"*Don't tell me about the science*"

Wind Turbines and Human Health: An Emotional Topic

Loren D. Knopper, Ph.D.
Intrinsik Environmental Sciences, Inc. Mississauga, ON, Canada

OEH Seminar Series: March 20, 2014

The next 60 minutes

- Introduction
- Issues
- Weight of evidence conclusions
- Questions/Discussion

My opinions do not necessarily reflect the official policies or views of Public Health Ontario or the other partners involved with this seminar series.

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Objectives

1. Provide a balanced discussion on the issue of wind turbines and human health
2. Provide information for health care practitioners and academics so they can offer informed discussions
3. Provide a list of resources for further learning

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Who am I?

- Environmental Health Scientist
  - human health and ecological risk assessment, human and ecological toxicology and health, public communication and scientific training
- Co-lead of Intrinsik's Renewable Energy Health Team
  - Dr. Christopher Ollson
  - Dr. Melissa Whitfield Aslund
  - Ms. Lindsay McCallum (Ph.D. Candidate)
  - Dr. Mary McDaniel, DO, JD, MPH
  - Dr. Robert Berger

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Expertise in Wind Turbines and Human Health

- As human health experts in public forums (e.g., open houses, town halls)
- Speakers at municipal and First Nation councils
- Provide legal support for a number of tribunals and legal challenges in Canada and the US
- Our ongoing interest and involvement has led to a number of peer-reviewed scientific publications

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Knopper and Ollson *Environmental Health* 2011, **10**:78
http://www.ehjournal.net/content/10/1/78

ENVIRONMENTAL HEALTH

REVIEW Open Access

Health effects and wind turbines: A review of the literature

Loren D Knopper[1*] and Christopher A Ollson[2]

Viewed >27,000 times
Ranks 8th most viewed 2013
Ranks 11th all time
Cited >30 times

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Noise & Health
A Bi-monthly Inter-disciplinary International Journal
www.noiseandhealth.org

Letter to Editor: Are the findings of "Effects of industrial wind turbine noise on sleep and health" supported?

Christopher A. Ollson,
Loren D. Knopper, Lindsay C. McCallum,
Melissa L. Whitfield-Aslund

Noise & Health, March-April 2013, Volume 15:63, 148-52

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Energy Policy 62 (2013) 44–50

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Projected contributions of future wind farm development to community noise and annoyance levels in Ontario, Canada

Melissa L. Whitfield Aslund, Christopher A. Ollson, Loren D. Knopper *

ENVIRONMENTAL HEALTH

Research

Highly accessed Open Access

Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern?

Lindsay C McCallum[1,2], Melissa L Whitfield Aslund[2], Loren D Knopper[2], Glenn M Ferguson[2] and Christopher A Ollson[2*]

* Corresponding author: Christopher A Ollson collson@intrinsik.com

1 Department of Physical and Environmental Sciences, University of Toronto at Scarborough, Toronto, Ontario, Canada

2 Intrinsik Environmental Sciences Inc, 500 - 6605 Hurontario Street, L5T 0A3, Mississauga, Ontario, Canada

For all author emails, please log on.

Environmental Health 2014, **13**:9 doi:10.1186/1476-069X-13-9

In last 30 days viewed ~1500 times, 3rd most viewed

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frontiers in
PUBLIC HEALTH

Epidemiology

Wind turbines and human health: The issues fueling the debate

Topic Editors:
Loren Knopper, Intrinsik Environmental Sciences, Canada
Christopher A. Ollson, Intrinsik Environmental Sciences, Canada

nature publishing group npg
frontiers

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The Issues

- Public generally favours the idea of wind energy.

In the future, there will be no difference between waste and energy.

HSBC

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The Issues

- The favour does not always translate into local acceptance of projects.

The Issues

- Those opposed point to a number of issues concerning wind turbines.
  - Human health is commonly discussed.
- A proportion of people that live near wind turbines self-report health effects they attribute to turbines.

Self-reported Health Effects

- Chapman, S. 2013. Symptoms, Diseases and Aberrant Behaviours Attributed to Wind Turbine Exposure
  - 234 symptoms from sources around the world
  - http://tobacco.health.usyd.edu.au/assets/pdfs/publications/DiseaseListIntro.pdf

Self reported symptoms generally include:

- sleep disturbance
- tiredness
- headache
- tinnitus (ringing in the ears)
- ear pressure
- dizziness
- vertigo
- nausea
- visual blurring
- tachycardia (rapid heart rate)
- irritability
- problems with concentration and memory
- panic episodes
- (death)

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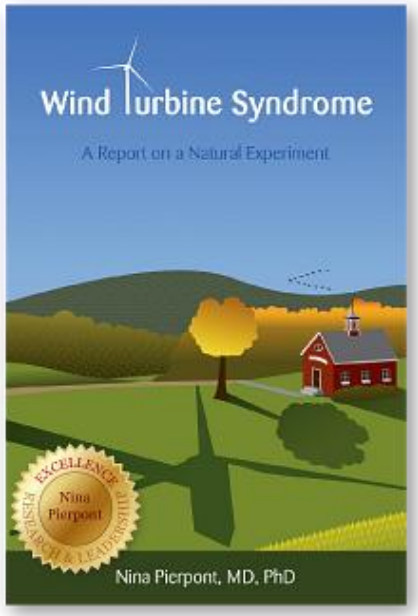
The Emergence of Health Effects as an Issue for Wind Turbines

- This collection of effects has received the colloquial name “Wind Turbine Syndrome”
  - Coined by Dr. Nina Pierpont in her self-published book “Wind Turbine Syndrome: A Report on a Natural Experiment” (Pierpont, 2009).



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Human Health - the debate

- Science
  - ~60 peer-reviewed articles
- Government/Medical agency reviews
  - global
- Legal arena
  - Tribunals, hearings, suits
- Internet
  - “wind turbines and human health”
  - 1,350,000 hits (of variable quality)

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Human Health – the debate

Health effects related to wind turbine operation

- shadow flicker;
- electromagnetic fields;
- audible/inaudible noise.

Health effects related to subjective issues*

- attitude;
- economics;
- visual cue;
- stress;
- expectations.

*based on proper noise setbacks

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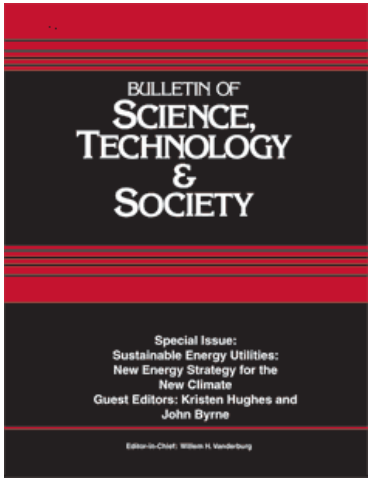
Health effects related to wind turbine operation

- Around 20 articles
- Many published in one journal
- Many of these authors on advisory board of the Society for Wind Vigilance, an advocacy group in ON



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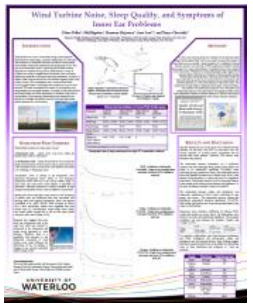
A few key "*Health effects related to wind turbine operation*" papers

- **Nissenbaum, M.A., Aramini, J.J., Hanning, C.D.** 2012. Effects of industrial wind turbines noise on sleep and health. Noise & Health 14 (60): 237-243
- Paller, C., Bigelow, P., Majowicz, S., Law, J., and Christidis, T. 2013 "Wind Turbine Noise, Sleep Quality and Symptoms of Inner Ear Problems"
- **Jeffery, R.D., Krogh, C., and Horner, B.** 2013. Adverse health effects of industrial wind turbines. Canadian Family Physician. 59: 473-475
- **Jeffery, R.D., Krogh, C., and Horner, B.** 2014. Industrial wind turbines and adverse health effects. Canadian Journal of Rural Medicine. 19(1): 21-26



Canadian Journal of Rural Medicine

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Nissenbaum et al. 2012

- Compared the sleep and general health people living between 375 and 6,600 metres of two wind farms in Maine.
- The study used validated questionnaires to collect this information (PSQI, ESS, SF-36).
- The authors reported that those living between 375 metres to 1,400 metres had worse sleep, were sleepier during the day and had poorer mental health scores than those people living between 3,300 metres to 6,600 metres from the two wind farms.
- Attributed effects to wind turbine noise.

Letter to Editor: Are the findings of "Effects of industrial wind turbine noise on sleep and health" supported?

Christopher A. Ollson, Loren D. Knopper, Lindsay C. McCallum, Melissa L. Whitfield-Aslund

Intrinsik Environmental Sciences, 6605 Hurontario St., Mississauga, ON L5T 0A3, Canada.

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Dr. Christopher A. Ollson, Intrinsik Environmental Sciences Inc, 6605 Hurontario Street, Suite 500, Mississauga, ON L5T 0A3, Canada.
E-mail: collson@intrinsik.com

Are the Authors Conclusions Supported?

Based on their findings the author's concluded that:
"…the noise emissions of IWTs disturbed the sleep and caused day-time sleepiness and impaired mental-health in residents living within 1.4 km of the two IWT installations studied."[1]

Overall, in our opinion the authors extend their conclusions and discussion beyond the statistical findings of their study. We believe that they have not demonstrated a statistical link between wind turbines – distance – sleep quality – sleepiness and health. In fact, their own statistical findings suggest that although, scores may be statistically different between near and far groups for sleep quality and sleepiness, they are no different than those reported in the general population. The claims of causation by the authors (i.e., wind turbine noise) for negative MCS scores are not supported by their data. This work is exploratory in nature and should not be used to set definitive setback guidelines for wind-turbine installations.

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Nissenbaum et al. (PSQI)

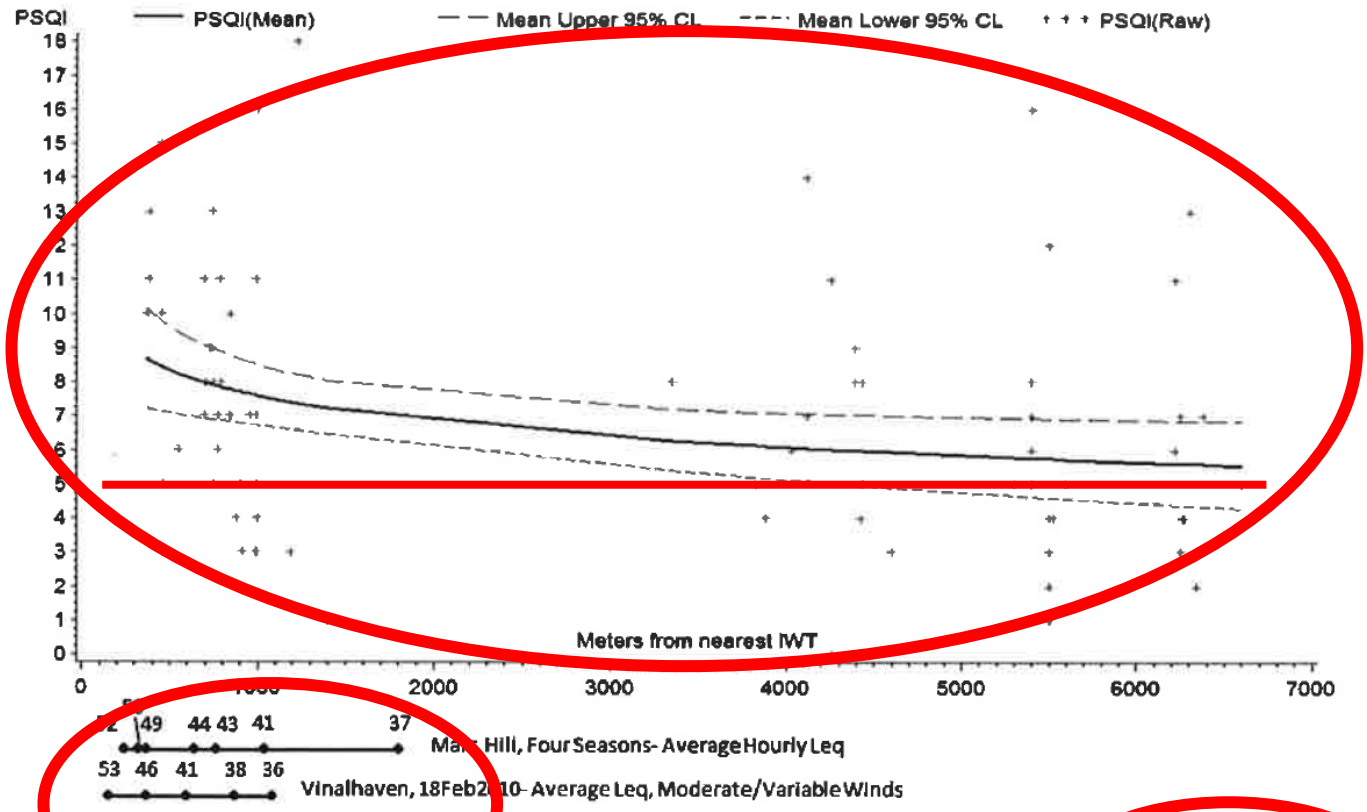

Figure 1: Modeled Pittsburgh Sleep Quality Index (PSQI) versus distance to nearest IWT (mean and 95% confidence limits) Regression equation: PSQI = ln (distance) + sex + age + site [controlled for household clustering]. Ln (distance) *p*-value = 0.0198

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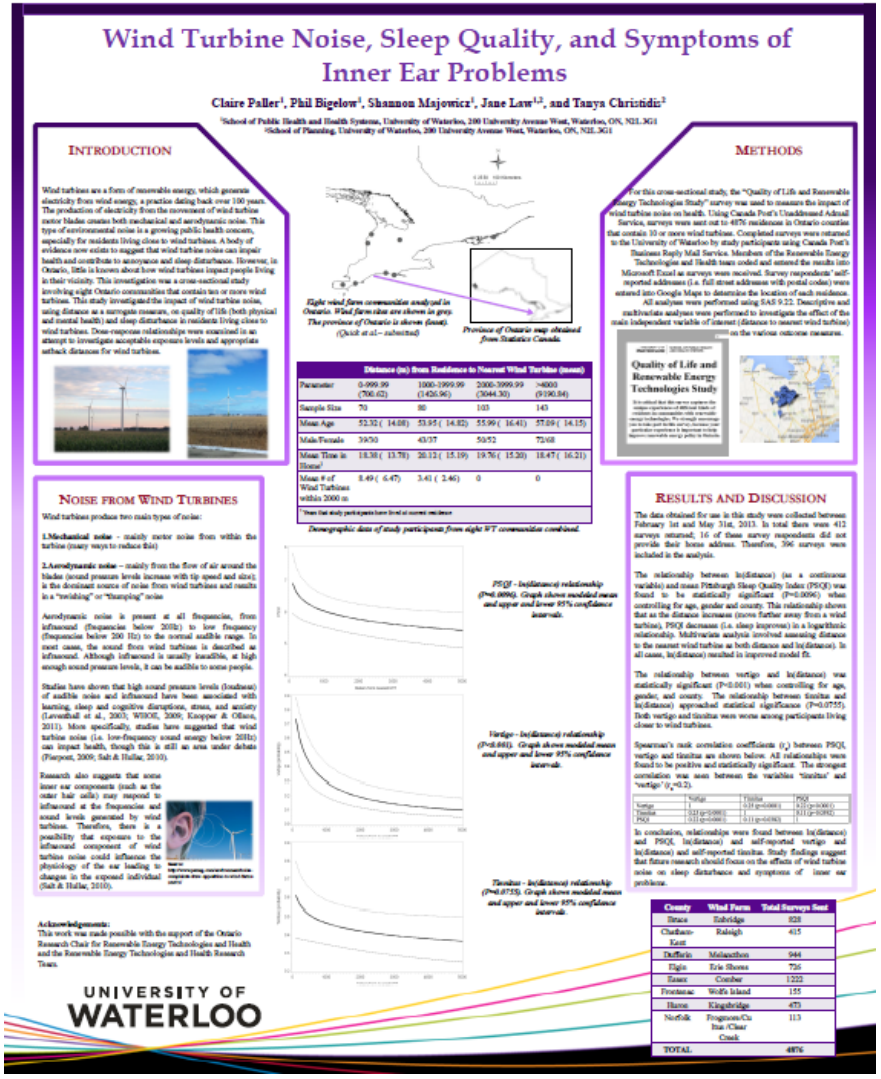
U of Waterloo Paller et al. (PSQI)



Wind Turbine Noise, Sleep Quality, and Symptoms of Inner Ear Problems

Claire Paller[1], Phil Bigelow[1], Shannon Majowicz[1], Jane Law[1,2], and Tanya Christidis[2]

[1]School of Public Health and Health Systems, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1
[2]School of Planning, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1

INTRODUCTION

Wind turbines are a form of renewable energy, which generate electricity from wind energy, a practice dating back over 100 years. The production of electricity from the movement of wind turbine rotor blades creates both mechanical and aerodynamic noise. This type of environmental noise is a growing public health concern, especially for residents living close to wind turbines. A body of evidence now exists to suggest that wind turbine noise can impair health and contribute to annoyance and sleep disturbance. However, in Ontario, little is known about how wind turbines impact people living in their vicinity. This investigation was a cross-sectional study involving eight Ontario communities that contain ten or more wind turbines. This study investigated the impact of wind turbine noise, using distance as a surrogate measure, on quality of life (both physical and mental health) and sleep disturbance in residents living close to wind turbines. Dose-response relationships were examined in an attempt to investigate acceptable exposure levels and appropriate setback distances for wind turbines.

Eight wind farm communities analyzed in Ontario. Wind farm sites are shown in grey. The province of Ontario is shown (inset). (Quick et al.– submitted)

Province of Ontario map obtained from Statistics Canada.

METHODS

For this cross-sectional study, the "Quality of Life and Renewable Energy Technologies Study" survey was used to measure the impact of wind turbine noise on health. Using Canada Post's Unaddressed Admail Service, surveys were sent out to 4876 residences in Ontario counties that contain 10 or more wind turbines. Completed surveys were returned to the University of Waterloo by study participants using Canada Post's Business Reply Mail Service. Members of the Renewable Energy Technologies and Health team coded and entered the results into Microsoft Excel as surveys were received. Survey respondents' self-reported addresses (i.e. full street addresses with postal codes) were entered into Google Maps to determine the location of each residence. All analyses were performed using SAS 9.22. Descriptive and multivariate analyses were performed to investigate the effect of the main independent variable of interest (distance to nearest wind turbine) on the various outcome measures.

Distance (m) from Residence to Nearest Wind Turbine (mean)				
Parameter	0-999.99 (706.62)	1000-1999.99 (1426.96)	2000-3999.99 (3044.30)	>4000 (9190.84)
Sample Size	70	80	103	143
Mean Age	52.32 (14.08)	53.95 (14.82)	55.99 (16.41)	57.09 (14.15)
Male/Female	39/30	43/37	50/52	72/68
Mean Time in Home[1]	18.38 (13.78)	20.12 (15.19)	19.76 (15.20)	18.47 (16.21)
Mean # of Wind Turbines within 2000 m	8.49 (6.47)	3.41 (2.46)	0	0

[1]Years that study participants have lived at current residence

Demographic data of study participants from eight WT communities combined.

NOISE FROM WIND TURBINES

Wind turbines produce two main types of noise:

1.**Mechanical noise** - mainly motor noise from within the turbine (many ways to reduce this)

2.**Aerodynamic noise** – mainly from the flow of air around the blades (sound pressure levels increase with tip speed and size); is the dominant source of noise from wind turbines and results in a "swishing" or "thumping" noise

Aerodynamic noise is present at all frequencies, from infrasound (frequencies below 20Hz) to low frequency (frequencies below 200 Hz) to the normal audible range. In most cases, the sound from wind turbines is described as infrasound. Although infrasound is usually inaudible, at high enough sound pressure levels, it can be audible to some people.

Studies have shown that high sound pressure levels (loudness) of audible noise and infrasound have been associated with learning, sleep and cognitive disruptions, stress, and anxiety (Leventhall et al., 2003; WHOE, 2009; Knopper & Ollson, 2011). More specifically, studies have suggested that wind turbine noise (i.e. low-frequency sound energy below 20Hz) can impact health, though this is still an area under debate (Pierpont, 2009; Salt & Hullar, 2010).

Research also suggests that some inner ear components (such as the outer hair cells) may respond to infrasound at the frequencies and sound levels generated by wind turbines. Therefore, there is a possibility that exposure to the infrasound component of wind turbine noise could influence the physiology of the ear leading to changes in the exposed individual (Salt & Hullar, 2010).

PSQI - ln(distance) relationship (P=0.0096). Graph shows modeled mean and upper and lower 95% confidence intervals.

Vertigo - ln(distance) relationship (P=0.041). Graph shows modeled mean and upper and lower 95% confidence intervals.

Tinnitus - ln(distance) relationship (P=0.0755). Graph shows modeled mean and upper and lower 95% confidence intervals.

RESULTS AND DISCUSSION

The data obtained for use in this study were collected between February 1st and May 31st, 2013. In total there were 412 surveys returned; 16 of these survey respondents did not provide their home address. Therefore, 396 surveys were included in the analysis.

The relationship between ln(distance) (as a continuous variable) and mean Pittsburgh Sleep Quality Index (PSQI) was found to be statistically significant (P=0.0096) when controlling for age, gender and county. This relationship shows that as the distance increases (move further away from a wind turbine), PSQI decreases (i.e. sleep improves) in a logarithmic relationship. Multivariate analysis involved assessing distance to the nearest wind turbine as both distance and ln(distance). In all cases, ln(distance) resulted in improved model fit.

The relationship between vertigo and ln(distance) was statistically significant (P=0.041) when controlling for age, gender, and county. The relationship between tinnitus and ln(distance) approached statistical significance (P=0.0755). Both vertigo and tinnitus were worse among participants living closer to wind turbines.

Spearman's rank correlation coefficients (r_s) between PSQI, vertigo and tinnitus are shown below. All relationships were found to be positive and statistically significant. The strongest correlation was seen between the variables 'tinnitus' and 'vertigo' (r_s=0.2).

	Vertigo	Tinnitus	PSQI
Vertigo	1	0.20 (p=0.0001)	0.12 (p=0.0017)
Tinnitus	0.20 (p=0.0001)	1	0.11 (p=0.0282)
PSQI	0.12 (p=0.0017)	0.11 (p=0.0282)	1

In conclusion, relationships were found between ln(distance) and PSQI, ln(distance) and self-reported vertigo and ln(distance) and self-reported tinnitus. Study findings suggest that future research should focus on the effects of wind turbine noise on sleep disturbance and symptoms of inner ear problems.

Acknowledgements:
This work was made possible with the support of the Ontario Research Chair for Renewable Energy Technologies and Health and the Renewable Energy Technologies and Health Research Team.

County	Wind Farm	Total Surveys Sent
Bruce	Enbridge	828
Chatham-Kent	Raleigh	415
Dufferin	Melancthon	944
Elgin	Erie Shores	726
Essex	Comber	1222
Frontenac	Wolfe Island	155
Huron	Kingsbridge	473
Norfolk	Frogmore/Cultus /Clear Creek	113
TOTAL		4876

UNIVERSITY OF WATERLOO

One of the findings of the study is that industrial wind turbines could have an impact on health

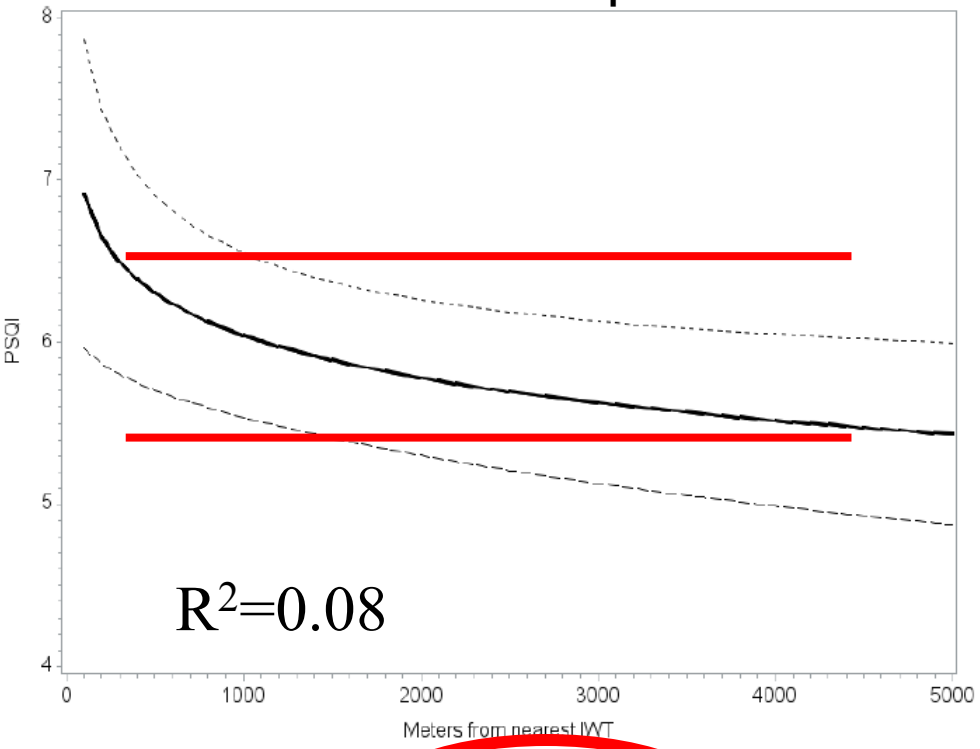


Figure 10: ***PSQI ln_dist Relationship (P=0.01). Graph shows modeled mean and upper and lower 95% confidence intervals***

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Jeffery et al. 2013, 2014

- The overall goal of these commentary pieces was to provide information to physicians about the topic regarding the possible health effects of exposure to noise produced by wind turbines and how these may manifest in patients.
- Case reports and publications that reported adverse effects following wind turbines noise exposure were briefly discussed; however, only the negative health effects were highlighted. Older literature and a number of non-peer reviewed articles and media reports were used to support the author's opinions.
- Missed a number of key and pertinent articles.
- Overall the authors did not provide adequate data or support for their arguments nor did they provide accurate information regarding the weight of scientific data on the issue.

Some other recent reviews

- Knopper and Ollson 2011
- Municipality of the County of Kings 2012
- MDPH/EP 2012
- Oregon Health Authority 2013
- South Australia Environmental Protection Authority 2013
- NHMRC 2014

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Weight of Scientific Evidence

1. People tend to notice sound from wind turbines almost linearly with increasing sound pressure level

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ORIGINAL ARTICLE

Wind turbine noise, annoyance and self-reported health and well-being in different living environments

Eja Pedersen, Kerstin Persson Waye

Occup Environ Med 2007;**64**:480–486. doi: 10.1136/oem.2006.031039

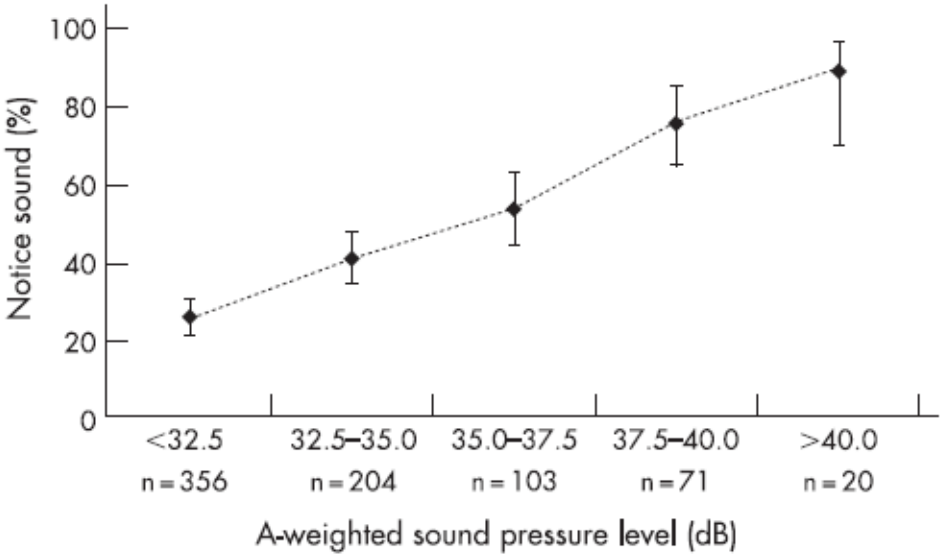

Figure 1 Proportion of respondents who noticed sound from wind turbines outside their dwelling, in relation to A-weighted sound pressure levels in 2.5-dB intervals. Vertical bars indicate 95% confidence intervals; n, the total number of respondents in each interval.

Weight of Scientific Evidence

1. People tend to notice sound from wind turbines almost linearly with increasing sound pressure level

2. A proportion of people that notice sound from wind turbines find it annoying

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A comparison between exposure-response relationships for wind turbine annoyance and annoyance due to other noise sources

Sabine A. Janssen[a] and Henk Vos
Department of Urban Environment and Safety, Netherlands Organization for Applied Scientific Research, P.O. Box 49, 2600 AA Delft, The Netherlands

Arno R. Eisses
Department of Acoustics and Sonar, Netherlands Organization for Applied Scientific Research, P.O. Box 96864, 2509 JG The Hague, The Netherlands

J. Acoust. Soc. Am. **130** (6), December 2011

Eja Pedersen[b]
Ecology and Environmental Science, Halmstad University, P.O. Box 823, SE-301 18 Halmstad, Sweden

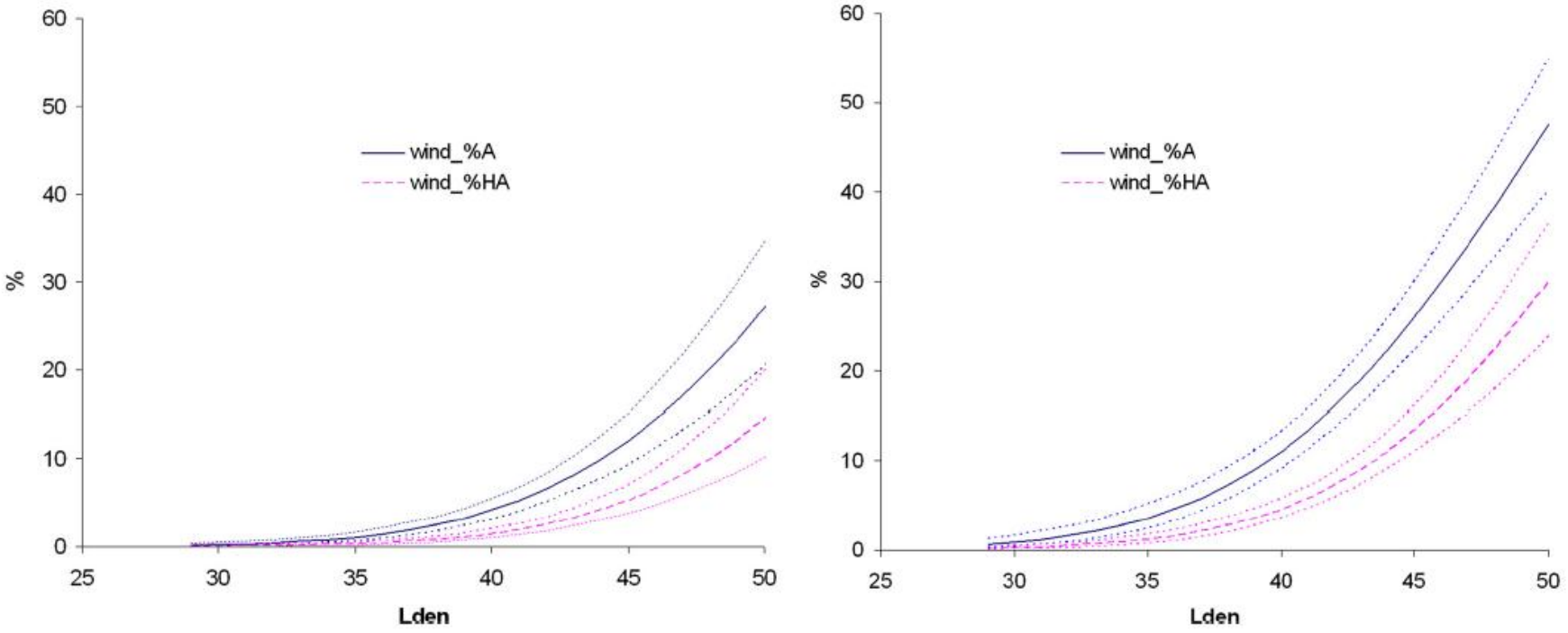

FIG. 1. (Color online) The exposure-response relationships between L_{den} and the percentage of residents annoyed (*%A*) and highly annoyed (*%HA*) indoors (left) and outdoors (right).

Weight of Scientific Evidence

1. People tend to notice sound from wind turbines almost linearly with increasing sound pressure level

2. A proportion of people that notice sound from wind turbines find it annoying

3. Noise-related annoyance is within the range of existing levels of community noise related annoyance in Canada and elsewhere

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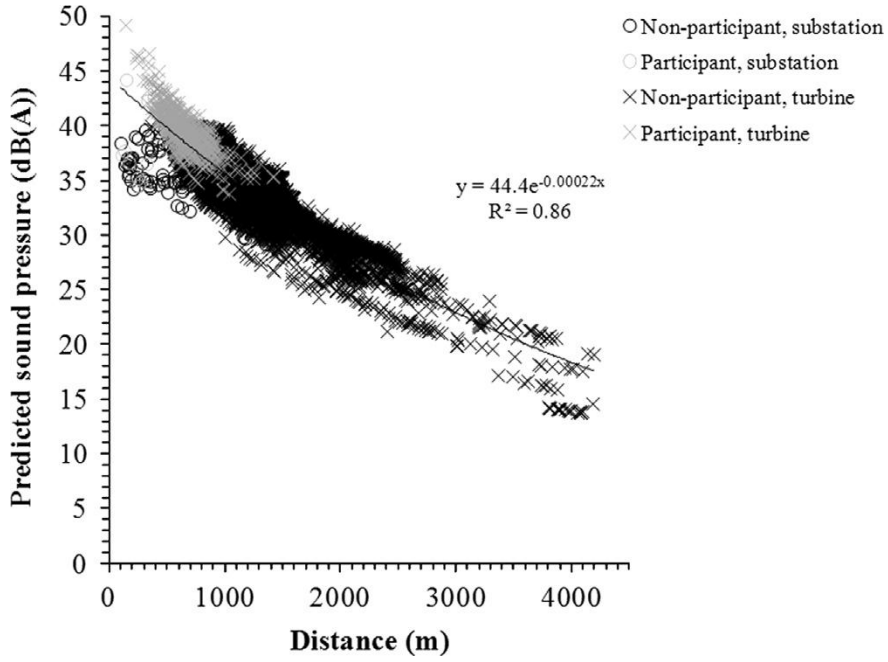
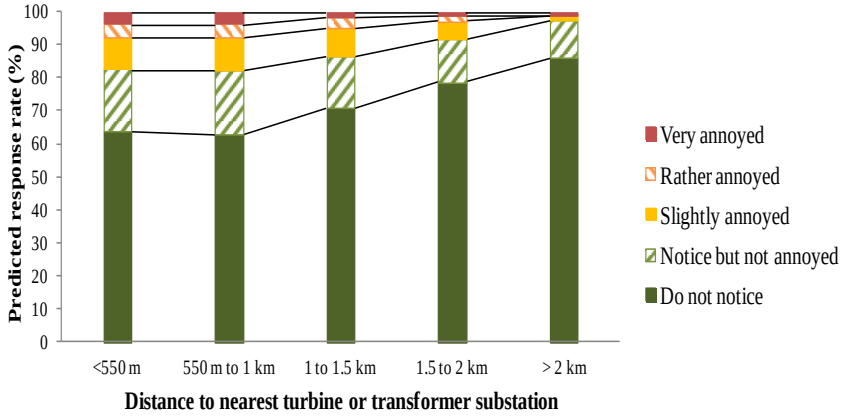
journal homepage: www.elsevier.com/locate/enpol

Projected contributions of future wind farm development to community noise and annoyance levels in Ontario, Canada

Melissa L. Whitfield Aslund, Christopher A. Ollson, Loren D. Knopper *

Intrinsik Environmental Sciences Inc., 6605 Hurontario Street, Suite 500, Mississauga, Ontario, Canada L5T 0A3





Impact of Wind Turbine Noise in The Netherlands

Verheijen, E., Jabben, J., Schreurs, E., Smith, K.B
Noise & Health, November-December 2011, Volume 13:55, 459-63

National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

- "*The percentage of severely annoyed at 45 dB* [Lden] *is rated at 5.2% for wind turbine noise, which is well below 10% that corresponds to the existing road and railway traffic noise limits".*

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Weight of Scientific Evidence

1. People tend to notice sound from wind turbines almost linearly with increasing sound pressure level

2. A proportion of people that notice sound from wind turbines find it annoying

3. Noise-related annoyance is within the range of existing levels of community noise related annoyance in Canada and elsewhere

4. People who economically benefit from wind turbines have significantly decreased levels of annoyance compared to individuals that received no economic benefit

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Science of the Total Environment 425 (2012) 42–51

Contents lists available at SciVerse ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Impact of wind turbine sound on annoyance, self-reported sleep disturbance and psychological distress

R.H. Bakker [a,*], E. Pedersen [b], G.P. van den Berg [c], R.E. Stewart [d], W. Lok [a,1], J. Bouma [e]

Table 4
Response to indoor wind turbine sound among economically benefitting and non-benefitting respondents.

	Response											
	Do not notice		Notice, not annoyed		Slightly annoyed		Rather annoyed		Very annoyed		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
No economical benefit	394	68	98	17	46	8	21	4	20	4	579	100
Economical benefit	53	54	39	39	7	7	0	0	0	0	99	100

Table 7
Sound sources of sleep disturbance in rural and urban area types, only respondents who did not benefit economically from wind turbines.

Sound source of sleep disturbance	Rural		Urban		Total	
	n	%	n	%	n	%
Not disturbed	196	69.8	288	64.9	484	66.8
Disturbed by people/ animals	33	11.7	64	14.4	97	13.4
Disturbed by traffic/ mechanical sounds	35	12.5	75	16.9	110	15.2
Disturbed by wind turbines	17	6.0	17	3.8	34	4.7
Total	281	100	444	100	725	100

Response to noise from modern wind farms in The Netherlands

J. Acoust. Soc. Am. **126** (2), August 2009

Eja Pedersen[a)]
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Jelte Bouma
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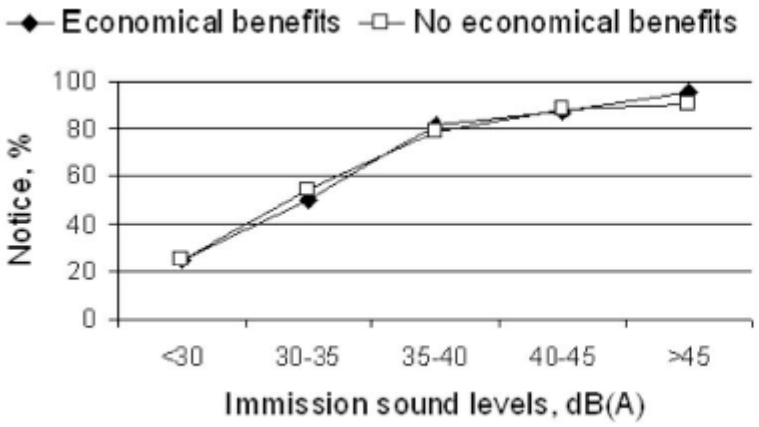

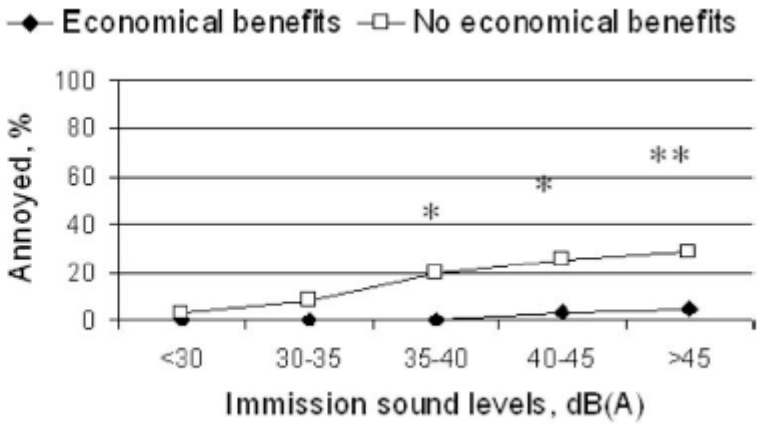

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Weight of Scientific Evidence

1. People tend to notice sound from wind turbines almost linearly with increasing sound pressure level

2. A proportion of people that notice sound from wind turbines find it annoying

3. Noise-related annoyance is within the range of existing levels of community noise related annoyance in Canada and elsewhere

4. People who economically benefit from wind turbines have significantly decreased levels of annoyance compared to individuals that received no economic benefit

5. Annoyance is not only related to wind turbine noise but also to subjective factors like attitude, visual cue, stress and expectations

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SCIENCE INTEGRITY KNOWLEDGE

Perception and annoyance due to wind turbine noise—a dose–response relationship

Eja Pedersen[a)] and Kerstin Persson Waye

J. Acoust. Soc. Am. **116** (6), December 2004

Health Psychology

0278-6133/13/$12.00 http://dx.doi.org/10.1037/a0031760

Can Expectations Produce Symptoms From Infrasound Associated With Wind Turbines?

Fiona Crichton, George Dodd, Gian Schmid, Greg Gamble, and Keith J. Petrie
University of Auckland

Health Psychol. 2013 Nov 25. [Epub ahead of print]

The Power of Positive and Negative Expectations to Influence Reported Symptoms and Mood During Exposure to Wind Farm Sound.

Crichton F, Dodd G, Schmid G, Gamble G, Cundy T, Petrie KJ.

The Effects of Vision-Related Aspects on Noise Perception of Wind Turbines in Quiet Areas

Luigi Maffei [1,*], Tina Iachini [2], Massimiliano Masullo [1], Francesco Aletta [1], Francesco Sorrentino [1], Vincenzo Paolo Senese [2] and Francesco Ruotolo [2]

Int. J. Environ. Res. Public Health **2013**, *10*

PLOS ONE

The Pattern of Complaints about Australian Wind Farms Does Not Match the Establishment and Distribution of Turbines: Support for the Psychogenic, 'Communicated Disease' Hypothesis

Simon Chapman*, Alexis St. George, Karen Waller, Vince Cakic
Sydney School of Public Health, University of Sydney, New South Wales, Australia

Shadow Flicker

- Medical Issue: Can shadow flicker induce seizures?
- Two seminal papers
  - Harding et al. (2008); Smedley et al. (2010)
  - Risk of inducing photosensitive seizures in 1.7 out of 100,000 of the photosensitive population when flicker is greater than 3 Hz.
- For turbines with three blades, this translates to a maximum speed of rotation of 60 rpm.

Turbine spin rates

- Siemens SWT 2.3:
  - 6-16 rpm
- REpower MM92:
  - 7.8 –15.0 rpm
- GE 1.6-100:
  - 9.75-16.2 rpm
- Vestas V112-3.0:
  - 6.2-17.1 rpm

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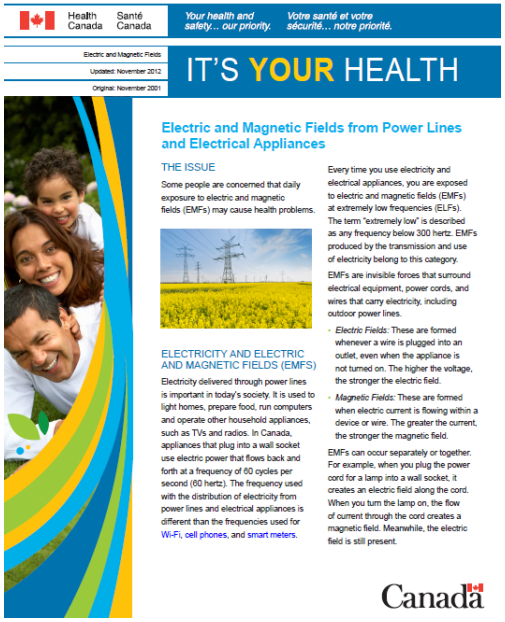
EMF From Operation

- "*Health Canada does not consider that any precautionary measures are needed regarding daily exposures to EMFs at ELFs. There is no conclusive evidence of any harm caused by exposures at levels found in Canadian homes and schools, including those located just outside the boundaries of power line corridors*"

  Health Canada 2012


Health Canada Santé Canada

Your health and safety... our priority. Votre santé et votre sécurité... notre priorité.

Electric and Magnetic Fields

Updated: November 2012

Original: November 2001

IT'S YOUR HEALTH

Electric and Magnetic Fields from Power Lines and Electrical Appliances

THE ISSUE

Some people are concerned that daily exposure to electric and magnetic fields (EMFs) may cause health problems.

ELECTRICITY AND ELECTRIC AND MAGNETIC FIELDS (EMFS)

Electricity delivered through power lines is important in today's society. It is used to light homes, prepare food, run computers and operate other household appliances, such as TVs and radios. In Canada, appliances that plug into a wall socket use electric power that flows back and forth at a frequency of 60 cycles per second (60 hertz). The frequency used with the distribution of electricity from power lines and electrical appliances is different than the frequencies used for Wi-Fi, cell phones, and smart meters.

Every time you use electricity and electrical appliances, you are exposed to electric and magnetic fields (EMFs) at extremely low frequencies (ELFs). The term "extremely low" is described as any frequency below 300 hertz. EMFs produced by the transmission and use of electricity belong to this category.

EMFs are invisible forces that surround electrical equipment, power cords, and wires that carry electricity, including outdoor power lines.

- *Electric Fields:* These are formed whenever a wire is plugged into an outlet, even when the appliance is not turned on. The higher the voltage, the stronger the electric field.
- *Magnetic Fields:* These are formed when electric current is flowing within a device or wire. The greater the current, the stronger the magnetic field.

EMFs can occur separately or together. For example, when you plug the power cord for a lamp into a wall socket, it creates an electric field along the cord. When you turn the lamp on, the flow of current through the cord creates a magnetic field. Meanwhile, the electric field is still present.

Canada

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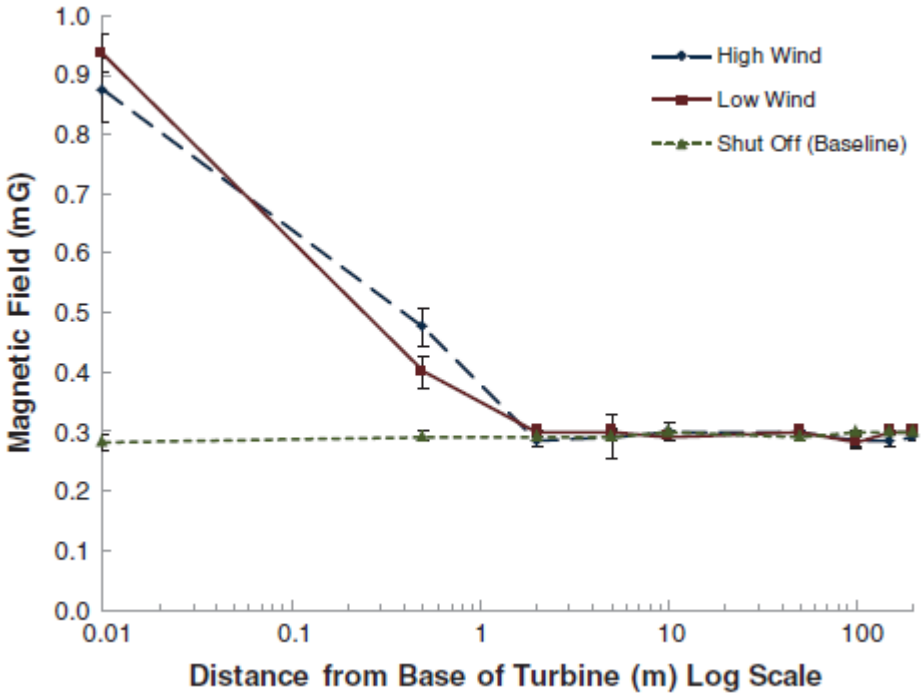
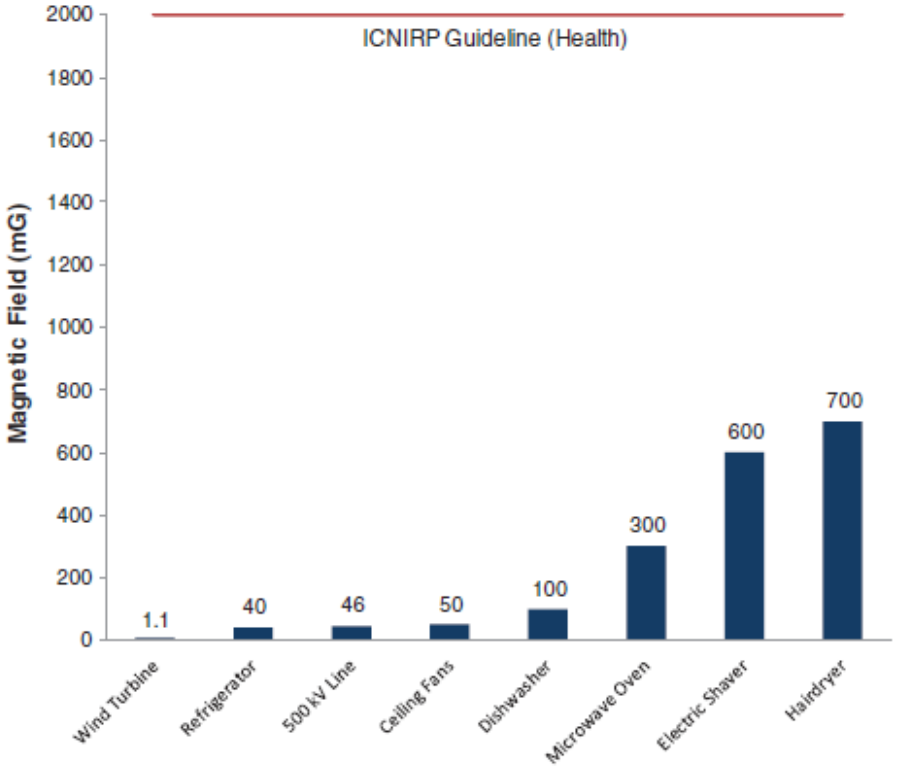
Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern?

ENVIRONMENTAL HEALTH

Lindsay C McCallum[1,2], Melissa L Whitfield Aslund[2], Loren D Knopper[2], Glenn M Ferguson[2] and Christopher A Ollson[2*]





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Infrasound/Low Frequency Noise

Measurement and Level of Infrasound From Wind Farms and Other Sources

Chris Turnbull, Jason Turner and Daniel Walsh
Acoustics Australia Vol. 40, No. 1, April 2012 - 45

- Infrasound is prevalent in urban and coastal environments at similar (or greater) levels to the level measured near wind turbines.
- Also O'Neal et al. 2011
  - LFN/IS from 1.6 and 2.1 MW turbines less than international standards at 305 and 457 m

Table 2. Measured levels of infrasound

Noise Source	Measured Level (dB(G))
Clements Gap Wind Farm at 85m	72
Clements Gap Wind Farm at 185m	67
Clements Gap Wind Farm at 360m	61
Cape Bridgewater Wind Farm at 100m	66
Cape Bridgewater Wind Farm at 200m	63
Cape Bridgewater Wind Farm ambient	62
Beach at 25m from high water line	75
250m from coastal cliff face	69
8km inland from coast	57
Gas fired power station at 350m	74
Adelaide CBD at least 70m from any major road	76

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Weight of Scientific Evidence

- Based on the findings and scientific merit of the available studies, the weight of evidence suggests that when sited properly, wind turbines are not related to adverse health effects
- Government findings
  - e.g.,: National Health and Medical Research Council in Australia, 2010; Chief Medical Officer of Health (ON), May 2010; MassDEP and MDPH, 2012; Oregon Health Authority, 2013; National Health and Medical Research Council in Australia, 2014
- Legal decisions
  - 19 ERTs in ON (completed or in progress)
  - 1 appeal court ON (Ostrander)
  - 1 hearing for AUC (Bull Creek)
  - Sask Queen's bench (Red Lily)

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Weight of Scientific Evidence

- Noise from wind turbines can be annoying to some and associated with sleep disturbance
  - especially when found at levels greater than **40 dB(A)**
  - setback in Ontario and WHO (EU) night noise guideline
- Environmental noise above certain levels is a recognized factor in a number of human health issues
  - e.g., hearing, sleep, myocardial infarction (WHO 2009)
- Proper siting of wind turbines is key
  - Many jurisdictions have established noise restrictions (and/or minimum setback distances) in order to mitigate potential noise-based health effects

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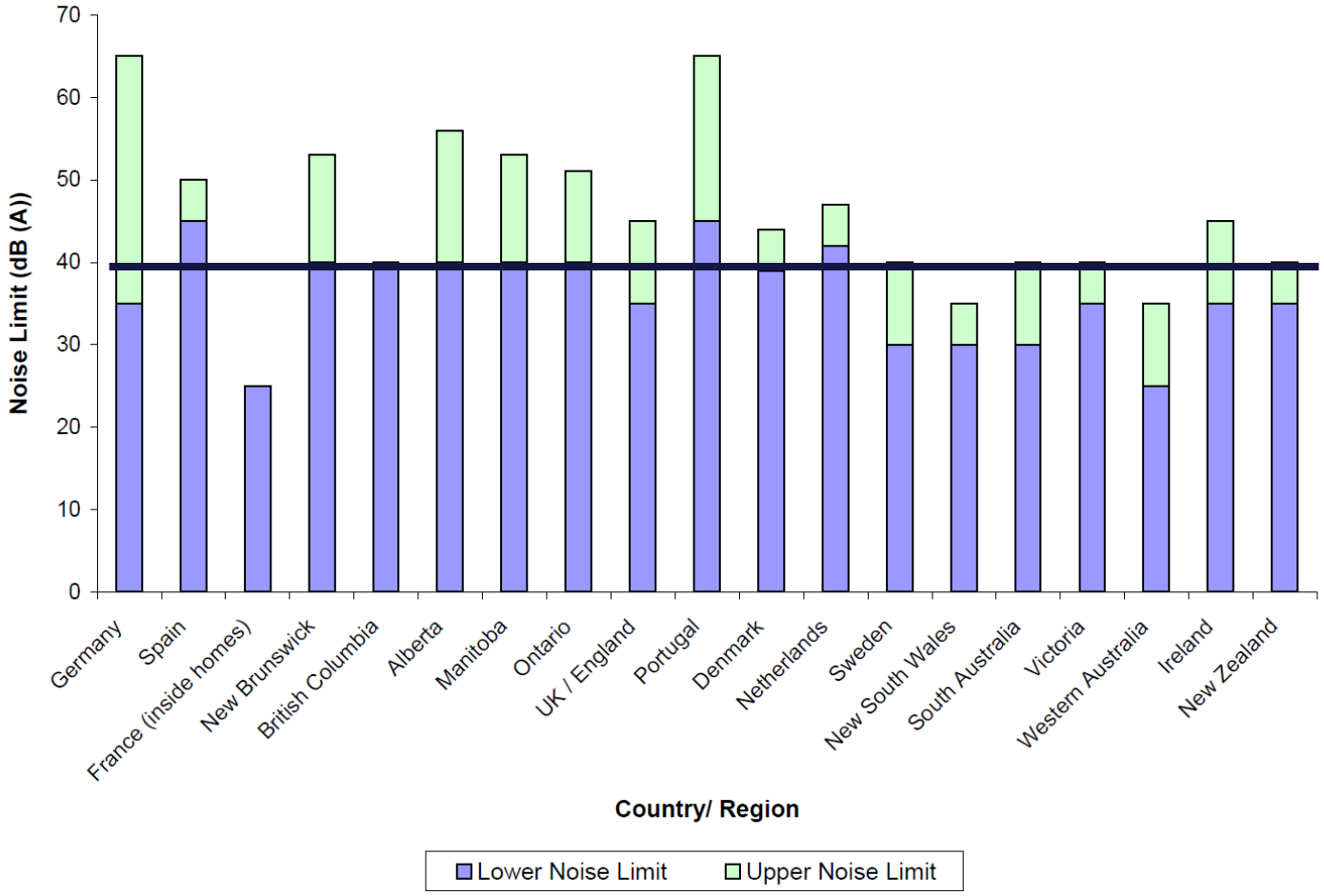
Global Setbacks (Haugen 2011)



WHO (2010) Night Noise Guideline = 40dBA

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What do we support?

- Sound, not distance setbacks
- Preference is ≤40 dBA for non-participating receptors
- Post construction monitoring
- Not against 40-45 dBA setback, but see need for community consultation and support
- Not supportive of setbacks >45 dBA based on possible direct effects from audibility and possible annoyance above background

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What is next...

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Thank you

http://inanutshell.ca/lifestyle/revamp-your-space-for-spring/

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