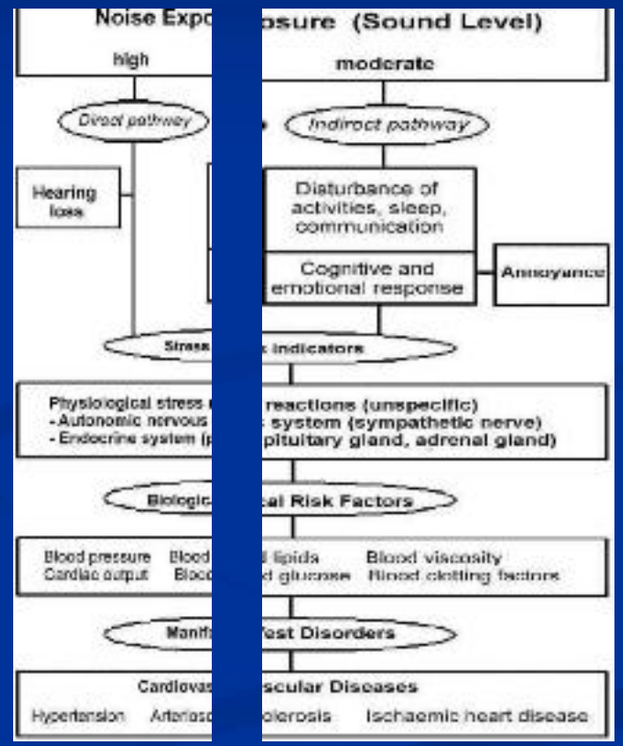
- Chief Medical Officer of Health. The potential health impact of wind turbines. http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf

2011 Ontario Chief Medical Officer Health author



CMOH report only looked at direct links [2]

CMOH author agrees with schema [1]



- Case Nos.: 10-121/10-122 Erickson v. Director, Ministry of the Environment Transcript of Dr. G. Rachamin, Mar, 4, 2011 [1] p. 211, [2] p. 216

2011 Direct and indirect impacts

- "… The Tribunal has found above that "serious harm to human health" includes both direct impacts (e.g., a passer-by being injured by a falling turbine blade or a person losing hearing) or indirect impacts (e.g., a person being exposed to noise and then exhibiting stress and developing other related symptoms). This approach is consistent with both the WHO definition of health and Canadian jurisprudence on the topic."

  - Case Nos.: 10-121/10-122 Erickson v. Director, Ministry of the Environment Environmental Review Tribunal, Decision, p190

2011 Indirect health effects & precaution

- The ERT Decision expressed concerns :

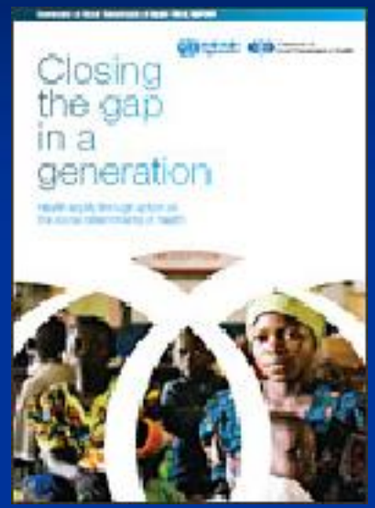
  "…about the Director's apparent lack of consideration of indirect health effects and the need for further work on the MOE's practice of precaution…"

  - Case Nos.: 10-121/10-122 Erickson v. Director, Ministry of the Environment Environmental Review Tribunal, Decision, p 206

1986 Policy: Health Canada

- "It is clear … that existing policies and practices are not sufficiently effective to ensure that Canadian men and women of all ages and backgrounds can have an equitable chance of achieving health … Conflicting interests may exist between sectors."

2008 Policy: World Health Organisation



- "Different government policies, depending on their nature, can either improve or worsen health and health equity."

Green Energy Act, 2009

Ontario

Preamble

The Government of Ontario is committed to fostering the growth of renewable energy projects, which use cleaner sources of energy, and to removing barriers to and promoting opportunities for renewable energy projects and to promoting a green economy.

S.O. 2009, CHAPTER 12
SCHEDULE A

Industry-led : government-supported

Wind Technology Road Map

Yesterday's and Today's Industrial Wind Turbines

La Gaspésie Quebec

Courtesy of Eco Awareness Society, Nova Scotia

Germany

Michigan USA

Source: Appraisal Institute Webinar – October, 2012

Perspective visuals: Ontario

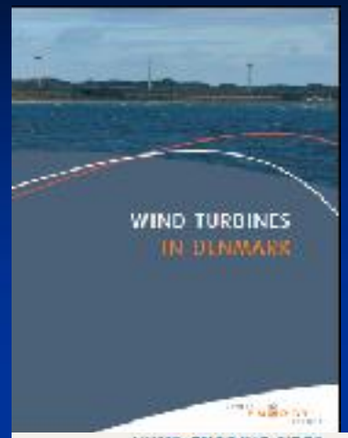
Photo courtesy of Bonny McKeough, Ontario, estimate 0.5 mile from home

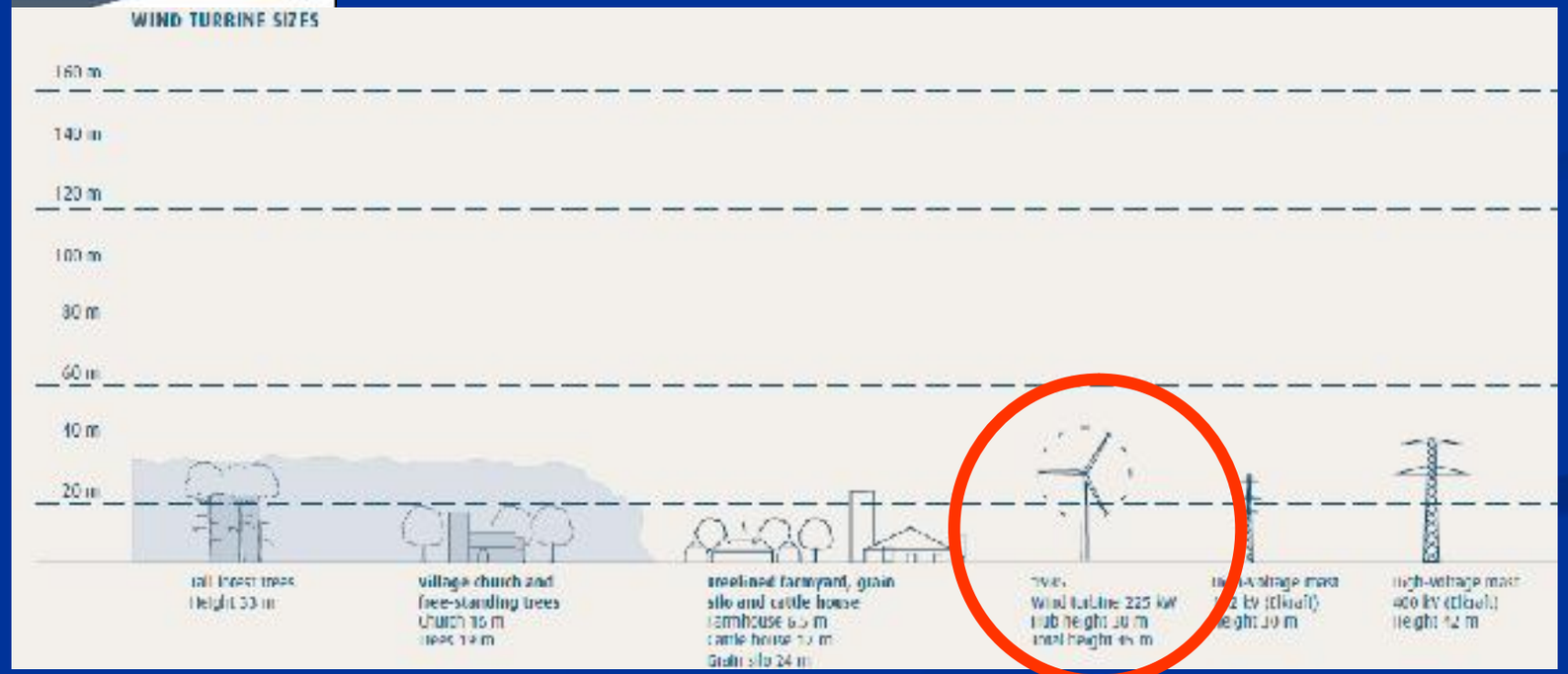
Amherst Island Ontario - projected model

Prince Edward Island

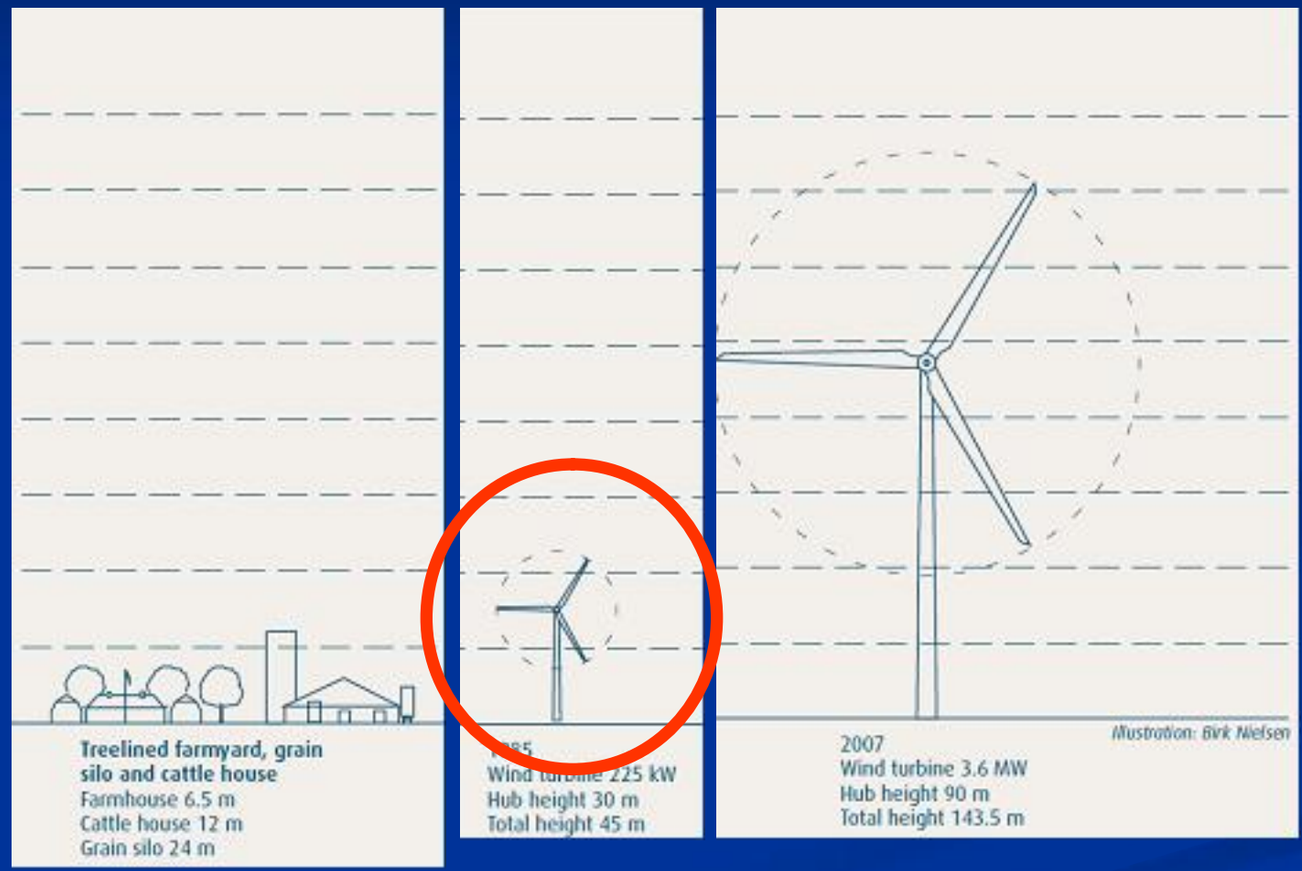
Palm Springs California

Wind turbines 1985





2007 Wind turbines today



Real property value: Demark

DANISH ENERGY AGENCY

OIL AND GAS | SUPPLY | CONSTRUCTION | CONSUMPTION AND SAVINGS | CLIMATE AND CO2 | POLICY

›Frontpage›Supply›Renewable energy›Wind Power›Onshore Wind Power›Loss of value to real property

Loss of value to real property due the erection of wind turbines

An erector of a wind turbine has a duty to pay compensation for loss of value of real property following the erection of the wind turbine. The size of the loss of value is determined by an appraisal authority.

CONTACT

Jens Bengtsson

Energy Supply

Phone: +45 3392 6776

›jbe@ens.dk

- Danish Energy Agency, "Loss of value to real property due the erection of wind turbines", http://www.ens.dk/en-US/supply/Renewable-energy/WindPower/Onshore-Wind-Power/Loss-of-value-to-real-property/Sider/Forside.aspx , Cited August 21, 2012

2011 Ontario disclosure

OREA Ontario Real Estate Association

Seller Property Information Statement
Residential

Form 220
for use in the Province of Ontario

ANSW
inform
broker
inform
even i
accura

ENVIRONMENTAL: (Provide Applicable ADDITIONAL COMMENTS)	YES	NO	UNKNOWN	NOT APPLICABLE
1. Are you aware of possible environmental problems or soil contamination of any kind on the property or in the immediate area? eg: radon gas, toxic waste, underground gasoline or fuel tanks etc.				
2. Are there any existing or proposed waste dumps, disposal sites or land fills in the immediate area?				
3. Are there any hydro generating projects planned for the immediate area? eg: Wind Turbines				

- Ontario Real Estate Association, Seller Property Information Statement, Form 220 for use in the Province of Ontario, Revised 2011

Reviews

Other research

2004 Special edition

Noise & Health
A Bimonthly Inter-disciplinary International Journal

- "It is difficult for residents to protect themselves against low frequency emissions."

- "Conventional methods of assessing annoyance, typically based on Aweighed equivalent sound level, are inadequate for low frequency noise and lead to incorrect decisions by regulatory authorities.

- Experiments with both animals and humans have shown that the vibroacoustic stress or causes thickening of cardiovascular structures (cardiac muscle and blood vessels).

EDITORIAL
Year : 2004 | Volume : 6 | Issue : 23 | Page : 1-2

2007 Examples of reviews

- "LFN-exposed animal models: "LFN is an agent of disease and the respiratory tract is one of its preferential targets."
  - Branco NA et al 2007 Respiratory pathology in vibroacoustic disease: 25 years of research. [Review] Revista Portuguesa de Pneumologia. 13(1):129-35, 2007 Jan-Feb [27 refs]
- "Patients and animals: At present, infrasound (0-20 Hz) and low-frequency noise (20-500 Hz) (ILFN, 0-500 Hz) are agents of disease that go unchecked."
- "Frequency-specific effects are not yet known, valid dose-responses have been difficult to identify, and large-scale epidemiological studies are still lacking."
  - Alves-Pereira M & Branco NA Vibroacoustic disease: biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling. [Review] Progress in Biophysics & Molecular Biology. 93(1-3):256-79, 2007 Jan-Apr. [123 refs]

2011 Review

Wind Turbine Infra and Low-Frequency Sound: Warning Signs That Were Not Heard

There is sufficient research and history to link the sensitivity of some people to inaudible amplitude-modulated infra and low-frequency noise to the type of symptoms described by those living near industrial wind turbines.

This information should have served as a warning sign.

- James, Richard R. Wind Turbine Infra and Low-Frequency Sound: Warnings Signs That Were Not Heard DOI: 10.1177/0270467611421845Bulletin of Science Technology & Society published online 15 December 2011 http://bst.sagepub.com/content/early/2011/11/07/0270467611421845

Reviews

Other research

1982 Investigation

A Methodology for Assessment of Wind Turbine Noise Generation

- Upwind 2 MW, MOD - turbine (Boone, North Carolina):
  - “unexpected noise complaints from a few residents within 3 km”

N. D. Kelley

R. R. Hemphill

H. E. Mc Kenna

Solar Energy Research Institute, Golden, Colo. 80401

Journal of Solar Energy Engineering

MAY 1982, Vol. 104 / 119

Audio clarification: Modern upwind wind turbines are typically utilized where the rotor is in the front of the unit rather than behind the unit.

1982 Results

A Methodology for Assessment of Wind Turbine Noise Generation

- "… hypothesize one of the causal factors related to annoyance associated with the pulsating pressure fields in the rooms measured is a coupling with human body resonances … creating a sensation of a whole-body vibration."

- "This perception is more noticeable indoors…"

1987 Proposed Metric

A Proposed Metric for Assessing the Potential of Community Annoyance from Wind Turbine Low-Frequency Noise Emissions

Prepared under Task No. WE721201
Program No. 8

Solar Energy Research Institute
A Division of Midwest Research Institute

1617 Cole Boulevard
Golden, Colorado 80401-3393

Prepared for the
U.S. Department of Energy
Contract No. DE-AC02-83CH10093

Presented at the Windpower '87
Conference and Exposition
October 5-8, 1987
San Francisco, California

November 1987

N.D. Kelley

1987 Proposed Metric

A Proposed Metric for Assessing the Potential of Community Annoyance from Wind Turbine Low-Frequency Noise Emissions

- "… over a range of 5-100 Hz…"
- "4. Calculate the equivalent PLSL or PC levels at the reference distance of 1 km …"
- "Add 15 dB to the results of step (4)"

Audio clarification: the distance cited is 1 km rather than 1 meter

1995

Sources and effects of low-frequency noise

Birgitta Berglund[a)] and Peter Hassmén
Institute of Environmental Medicine, Karolinska Institute and Department of Psychology, Stockholm University, Stockholm, Sweden

VIII. RECOMMENDATIONS

A. Research needs

Further research is needed in relation to a number of features and outcomes of low-frequency noise. These needs include the following.

(1) In general, there has been too little research on the role of different frequency spectra of noise in the production of effects on humans. Greater consideration of this factor in many studies of noise is desirable.

(2) Most of the research of adverse effects of low-frequency noise in humans has used short durations of exposure. It is of great importance to research prolonged expo-

J. Acoust. Soc. Am. **99** (5), May 1996

2000 WHO on low frequency noise in general

- “Health effects due to low-frequency components in noise are estimated to be more severe than for community noises in general”
  - World Health Organization, Guidelines for Community Noise, 2000 http://www.euro.who.int/mediacentre/PR/2009/20091008_1

2004 Low frequency noise exposure in general

- "… chronic psychophysiological damage may result from long-term exposure to low-level low frequency noise."

- 'The claim that their "lives have been ruined" by the noise is not an exaggeration…'

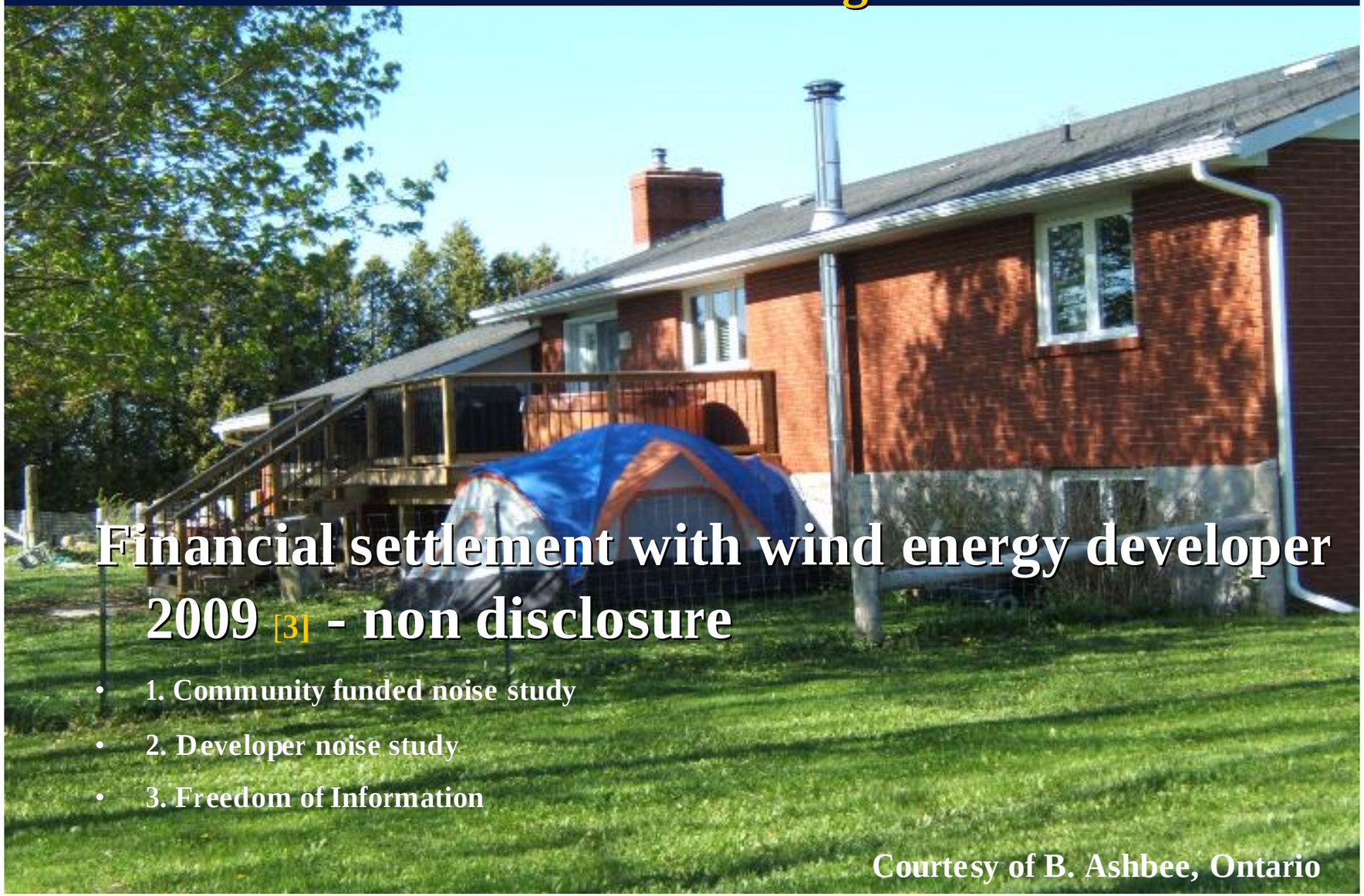
- Leventhall HG. Low frequency noise and annoyance. Noise Health [serial online] 2004 [cited 2009 Dec 31];6:59-72. Available from: http://www.noiseandhealth.org/text.asp?2004/6/23/59/31663

2004 Low frequency noise annoyance

- ‘Those exposed may adopt protective strategies, such as sleeping in their garage if the noise is less disturbing there. Or they may sleep elsewhere, returning to their own homes only during the day.’

  - Leventhall HG. Low frequency noise and annoyance. Noise Health [serial online] 2004 [cited 2009 Dec 31];6:59-72. Available from: http://www.noiseandhealth.org/text.asp?2004/6/23/59/31663

2009 Escaping wind turbine LFN [1, 2, 3] – 5 shut down at night



Financial settlement with wind energy developer 2009 [3] - non disclosure

- 1. Community funded noise study
- 2. Developer noise study
- 3. Freedom of Information

Courtesy of B. Ashbee, Ontario

2007 National Research Council

The National Research Council:

- "Low-frequency vibration and its effects on humans are not well understood. Sensitivity to such vibration resulting from wind-turbine noise is highly variable among humans…. studies on human sensitivity to very low frequencies are recommended."

  - National Research Council (NRC). Environmental Impacts of Wind-Energy Projects, 2007 NRC, Washington, DC

2007 Wind turbine noise characteristics

- ‘Sound generated by wind turbines has particular characteristics and it creates a different type of nuisance compared to usual urban, industrial, or commercial noise.’

  - Soysai, H., and O. Soysai. Wind farm noise and regulations in the eastern United States. 2007. Proceedings of the Second International Meeting on Wind Turbine Noise. Lyon, France: September 20-21, 2007. INCE/Europe.

2008 Wind turbine noise is more annoying

- '…wind turbine sound is relatively annoying, more so than equally loud sound from aircraft or road traffic.'

- '…and (more) sound mitigation measures must be considered.'

  - Pedersen et al., 2008,Project WINDFARMperception Visual and acoustic impact of wind turbine farms on residents Netherlands

2010 to 2014 Inner ear research

- 2010 “In this review, we consider possible ways that low frequency sounds, at levels that may or may not be heard, could influence the function of the ear.” [1]
- 2011 “Based on our current knowledge of how the ear works, it is quite possible that low-frequency sounds at the levels generated by wind turbines could affect those living nearby.” [2]
- 2012 “… we have to be concerned that sounds that are not perceived are clearly transduced by the ear and may still affect people in ways that have yet to be fully understood.” [3]
- 2014 “Based on well-established principles of the physiology of the ear and how it responds to very low-frequency sounds, there is ample justification to take this problem more seriously than it has been to date.” [4]

2010 to 2014 Inner ear research references

1. Salt, Alec N. and Hullar, T.E. Responses of the ear to low frequency sounds, infrasound and wind turbines. Department of Otolaryngology, Washington University School of Medicine, St. Louis, MO, 63110, USA. Hearing Research 2010 Sep 1; 268(1-2):12-21. Epub 2010 Jun 16

2. Salt, Alec N. and Kaltenbach, James A. Infrasound From Wind Turbines Could Affect Humans Bulletin of Science Technology & Society 2011 31: 296, DOI: 10.1177/0270467611412555 http://bst.sagepub.com/content/31/4/296

3. Salt, Alec N. and Lichtenhan, Jeffery T. Perception-based protection from low-frequency sounds may not be enough Invited paper presented at Inter-noise 2012, New York City, NY4.

4. Salt AN and Lichtenhan JT, How Does Wind Turbine Noise Affect People? Acoustics Today. A publication of the Acoustical Society of America. Volume 10: Issue One: Winter 2014

Acknowledgements

2012 - 2014

2012 Wisconsin: Brown County Board of Health

HEALTH DEPARTMENT

Brown County

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JUDY FRIEDERICHS, R.N., B.S.
DIRECTO

THEREFORE, BE IT RESOLVED that the Brown County Board of Health formally requests temporary emergency financial relocation assistance from the State of Wisconsin for those Brown County families that are suffering adverse health effects and undue hardships caused by the irresponsible placement of industrial wind turbines around their homes and property. The State of Wisconsin emergency financial assistance is requested until the conditions that have caused these undue hardships are studied and resolved, allowing these families to once again return safely to their homes and property.

Audrey S. Murphy, BSN
Chairman
Brown County Board of Health

Jay J. Tibbetts, MD
Vice-Chairman
Brown County Board of Health

2012

A Cooperative Measurement Survey and Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County, Wisconsin

Prepared Cooperatively By:

Channel Islands Acoustics, Camarillo, CA
Principal: Dr. Bruce Walker

Hessler Associates, Inc., Haymarket, VA
Principals: George F. and David M. Hessler

Rand Acoustics, Brunswick, ME
Principal: Robert Rand

Schomer and Associates, Inc., Champaign, IL
Principal: Dr. Paul Schomer

Report Number 122412-1
Issued: December 24, 2012

2012

A Cooperative Measurement Survey and Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County, Wisconsin

The four investigating firms are of the opinion that enough evidence and hypotheses have been given herein to classify LFN and infrasound as a serious issue, possibly affecting the future of the industry. It should be addressed beyond the present practice of showing that wind turbine levels are magnitudes below the threshold of hearing at low frequencies.

2012

Falmouth Health Department

The Falmouth Board of Health requests that **Mass DPH immediately initiate a health assessment of the impacts of the operation of wind turbines in Falmouth**. This appeal is compelled by two years of consistent and persistent complaints of health impacts during turbine operation.

Due to the increasing intensity of the reported health impacts, the Board is considering emergency actions. To determine the appropriateness of such actions, the Board requests immediate guidance on interim measures to protect the health of affected individuals while the complete health assessment is being conducted.

FALMOUTH, MASSACHUSETTS June 11, 2012

2013

TOWN OF FALMOUTH

vs.

TOWN OF FALMOUTH ZONING BOARD OF APPEALS & others[1]

ORDER

By order of the court, preliminary injunction shall issue until further order of the court.

1. The Town of Falmouth, its Selectmen, agents and persons acting in concert shall be restrained from operating the Wind Turbines located at the Waste Water Treatment Facility except during the hours of 7am to 7pm, every day of the week except Sunday. This schedule shall commence on November 22, 2013. Additionally, the same parties shall be restrained from operating said turbines in any fashion on the following limited dates: November 27, 2013; December 25, 2013; and January 1, 2014.

SUPERIOR COURT
CIVIL ACTION
NO. BACV2013-00281

Dated: November 21, 2013

Judicial processes in other venues

- 2012 Supreme Court Bavaria Germany:
  - 3 dB addition for pulsed noise for the E82 and compensation
- 2012 High Court UK:
  - Viewscape/landscape
- 2013 Supreme Court Portugal *
  - Removal of 4 turbines and compensation

** by Google Translate which may not reflect exact wording*

Children and vulnerability to noise

WHO: vulnerable groups

- "VULNERABLE GROUPS OF CHILDREN
  - The fetus and babies
  - Preterm, low birth weight and small for gestational age babies
  - Children with dyslexia and hyperactivity
  - Children on ototoxic medication"

    - World Health Organization, Children and Noise, Children's Health and the Environment, WHO Training Package for the Health Sector, www.who.int/ceh

Children: direct and indirect effects

- Direct:
  - ear damage

- Indirect (physiological and psychological effects)
  - impaired cognition
  - stress-related somatic effects (stress hormone, blood pressure and muscle spasm)
  - psychological effects
    - annoyance / isolation
    - sleep disturbance and mental health issues
    - cognitive effects - reading, concentration, memory and attention issues, (reading comprehension and long term memory)
    - Academic performance affects

      - World Health Organization, Children and Noise, Children's Health and the Environment, WHO Training Package for the Health Sector, www.who.int/ceh

Pre-existing medical conditions

- Autism [1,2,3]
- Asthma [4,5]
- Migraine [6,7]
- Bronchitis [8]
- Epilepsy [9,10]
- Childhood asthma [11] and migraine [12] can be triggered by stress

Pre-existing medical conditions references

- [1] Cristina Becchio, Morena Mari, Umberto Castiello, (2010). Perception of Shadows in Children with Autism Spectrum Disorders PLoS ONE | May 2010 | Volume 5 | Issue 5 | e10582. Retrieved from www.plosone.org
- [2] Catherine Purple Cherry and Lauren Underwood. The ideal home for the autistic child: physiological rationale for design strategies. Autism Science Digest: The Journal Of Autismone, Issue 03 Retrieved from www.purplecherry.com.
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2003 Children and possible irreversible negative consequences

- "It is likely that children represent a group which is particularly vulnerable to the non-auditory health effects of noise.

- "… there is a possible risk that exposure to an environmental stressor such as noise may have irreversible negative consequences for this group…"

  - Stephen A Stansfeld and Mark P Matheson (2003), Noise pollution: non-auditory effects on health, British Medical Bulletin 2003; 68: 243–257 DOI: 10.1093/bmb/ldg033 Retrieved from http://bmb.oxfordjournals.org/content/68/1/243.full.pdf

2009 Children & learning

- "The American National Standards Institute emphasizes that school buildings' sound isolation should prevent two types of noise: … outside of the school building … within the school building such as unwanted speech."

  - Robert Ljung, Patrik Sorqvist and Staffan Hygge (2009) Effects of road traffic noise and irrelevant speech on children's reading and mathematical performance. Noise and Health, Oct-Dec 2009 http://www.noiseandhealth.org/article.asp?issn=1463-1741;year=2009;volume=11;issue=45;spage=194;epage=198;aulast=Ljung

2010

Review article

Long-term sleep disturbances in children: A cause of neuronal loss

- "Animal experiments unequivocally show that sleep loss even for three or four days can adversely and permanently affect neurophysiological functions and neurogenesis."

- "This review summarises the increasing evidence … that chronic disturbances of sleep adversely affect brain development … Pediatric neurologists, the scientific community and the public must be aware of these recent scientific developments. Further studies are urgently required."

James E. Jan [a,b,*], Russ J. Reiter [c], Martin C.O. Bax [d], Urs Ribary [e], Roger D. Freeman [f,g], Michael B. Wasdell [h]

EUROPEAN JOURNAL OF PAEDIATRIC NEUROLOGY 14 (2010) 380–390

2012 WHO: short- and long-term health problems

- **“Facts and figures**

  - Noise is an underestimated threat that can cause a number of short- and long-term health problems, such as for example sleep disturbance, cardiovascular effects, poorer work and school performance, hearing impairment, etc.”

    - World Health Organization Noise Facts and Figures, Sited December 23, 2012, http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/noise/facts-and-figures cited dec 23 2012

Low frequency noise guidelines

2009 Low frequency noise guidelines

From: Minister, MOE (ENE)
Sent: July 13, 2009 3:56 PM

It is proposed that wind turbines would not be permitted less than 550 metres from the nearest dwelling and this minimum setback would increase with the number and loudness of turbines. It is also proposed that there would be setback distances from all roads, railways, and property side and rear lot lines, and there would be ongoing requirements to monitor and address low frequency noise and vibrations.

Sincerely,

John Gerretsen
Minister

2009 LFN / infrasound guidelines

- "…CanWEA submits that the proposed requirement for infrasound or low frequency noise monitoring as a condition of the REA be removed."

  - CanWEA EBR Posting 010-6516 (Proposed Ministry of the Environment Regulations to Implement the Green Energy and Green Economy Act. 2009) – CanWEA's Supplemental Submission Dated July 24, 2009, EBR Comment ID 123788. Signed Robert Hornung President.

2011 LFN / infrasound guidelines

Vestas

In fact, according to our analyses, the most economical turbines, the 3 MW category, are the ones that will be strongly affected by the new rules. This applies to open terrain in particular, where in future low frequency noise will dictate and increase the distance requirements to neighbours for close to half of the projects that we are already aware of over the next 2 to 3 years.

The proposed low frequency limit values may hinder the development of onshore wind in Denmark, including meeting our commitments in relation to the EEC. Ultimately, we consider there is a danger that the regulations will be copied by other countries and accordingly this will provide an obstacle to the popularisation of wind energy at a global level. Both issues will damage Vestas as a business, including affecting Danish activities.

Vestas Wind systems A/S

[Signature]
Ditlev Engel
Chief Executive Officer

Date
Randers, 29 June 2011/erkjs

Wrap up

2009 Health effect "Conclusively demonstrated"

"Health Canada provides advice on the health effect of noise and low-frequency electric and magnetic fields from proposed wind turbine projects, particularly for environmental assessments done under the Canadian Environmental Assessment Act. To date, their examination of the scientific literature on wind turbine noise is that the only health effect conclusively demonstrated from exposure to wind turbine noise is an increase of self-reported general annoyance and complaints (i.e., headaches, nausea, tinnitus, vertigo)." [48]

Honourable Rona Ambrose, P.C., M.P.
L'honorable Rona Ambrose, C.P., députée

JUL 30 2009

Health Canada provides advice on the health effects of noise and low-frequency electric and magnetic fields from proposed wind turbine projects, particularly for environmental assessments done under the Canadian Environmental Assessment Act. To date, their examination of the scientific literature on wind turbine noise and health is that the only health effect conclusively demonstrated from exposure to wind turbine noise is an increase in self-reported general annoyance and complaints (i.e., headaches, nausea, tinnitus, vertigo).

Correspondence from the Honourable Rona Ambrose, June 30, 2009

2010 ON Freedom of Information - 30 to 32 dBA recommended

April 9, 2010

MEMORANDUM

FROM:

Re:

- "… the setback distances should be calculated using a sound level limit of **30 to 32 dBA** at the receptor, instead of the 40 dBA sound level limit."

  - MOE memorandum, Ontario Senior Environmental Officer, April 9, 2010

2010 MOE Freedom of Information on setback / noise

Ministry of the Environment
Guelph District Office

Ministère de l'Environnement

Ontario

April 9, 2010

MEMORANDUM

TO: Jane Glassco, District Manager, Guelph District Office — and — Dave Bray, Supervisor, Guelph District Office

FROM: Cameron Hall, Senior Environmental Officer, Guelph District Office

Re: Comments - March 1, 2010 draft document, "Renewable Energy Approvals Technical Bulletin Six Required Setbacks for Wind Turbines"

- "It appears compliance with the minimum setbacks and the noise study approach currently being used to approve the siting of WTGs **will result or likely result in adverse effects**…"

  - MOE memorandum, Ontario Senior Environmental Officer, April 9, 2010

2010 Setbacks and noise levels expected to adversely affect some


HGC ENGINEERING

LOW FREQUENCY NOISE AND INFRASOUND
ASSOCIATED WITH WIND TURBINE GENERATOR SYSTEMS
A LITERATURE REVIEW

- "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.** As with sounds from many sources, research has shown that **annoyance associated with sound from wind turbines can be expected to contribute to stress related health impacts** in some persons."

  - Low frequency Noise and Infrasound Associated with Wind Turbine Generation Systems, A Literature Review, Ontario Ministry of Environment RFP December 10, 2010 [MOE consultant report]

2011 Environmental Review Tribunal

- "This case has successfully shown that the debate should not be simplified to one about whether wind turbines **can cause harm** to humans. The evidence presented to the Tribunal demonstrates that **they can**, if facilities are placed too close to residents. The debate has now evolved to one of degree."

  - Case Nos.: 10-121/10-122 Erickson v. Director, Ministry of the Environment Environmental Review Tribunal, Decision, p 207

2013 Health Canada wind turbine noise study

Dr. Michaud acknowledged that there is credible scientific support for an association between wind turbine noise and community annoyance. He explained that the study will help to build the evidence base to determine the link between noise created by wind turbines, including infrasound and low frequency, and variables like sleep disturbance, stress, quality of life and annoyance.

Dr. David Michaud, meeting with MP Poilieve June 2013 newsletter

2012 – 2014 Reported wind turbine health effects

- Austrian Medical Association Issues Warning, Calls for Comprehensive Studies on Wind Turbine Noise and minimum safety distances to populated areas. April 30 2014 http://waubrafoundation.org.au/2014/austrian-medical-association-issues-warning-calls-for-comprehensive-studies-wind-turbine-noise/

- Roy D. Jeffery, Carmen M.E. Krogh, and Brett Horner, Industrial wind turbines and adverse health effects Can J Rural Med 2014;19(1) http://www.cma.ca/multimedia/staticContent/HTML/N0/l2/cjrm/vol-19/issue-1/pdf/pg21.pdf

- Enbom H and Enbom IM, Infrasound from wind turbines: An overlooked health hazard," Läkartidningen, vol. 110 (2013), pp. 1388-89.

- Roy D. Jeffery, Carmen Krogh, and Brett Horner, Adverse health effects of industrial wind turbines Can Fam Physician 2013; 59: 473-475 (Commentary) http://www.cfp.ca/content/59/5/473.full

- Roy D. Jeffery MD FCFP, Carmen Krogh, Brett Horner CMA, Adverse health effects of industrial wind turbines, Letter to editor, Vol 59: September • septembre 2013, Canadian Family Physician • Le Médecin de famille canadien

- Hanning, Christopher D. and Evans, Alun Editorial: Wind turbine noise British Medical Journal, BM J2 012;344 doi: 10.1136/ bmj.e1527 (8 March 2012)www.bmj.com

- Nissenbaum, Michael A.; Aramini, Jeffery J.; and Hanning, Christopher D. Effects of industrial wind turbine noise on sleep and health Noise & Health, September-October 2012, Volume 14, p243 www.noiseandhealth.org

1999 WHO precaution in general

- "…where there is a reasonable possibility that public health will be damaged, action should be taken to protect public health without awaiting full scientific proof."

  - World Health Organization, Guidelines for Community Noise, WHO (1999). http://www.who.int/docstore/peh/noise/guidelines2.html

Children: precaution

- Policy Interpretation Network on Children's Health and Environment:
  - "Policies that may protect children's health or may minimise irreversible health effects should be implemented, and policies or measures should be applied based on the precautionary principle, in accordance with the Declaration of the WHO Fourth Ministerial Conference on Environment and Health in Budapest in 2004."
    - Report WP7 Summary PINCHE policy recommendations Policy Interpretation Network on Children's Health and Environment (PINCHE) Policy Interpretation Network on Children's Health and Environment QLK4-2002-02395

Observations

- Government lack of acknowledgement of health issues
- Burden of proof of causality before prevention and precaution
- Reported loss of trust in the processes/systems
- Loss of decision-making rights (imposed without consent)
- Characterizations: “NIMBYISM” [not in my backyard]; “anti-wind”, “anti-wind activist”; “opponent”; and attributing negative effects based on fright factors/lack of financial agreements/*nocebo* effect.
- Community / individual financial burdens: consultation and appeal processes; relocate; remain exposed; enter into legal actions

Conclusion

- Acknowledge that:
  - Experimental and human research on noise including low frequency noise/infrasound and risk factors are available.
  - If sited too close to residences, wind turbines can cause harm to humans.
  - Children are vulnerable to effects of noise.
- Invoke prevention and precaution before approving more projects.
- Provide relief/remedy to those reporting harm.
- Implement vigilance and long term surveillance monitoring.

For more information

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