New Report from Ontario's Chief Medical Officer Of Health Says There Is No Direct Causal Link Between Wind Turbines And Adverse Health Effects

May 20, 2010 11:00 AM

The scientific evidence does not demonstrate any direct causal link between wind turbine noise and adverse health effects according to a new report from Dr. Arlene King, Ontario's Chief Medical Officer of Health.

The report was prepared by the Chief Medical Officer of Health and in consultation with the Ontario Agency for Health Protection and Promotion, the Ministry of Health and Long-Term Care and the Council of Ontario Medical Officers of Health. The report summarizes the scientific evidence on the potential health impacts of wind turbines.

The report concludes that:

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

- The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct adverse health effects, but it may annoy some people.

QUICK FACTS

- The Ministry of the Environment regulates wind turbines in Ontario.
- The minimum setback distance for wind projects is 550 meters; this intends to ensure noise levels do not exceed 40 decibels at the nearest residence.
- Forty decibels is approximately the noise level experienced in a quiet office or library.
- Ontario has over 690 wind turbines.

- David Jensen
  Ministry of Health and Long-Term Care
  416-314-6197
  ontario.ca/health

The Potential Health Impact of Wind Turbines

Chief Medical Officer of Health (CMOH) Report

May 2010

Summary of Review

This report was prepared by the Chief Medical Officer of Health (CMOH) of Ontario in response to public health concerns about wind turbines, particularly related to noise.

Assisted by a technical working group comprised of members from the Ontario Agency for Health Protection and Promotion (OAHPP), the Ministry of Health and Long-Term Care (MOHLTC) and several Medical Officers of Health in Ontario with the support of the Council of Ontario Medical Officers of Health (COMOH), this report presents a synopsis of existing scientific evidence on the potential health impact of noise generated by wind turbines.

The review concludes that 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. The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct health effects, although some people may find it annoying.

1 Introduction

In response to public health concerns about wind turbines, the CMOH conducted a review of existing scientific evidence on the potential health impact of wind turbines in collaboration and consultation with a technical working group composed of members from the OAHPP, MOHLTC and COMOH.

A literature search was conducted to identify papers and reports (from 1970 to date) on wind turbines and health from scientific bibliographic databases, grey literature, and from a structured Internet search. Databases searched include MEDLINE, PubMed, Environmental Engineering Abstracts, Environment Complete, INSPEC, Scholars Portal and Scopus. Information was also gathered through discussions with relevant government agencies, including the Ministry of the Environment and the Ministry of Energy and Infrastructure and with input provided by individuals and other organizations such as Wind Concerns Ontario.

In general, published papers in peer-reviewed scientific journals, and reviews by recognized health authorities such as the World Health Organization (WHO) carry more weight in the assessment of health risks than case studies and anecdotal reports.

The review and consultation with the Council of Ontario Medical Officers of Health focused on the following questions:

- What scientific evidence is available on the potential health impacts of wind turbines?
- What is the relationship between wind turbine noise and health?
- What is the relationship between low frequency sound, infrasound and health?
- How is exposure to wind turbine noise assessed?
- Are Ontario wind turbine setbacks protective from potential wind turbine health and safety hazards?
- What consultation process with the community is required before wind farms are constructed?
- Are there data gaps or research needs?

The following summarizes the findings of the review and consultation.

2 Wind Turbines and Health

2.1 Overview

A list of the materials reviewed is found in Appendix 1. It includes research studies, review articles, reports, presentations, and websites.

Technical terms used in this report are defined in a Glossary (Page 11).

The main research data available to date on wind turbines and health include:

- Four cross-sectional studies, published in scientific journals, which investigated the relationships between exposure to wind turbine noise and annoyance in large samples of people (351 to 1,948) living in Europe near wind turbines (see section 2.2).
- Published case studies of ten families with a total of 38 affected people living near wind turbines in several countries (Canada, UK, Ireland, Italy and USA) (Pierpont 2009). However, these cases are not found in scientific journals. A range of symptoms including dizziness, headaches, and sleep disturbance, were reported by these people. The researcher (Pierpont) suggested that the symptoms were related to wind turbine noise, particularly low frequency sounds and infrasound, but did not investigate the relationships between noise and symptoms. It should be noted that no conclusions on the health impact of wind turbines can be drawn from Pierpont's work due to methodological limitations including small sample size, lack of exposure data, lack of controls and selection bias.
- Research on the potential health and safety hazards of wind turbine shadow flicker, electromagnetic fields (EMFs), ice throw and ice shed, and structural hazards (see section 2.3).

A synthesis of the research available on the potential health impacts of exposure to noise and physical hazards from wind turbines on nearby residents is found in sections 2.2 and 2.3, including research on low frequency sound and infrasound. This is followed by information on wind turbine regulation in Ontario (section 3.0), and our conclusions (section 4.0).

2.2. Sound and Noise

Sound is characterized by its sound pressure level (loudness) and frequency (pitch), which are measured in standard units known as decibel (dB) and Hertz (Hz), respectively. The normal human ear perceives sounds at frequencies ranging from 20Hz to 20,000 Hz. Frequencies below 200 Hz are commonly referred to as "low frequency sound" and those below 20Hz as "infrasound," but the boundary between them is not rigid. There is variation between people in their ability to perceive sound. Although generally considered inaudible, infrasound at high-enough sound pressure levels can be audible to some people. Noise is defined as an unwanted sound (Rogers et al. 2006, Leventhall 2003).

Wind turbines generate sound through mechanical and aerodynamic routes. The sound level depends on various factors including design and wind speed. Current generation upwind model turbines are quieter than older downwind models. The dominant sound source from modern wind turbines is aerodynamic, produced by the rotation of the turbine blades through air. The aerodynamic noise is present at all frequencies, from infrasound to low frequency to the normal audible range, producing the characteristic "swishing" sound (Leventhall 2006, Colby et al. 2009).

Environmental sound pressure levels are most commonly measured using an A-weighted scale. This scale gives less weight to very low and very high frequency components that is similar to the way the human ear perceives sound. Sound levels around wind turbines are usually predicted by modelling, rather than assessed by actual measurements.

The impact of sound on health is directly related to its pressure level. High sound pressure levels (>75dB) could result in hearing impairment depending on the duration of exposure and sensitivity of the individual. Current requirements for wind turbine setbacks in Ontario are intended to limit noise at the nearest residence to 40 dB (see section 3). This is a sound level comparable to indoor background sound. This noise limit is consistent with the night-time noise guideline of 40 dB that the World Health Organization (WHO) Europe recommends for the protection of public health from community noise. According to the WHO, this guideline is below the level at which effects on sleep and health occurs. However, it is above the level at which complaints may occur (WHO 2009).

Available scientific data indicate that sound levels associated with wind turbines at common residential setbacks are not sufficient to damage hearing or to cause other direct adverse health effects, but some people may still find the sound annoying.

Studies in Sweden and the Netherlands (Pedersen et al. 2009, Pedersen and Waye 2008, Pedersen and Waye 2007, Pedersen and Waye 2004) have found direct relationships between modelled sound pressure level and self-reported perception of sound and annoyance. The association between sound pressure level and sound perception was stronger than that with annoyance. The sound was annoying only to a small percentage of the exposed people; approximately 4 to 10 per cent were very annoyed at sound levels between 35 and 45dBA. Annoyance was strongly correlated with individual perceptions of wind turbines. Negative attitudes, such as an aversion to the visual impact of wind turbines on the landscape, were associated with increased annoyance, while positive attitudes, such as direct economic benefit from wind turbines, were associated with decreased annoyance. Wind turbine noise was perceived as more annoying than transportation or industrial noise at comparable levels, possibly due to its swishing quality, changes throughout a 24 hour period, and lack of night-time abatement.

2.2.1 Low Frequency Sound, Infrasound and Vibration

Concerns have been raised about human exposure to “low frequency sound” and “infrasound” (see section 2.2 for definitions) from wind turbines. There is no scientific evidence, however, to indicate that low frequency sound generated from wind turbines causes adverse health effects.

Low frequency sound and infrasound are everywhere in the environment. They are emitted from natural sources (e.g., wind, rivers) and from artificial sources including road traffic, aircraft, and ventilation systems. The most common source of infrasound is vehicles. Under many conditions, low frequency sound below 40Hz from wind turbines cannot be distinguished from environmental background noise from the wind itself (Leventhall 2006, Colby et al 2009).

Low frequency sound from environmental sources can produce annoyance in sensitive people, and infrasound at high sound pressure levels, above the threshold for human hearing, can cause severe ear pain. There is no evidence of adverse health effects from infrasound below the sound pressure level of 90dB (Leventhall 2003 and 2006).

Studies conducted to assess wind turbine noise indicate that infrasound and low frequency sounds from modern wind turbines are well below the level where known health effects occur, typically at 50 to 70dB.

A small increase in sound level at low frequency can result in a large increase in perceived loudness. This may be difficult to ignore, even at relatively low sound pressures, increasing the potential for annoyance (Jakobsen 2005, Leventhall 2006).

A Portuguese research group (Alves-Pereira and Castelo Branco 2007) has proposed that excessive long-term exposure to vibration from high levels of low frequency sound and infrasound can cause whole body system pathology (vibro-acoustic disease). This finding has not been recognized by the international medical and scientific community. This research group also hypothesized that a family living near wind turbines will develop vibro-acoustic disease from exposure to low frequency sound, but has not provided evidence to support this (Alves-Pereira and Castelo Branco 2007).

2.2.2 Sound Exposure Assessment

Little information is available on actual measurements of sound levels generated from wind turbines and other environmental sources. Since there is no widely accepted protocol for the measurement of noise from wind turbines, current regulatory requirements are based on modelling (see section 3.0).

2.3 Other Potential Health Hazards of Wind Turbines

The potential health impacts of electromagnetic fields (EMFs), shadow flicker, ice throw and ice shed, and structural hazards of wind turbines have been reviewed in two reports (Chatham-Kent Public Health Unit 2008; Rideout et al 2010). The following summarizes the findings from these reviews.

- **EMFs**
  Wind turbines are not considered a significant source of EMF exposure since emissions levels around wind farms are low.

- **Shadow Flicker**
  Shadow flicker occurs when the blades of a turbine rotate in sunny conditions, casting moving shadows on the ground that result in alternating changes in light intensity appearing to flick on and off. About 3 per cent of people with epilepsy are photosensitive, generally to flicker frequencies between 5-30Hz. Most industrial turbines rotate at a speed below these flicker frequencies.

- **Ice Throw and Ice Shed**
  Depending on weather conditions, ice may form on wind turbines and may be thrown or break loose and fall to the ground. Ice throw launched far from the turbine may pose a significant hazard. Ice that sheds from stationary components presents a potential risk to service personnel near the wind farm. Sizable ice fragments have been reported to be found within 100 metres of the wind turbine. Turbines can be stopped during icy conditions to minimize the risk.

- **Structural hazards**
  The maximum reported throw distance in documented turbine blade failure is 150 metres for an entire blade, and 500 metres for a blade fragment. Risks of turbine blade failure reported in a Dutch handbook range from one in 2,400 to one in 20,000 turbines per year (Braam et al 2005). Injuries and fatalities associated with wind turbines have been reported, mostly during construction and maintenance related activities.

3 Wind Turbine Regulation in Ontario

The Ministry of the Environment regulates wind turbines in Ontario. A new regulation for renewable energy projects came into effect on September 24, 2009. The requirements include minimum setbacks and community consultations.

3.1 Setbacks

Provincial setbacks were established to protect Ontarians from potential health and safety hazards of wind turbines including noise and structural hazards.

The minimum setback for a wind turbine is 550 metres from a receptor. The setbacks rise with the number of turbines and the sound level rating of the selected turbines. For example, a wind project with five turbines, each with a sound power level of 107dB, must have its turbines setback at a minimum 950 metres from the nearest receptor.

These setbacks are based on modelling of sound produced by wind turbines and are intended to limit sound at the nearest residence to no more than 40 dB. This limit is consistent with limits used to control noise from other environmental sources. It is also consistent with the night-time noise guideline of 40 dB that the World Health Organization (WHO) Europe recommends for the protection of public health from community noise. According to the WHO, this guideline is below the level at which effects on sleep and health occurs. However, it is above the level at which complaints may occur (WHO 2009).

Ontario used the most conservative sound modelling available nationally and internationally, which is supported by experiences in the province and in other jurisdictions (MOE 2009). As yet, a measurement protocol to verify compliance with the modelled limits in the field has not been developed. The Ministry of the Environment has recently hired independent consultants to develop a procedure for measuring audible sound from wind turbines and also to review low frequency sound impacts from wind turbines, and to develop recommendations regarding low frequency sound.

Ontario setback distances for wind turbine noise control also take into account potential risk of injury from ice throw and structural failure of wind turbines. The risk of injury is minimized with setbacks of 200 to 500 metres.

3.2 Community Consultation

The Ministry of the Environment requires applicants for wind turbine projects to provide written notice to all assessed land owners within 120 metres of the project location at a preliminary stage of the project planning. Applicants must also post a notice on at least two separate days in a local newspaper. As well, applicants are required to notify local municipalities and any Aboriginal community that may have a constitutionally protected right or interest that could be impacted by the project.

Before submitting an application to the Ministry of the Environment, the applicant is also required to hold a minimum of two community consultation meetings to discuss the project and its potential local impact. To ensure informed consultation, any required studies must be made available for public review 60 days prior to the date of the final community meeting. Following these meetings the applicant is required to submit as part of their application a Consultation Report that describes the comments received and how these comments were considered in the proposal.

The applicant must also consult directly with local municipalities prior to applying for a Renewable Energy Approval on specific matters related to municipal lands, infrastructure, and services. The Ministry of the Environment has developed a template, which the applicant is required to use to document project-specific matters raised by the municipality. This must be submitted to the ministry as part of the application. The focus of this consultation is to ensure important local service and infrastructure concerns are considered in the project.

For small wind projects (under 50 kW) the public meeting requirements above are not applicable due to their limited potential impacts.

4 Conclusions

The following are the main conclusions of the review and consultation on the health impacts of wind turbines:

- 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.
- The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct adverse health effects. However, some people might find it annoying. It has been suggested that annoyance may be a reaction to the characteristic "swishing" or fluctuating nature of wind turbine sound rather than to the intensity of sound.
- Low frequency sound and infrasound from current generation upwind model turbines are well below the pressure sound levels at which known health effects occur. Further, there is no scientific evidence to date that vibration from low frequency wind turbine noise causes adverse health effects.
- Community engagement at the outset of planning for wind turbines is important and may alleviate health concerns about wind farms.
- Concerns about fairness and equity may also influence attitudes towards wind farms and allegations about effects on health. These factors deserve greater attention in future developments.

The review also identified that sound measurements at residential areas around wind turbines and comparisons with sound levels around other rural and urban areas, to assess actual ambient noise levels prevalent in Ontario, is a key data gap that could be addressed. An assessment of noise levels around wind power developments and other residential environments, including monitoring for sound level compliance, is an important prerequisite to making an informed decision on whether epidemiological studies looking at health outcomes will be useful.

Glossary

A-weighted decibels (dBA)
The sound pressure level in decibels as measured on a sound level meter using an A-weighted filter. The A-weighted filter de-emphasizes the very low and very high frequencies of the sound in a manner similar to the frequency response of the human ear.

Decibel (dB)
Unit of measurement of the loudness (intensity) of sound. Loudness of normal adult human voice is about 60-70 dB at three feet. The decibel scale is a logarithmic scale and it increases/decreases by a factor of 10 from one scale increment to the next adjacent one.

Downwind model turbines
Downwind model turbines have the blades of the rotor located behind the supporting tower structure, facing away from the wind. The supporting tower structure blocks some of the wind that blows towards the blades.

Electromagnetic fields (EMFs)
Electromagnetic fields are a combination of invisible electric and magnetic fields. They occur both naturally (light is a natural form of EMF) and as a result of human activity. Nearly all electrical and electronic devices emit some type of EMF.

Grey literature
Information produced by all levels of government, academics, business and industry in electronic and print formats not controlled by commercial publishing, i.e., where publishing is not the primary activity of the producing body.

Hertz (Hz)
A unit of measurement of frequency; the number of cycles per second of a periodic waveform.

Infrasound
Commonly refers to sound at frequencies below 20Hz. Although generally considered inaudible, infrasound at high-enough sound pressure levels can be audible to some people.

Low frequency sound
Commonly refers to sound at frequencies between 20 and 200 Hz.

Noise
Noise is an unwanted sound.

Shadow Flicker
Shadow flicker is a result of the sun casting intermittent shadows from the rotating blades of a wind turbine onto a sensitive receptor such as a window in a building. The flicker is due to alternating light intensity between the direct beam of sunlight and the shadow from the turbine blades.

Sound
Sound is wave-like variations in air pressure that occur at frequencies that can be audible. It is characterized by its loudness (sound pressure level) and pitch (frequency), which are measured in standard units known as decibel (dB) and Hertz (Hz), respectively. The normal human ear perceives sounds at frequencies ranging from 20Hz to 20,000 Hz.

Upwind model turbines
Upwind model turbines have the blades of the rotor located in front of the supporting tower structure, similar to how a propeller is at the front of an airplane. Upwind turbines are a modern design and are quieter than the older downwind models.

Wind turbine
Wind turbines are large towers with rotating blades that use wind to generate electricity.

Appendix 1: List of Documents on Wind Turbines

Journal Articles and Books

Braam HGJ, et al. Handboek risicozonering windturbines. Netherlands: SenterNovem; 2005.

Jakobsen J. Infrasound emission from wind turbines. *J Low Freq Noise Vib Active Contr*. 2005;24(3):145-155.

Keith SE, Michaud DS, Bly SHP. A proposal for evaluating the potential health effects of wind turbine noise for projects under the Canadian Environmental Assessment Act. *J Low Freq Noise Vib Active Control*. 2008;27(4):253-265.

Leventhall G. Infrasound from wind turbines: fact, fiction or deception. *Can Acoust*. 2006;34(2):29-36.

Pedersen E, Hallberg LR-M, Waye KP. Living in the vicinity of wind turbines: a grounded theory study. *Qual Res Psychol*. 2007;4(1-2):49-63.

Pedersen E, Larsman P. The impact of visual factors on noise annoyance among people living in the vicinity of wind turbines. *J Environ Psychol*. 2008;28(4):379-389.

Pedersen E, Persson Waye K. Wind turbines: low level noise sources interfering with restoration? *Environ Res Lett*. 2008;3:015002. Available from: http://www.iop.org/EJ/article/1748-9326/3/1/015002/erl8_1_015002.pdf.

Pedersen E, Persson Waye K. Wind turbine noise, annoyance and self-reported health and well-being in different living environments. *Occup Environ Med*. 2007;64(7):480-6.

Pedersen E, van den Berg F, Bakker R, Bouma J. Response to noise from modern wind farms in The Netherlands. *J Acoust Soc Am*. 2009;126(2):634-43.

Pedersen E, Waye KP. Perception and annoyance due to wind turbine noise – a dose-response relationship. *J Acoust Soc Am*. 2004;116(6):3460-70.

van den Berg GP. Effects of the wind profile at night on wind turbine sound. *J Sound Vib*. 2004;277(4-5):955-970. Available from: http://www.nowap.co.uk/docs/windnoise.pdf.

Grey Literature

Chatham-Kent Public Health Unit. The health impact of wind turbines: a review of the current white, grey, and published literature. Chatham, ON: Chatham-Kent Municipal Council; 2008 [cited 2010 Mar 5]. Available from: http://www.wind-works.org/LargeTurbines/Health%20and%20Wind%20by%20C-K%20Health%20Unit.pdf.

Colby WD, Dobie R, Leventhall G, Lipscomb DM, McCunney RJ, Seilo MT, et al. Wind turbine sound and health effects. An expert panel review: American Wind Energy Association & Canadian Wind Energy Association; 2009 [cited 2009 Dec 21]. Available from: http://www.canwea.ca/pdf/talkwind/Wind_Turbine_Sound_and_Health_Effects.pdf.

Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 Mar 5]. Available from: http://www.ncceh.ca/files/Wind_Turbines_January_2010.pdf.

Wind turbines and Health: a review of evidence. Toronto: Ontario Agency for Health Protection and Promotion; 2009 [cited 2010 Mar 5]. Available from: http://www.oahpp.ca/resources/documents/presentations/2009sept10/Wind%20Turbines%20-%20Sept%2010%202009.pdf.

Environmental Protection Agency, Office of Water. Auxiliary and supplemental power fact sheet: wind turbines. Washington, DC: Environmental Protection Agency; 2007 [cited 2010 Jan 7]. Available from http://www.epa.gov/owm/mtb/wind_final.pdf.

Leventhall G, Pelmear P, Benton S. A review of published research on low frequency noise and its effects. London, England: Department for Environment, Food and Rural Affairs; 2003 [cited 2010 Mar 5]. Contract No.: EPG 1/2/50. Available from: http://www.defra.gov.uk/environment/quality/noise/research/lowfrequency/documents/lowfreqnoise.pdf.

Minnesota Department of Health, Environmental Health Division. Public health impacts of wind turbines.

Saint Paul, MN: Minnesota Department of Commerce, Office of Energy Security; 2009 [cited 2010 Mar 5]. Available from: http://energyfacilities.puc.state.mn.us/documents/Public%20Health%20Impacts%20of%20Wind%20Turbines,%205.22.09%20Revised.pdf.

National Research Council, Committee on Environmental Impacts of Wind-Energy Projects. Environmental impacts of wind-energy projects. Washington, DC: National Academies Press; 2007.

Ontario. Ministry of the Environment. Frequently asked questions: renewable energy approval. Toronto: Queen's Printer for Ontario; 2009. Available from: http://www.ene.gov.on.ca/en/business/green-energy/docs/FAQs%20-final.pdf.

Ontario. Ministry of the Environment. Noise guidelines for wind farms: interpretation for applying MOE NPC publications to wind power generation facilities. Toronto: Queen's Printer for Ontario; 2008 [cited 2010 Mar 5]. Available from: http://www.ene.gov.on.ca/publications/4709e.pdf.

Ontario. Ministry of the Environment. Development of noise setbacks for wind farms: requirements for compliance with MOE noise limits. Toronto, ON: Queen's Printer for Ontario; 2009. Available from http://www.ene.gov.on.ca/en/business/green-energy/docs/WindNoiseSetbacks.pdf.

Pedersen E. Human response to wind turbine noise: perception, annoyance and moderating factors. Göteborg, Sweden: Göteborgs Universitet, Sahlgrenska Acedemy, Department of Public Health and Community Medicine; 2007 [cited 2010 Mar 5]. Available from: http://gupea.ub.gu.se/dspace/bitstream/2077/4431/1/gupea_2077_4431_1.pdf.

Pierpont N. Wind turbine syndrome: a report on a natural experiment [pre-publication draft]. Santa Fe, NM: K-Selected Books; 2009 [cited 2010 Mar 5]. Available from: http://www.windturbinesyndrome.com/wp-content/uploads/2009/03/ms-ready-for-posting-on-wtscom-3-7-09.pdf.

Ramakrishnan R (Aiolos Engineering Corporation). Wind turbine facilities noise issues. Toronto: Queen's Printer for Ontario; 2007 [cited 2010 Mar 5]. Report No.: 4071/2180/AR155Rev3. Available from: https://ozone.scholarsportal.info/bitstream/1873/13073/1/283287.pdf.

Rogers AL, Manwell JF, Wright S. Wind turbine acoustic noise: a white paper. Amherst, MA: University of Massachusetts at Amherst, Department of Mechanical and Industrial Engineering, Renewable Energy Research Laboratory; 2006 [cited 2010 Mar 5]. Available from: http://www.ceere.org/rerl/publications/whitepapers/Wind_Turbine_Acoustic_Noise_Rev2006.pdf.

van den Berg F, Pedersen E, Bouma J, Bakker R. Project WINDFARMperception: visual and acoustic impact of wind turbine farms on residents: final report. Groningen, Netherlands: University of Groningen; 2008 [cited 2010 Mar 5]. Published jointly by the University of Groningen and the University of Gothenburg. Available from: http://www.wind-watch.org/documents/wp-content/uploads/wfp-final-1.pdf.

Whitford J. Model wind turbine by-laws and best practices for Nova Scotia municipalities: final report. Halifax, NS: Union of Nova Scotia Municipalities; 2008 [cited 2009 Apr 21]. Contract No.: 1031581. Available from: http://www.sustainability-unsm.ca/our-work.html.

World Health Organization

World Health Organization, Regional Office for Europe. Night noise guidelines for Europe. Geneva, Switzerland: World Health Organization; 2009 [cited 2010 Mar 5]. Available from: http://www.euro.who.int/document/e92845.pdf.

World Health Organization. Occupational and community noise. Fact sheet no. 258. Geneva, Switzerland: World Health Organization; 2001 [cited 2010 Mar 5]. Available from: http://www.who.int/mediacentre/factsheets/fs258/en/.

Community Concerns about Health Effects of Wind Turbines

Archives and Collections Society. Some health aspects of wind driven industrial turbines. Picton, ON: Archives and Collections Society; c2003-2004 [cited 2010 Mar 5]. Available from: http://www.aandc.org/research/wind_community_health.html.

Gillis L, Krogh C, Kouwen N. A self-reporting survey: adverse health effects with industrial wind turbines and the need for vigilance. London, ON: WindVOiCe: Wind Vigilance for Ontario Communities; 2009. Available from: http://windconcernsontario.files.wordpress.com/2009/04/windvoice__sept__24__20091.pdf.

McMurtry R. Deputation to the Ontario Standing Committee on General Government regarding Bill C-150. Scarborough, ON: Wind Concerns; 2009 Apr 22 [cited 2010 Mar 5]. Available from: http://windconcernsontario.files.wordpress.com/2009/04/deputation-to-standing-committee-mcmurtry.pdf

National Wind Watch: presenting the facts about industrial wind power. Rowe, MA: National Wind Watch; [cited 2010 Mar 5]. Available from: http://www.wind-watch.org/.

Wind Concerns Ontario: bringing sanity to wind development in Ontario. Scarborough, ON: Wind Concerns; [cited 2010 Mar 5]. Available from: http://windconcernsontario.wordpress.com/.

Conference Papers

Alves-Pereira M, Castelo Branco NAA. Infrasound and low frequency noise dose responses: contributions. In: Proceedings of the Inter-Noise Congress; 2007 Aug 28-31; Istanbul, Turkey.

Alves-Pereira M, Castelo Branco NAA. In-home wind turbine noise is conductive to vibroacoustic disease. In: Proceedings of the 2nd International Meeting on Wind Turbine Noise. 2007 Sep 20-21; Lyon, France.

Alves-Pereira M, Castelo Branco NAA. Public health and noise exposure: the importance of low frequency noise. In: Proceedings of the Inter-Noise Congress; 2007 Aug 28-31; Istanbul, Turkey.

Alves-Pereira M, Castelo Branco NAA. The scientific arguments against vibroacoustic disease. In: Proceedings of the Inter-Noise Congress. Istanbul; 2007 Aug 28-31; Istanbul, Turkey.

van den Berg GP. Do wind turbines produce significant low frequency sound levels? In: Proceedings of the 11th International Meeting on Low Frequency Noise and Vibration and its Control. 2004 Aug 30-Sep 1; Maastricht, Netherlands.

Institute for Energy Research Admits It Was Behind Anti-Wind Study

Danish journalists have confirmed that The Institute for Energy Research commissioned and paid for the anti-wind energy study released last year by a Danish think tank that claimed Denmark exaggerates the amount of wind energy it produces (it doesn't), questioned whether wind energy reduces carbon emissions (it does), and asserted that the U.S. should choose coal over wind because it's cheaper (it's not when you count the true costs of coal).

The Copenhagen Post reports:
"A controversial report critical of the wind energy industry from conservative think tank CEPOS was commissioned and paid for by an American think tank with close ties to the coal and oil industries."

That American think tank is the Institute for Energy Research, which has received $307,000 from ExxonMobil since 1998 and unknown additional sums from other oil and coal industry sources. The Guardian reported last year that the Institute for Energy Research has received recent funding from KBR and trusts set up by Koch Industries, which has multiple ties to IER and its sister organization American Energy Alliance.

IER's President Thomas J. Pyle previously worked as a lobbyist for Koch Industries, while IER's CEO Robert L. Bradley was formerly Director of Public Relations Policy at Enron, where he served as speechwriter for Enron CEO Kenneth Lay.

Pyle, Bradley and IER have direct and indirect ties to a laundry list of dirty energy industry front groups, including the Competitive Enterprise Institute, TASSC, the Cato Institute, the Heritage Foundation and the Mackinac Center for Public Policy. Bradley and the IER have argued that supplies of fossil fuels are virtually limitless, and that American dependence on oil imports from Middle Eastern dictatorships "pose no threat to national security."

IER has railed against green jobs, arguing that oil and gas are better job creators, despite the fact that investment in clean energy technology creates four times as many jobs as investment in oil and gas. IER continues its campaign against wind energy as well, asserting recently that the Obama administration had been "caught red-handed working with Big Wind energy lobbyists."

Yes, those scary "Big Wind energy lobbyists" pose a real threat to America. You can't make this stuff up folks. Unless, of course, you work at the oil-and-coal-funded Institute for Energy Research.

http://www.desmogblog.com/institute-energy-research-admits-it-was-behind-anti-wind-study

TORONTO STAR

Healthy wind blows away toxic coal

Gideon Forman Executive director, Canadian Association of Physicians for the Environment - November 26, 2010

This week's release of Ontario's long-term electricity plan raises anew the debate about coal and renewables' impact on health and the environment.

On one side is the anti-wind lobby. Organizations such as Wind Concerns Ontario say turbines negatively impact more than 100 Ontarians, depriving people of sleep, producing headaches, and even contributing to heart palpitations. They also believe the structures are a hazard to migrating birds and bats. No doubt these groups are displeased by the proposal to raise capital spending on wind to $14 billion.

On the other side are Ontario health professionals who for years have been advocating the coal plants' elimination. They point out these plants are the single largest source of greenhouse gases in the province and are no doubt pleased by the energy plan's commitment to fast-track the closure of two units at the Nanticoke facility; originally set to go in 2014, they'll now be shut in 2011.

But in the midst of this ruckus, there's an often-missed and very important distinction to be made: Coal plants are inherently harmful while wind turbines are not.

When you burn fossil fuel, you produce toxic by-products. In fact, at their peak Ontario's coal plants emit the greenhouse gases of 7 million automobiles. The plants also release lead and mercury (brain poisons), dioxin (an endocrine disrupter), chromium and arsenic (carcinogens), and sulphur dioxide and nitrogen oxide (which cause acid rain).

Even if you capture and store these chemicals — and they'd need to be secure for thousands of years — there's always the possibility they will escape. After all, storage doesn't destroy them, it only takes them out of circulation.

The upshot is burning coal always creates poisons. There is simply no getting around this. Hence the danger in fossil fuel combustion is intrinsic — the technology cannot be made safe.

The situation with wind power is importantly different. The turbines are not, in principle, destructive. They do need to be properly sited and not every location is appropriate. For example, they need to be set back from homes and schools to reduce noise disturbance. They need to be kept away from "important bird areas" and other significant animal habitats to ensure they don't negatively impact wildlife. But once these conditions are met, wind power is essentially benign.

As Ontario Chief Medical Officer of Health Dr. Arlene King has noted, “The scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects.”

And with respect to birds, the American Audubon Society is on record as saying: “Audubon strongly supports properly sited wind power as a clean alternative energy source that reduces the threat of global warming.”

Wind operations do not produce smog or acid rain. They do not contribute to cancer. They do not contribute to brain damage. They do not contribute to climate change.
They make some noise and sometimes throw ice but these problems can be resolved through setbacks. In other words, the turbines’ shortcomings can be satisfactorily addressed. Wind isn’t perfect but its problems aren’t in its very nature; they have to do with where the technology is placed.

Not so in the case of coal. No matter what we do with this fuel we’re left with the fact its combustion produces toxic chemicals. As long as we’re burning fossils, we’re doing something harmful.
Wind is fundamentally safe but can it power an advanced industrial society?

No one argues it can replace fossil fuel on its own but it’s a vital component of a smart mix that should include solar energy, Niagara Falls and geothermal power.

It’s also worth noting that on some days wind’s contribution to the grid is actually greater than coal’s. On the morning of Sept. 25, for example, the province received 698 megawatts from the former but only 488 from the latter.

Coal’s destructiveness is enormous. In Ontario alone it causes $371 million in environmental harm (e.g., the expense of greenhouse gas controls) and $3 billion in health damages annually, according to a study done for the Ministry of Energy. This is in addition to its harrowing human cost: 246 deaths and more than 120,000 people made sick (e.g., with asthma attacks) each year.

Ontario has promised to completely eliminate the use of this fuel by 2014, but a high-profile group of health organizations — including the Ontario College of Family Physicians, the Asthma Society of Canada, the Lung Association, and the Registered Nurses’ Association of Ontario — are urging Queen’s Park to shutter the plants by the end of 2010.

Doing so will save nearly 1,000 lives and prevent hundreds of thousands of illnesses. And the province has more than enough coal-free power (29,000 megawatt capacity vs. 25,000 megawatt demand) to supply all the electricity it needs.

A speedy end to coal would be Ontario’s gift to the world, the single largest GHG reduction project in North America and a powerful precedent capable of pushing other jurisdictions into action.
It would prove that industrial societies are ready — not some time in the future but right now — to abandon the planet’s most climate-destructive fuel while still keeping on the lights.