Part II

Errors of Omission in references by Knopper and Ollson (2011):

1. Erickson v. Director, Ministry of the Environment, Environmental Case Nos. 10-121 and 10-122. Transcript of Dr. G. Rachamin[1], Mar, 4, 2011 in which Dr. Rachamin "explicitly acknowledged the report looked *only* at direct links to human health." Dr. Ollson who attended the hearing was aware of this major omission. (Appendix A p2)

2. Both the Noise Guidelines for Wind Farms (Interpretation for Applying MOE NPC and the approvals (Renewable Energy Approval Number 7988-8AVKM5 Issue Date: November 10 2010) of Ontario permit noise levels of up to 51 dBA under certain circumstances. Knopper and Ollson fail to acknowledge this fact in their paper. (Appendix A, p3)

3. Knopper and Ollson failed to state that the 40 dBA noise limit identified in the WHO Night Noise Guidelines for Europe was not based on research related to wind turbines but rather road, rail and airplane noise. (Appendix A, p4)

4. Knopper and Ollson failed to reference a report (Colby, W. D., Dobie, R., Leventhall, G., Lipscomb, D. M., McCunney, R. J., Seilo, M. T., & Søndergaard, B. (2009, December). Wind turbine sound and health effects: An expert panel review. Washington, DC: American Wind Energy Association and Canadian Wind Energy Association.) The report attributes reported wind turbine symptoms (sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic attack episodes associated with sensations of internal pulsation or quivering when awake or asleep) to be the "well known stress effects of exposure to noise." (Appendix A , p5)

5. Knopper and Ollson (2011) failed to reference the published proceedings from the Fourth International Meeting on Wind Turbine Noise from April12-14, 2011. The Wind Turbine Noise (2011) post-conference report states:

> The main effect of daytime wind turbine noise is annoyance. The night time effect is sleep disturbance. These may lead to stress related illness in some people. Work is required in understanding why low levels of wind turbine noise may produce affects which are greater than might be expected from their levels.

6. Knopper and Ollson did not reference the 2007 report of United Kingdom physician Amanda Harry M.B. ChB, P.G. Dip. ENT http://www.wind-watch.org/documents/windturbines-noise-and-health/. Dr. Harry reports cases of 39 complainants using a standardized questionnaire to

[1] Dr. Rachamin was the primary author of the 2010 Chief Medical Officer of Health (Ontario) Report – The "Arlene King" Report.

document symptoms and concluded that "people living near wind turbines are genuinely suffering".

7. Knopper and Ollson did not reference the study: Phipps, R., Amati, M., McCoard, S., & Fisher, R. Visual And Noise Effects Reported By Residents Living Close To Manawatu Wind Farms: Preliminary Survey Results, (2007) Retrieved from http://www.wind-watch.org/documents/visual-and-noise-effects-reportedby-residents-living-close-to-manawatu-wind-farms-preliminarysurvey-results/

8. Knopper and Ollson did not reference: Committee on Environmental Impacts of Wind Energy Projects, National Research Council (2007). *Environmental Impacts of Wind-Energy Projects*, p. 158-9. The committee stated in regards to wind turbines: "More needs to be understood regarding the effects of low-frequency noise on humans."

9. Knopper and Ollson did not reference Health Canada, Community Noise Annoyance, It is Your Health, (2005, September) which stated "annoyance is an adverse health effect".

10. Knopper and Ollson might have considered referencing Niemann H, Bonnefoy X, Braubach M, Hecht K, Maschke C, Rodrigues C, Robbel N. Noise-induced annoyance and morbidity results from the pan-European LARES study. Noise Health 2006;8:63-79. The conclusion of the paper was: "The results of the LARES study in relation to severe annoyance by neighbourhood noise demonstrate that neighbourhood noise must be classified as a ***serious health endangerment*** for adults." (emphasis added). The paper was not about the more disturbing wind turbine noise (Pedersen et al.[2] which stated: "Wind turbine noise was more annoying than transportation noise or industrial noise at comparable levels, possibly due to specific sound properties such as a "swishing" quality, temporal variability, and lack of nighttime abatement.") but traffic noise (road noise, railway noise, aircraft noise, noise of parking cars).
The abstract summarizes the findings as follows:

> Adults who indicated chronically severe annoyance by neighbourhood noise were found to have an increased health risk for the cardiovascular system and the movement apparatus, as well as an increased risk of depression and migraine. Furthermore adults with chronically strong annoyance by traffic noise additionally showed an increased risk for respiratory health problems. With regards to older people both neighbourhood and traffic noise indicated in general a lower risk of noise annoyance induced illness than in adults. It can be assumed that the effect of noise-induced annoyance in older people is concealed by

[2] Pedersen, E., van den Berg, F., Bakker, R., & Bouma, J., "Response To Noise From Modern Wind Farms In The Netherlands", Journal of the Acoustical Society of America, 126, 634-643, (2009)

> physical consequences of age (with a strong increase of illnesses). With children the effects of noise-induced annoyance from traffic, as well as neighbourhood noise, are evident in the respiratory system. The increased risk of illness in the respiratory system in children does not seem to be caused primarily by air pollutants, but rather, as the results for neighbourhood noise demonstrate, by emotional stress. (abstract p.1)

Why would Knopper and Ollson assume there is no relevance to such a study focused on health effects of community noise?

11. Knopper and Ollson might have referenced the Acoustic Ecology Institute (AEI) which is an exceptionally well run blog site which is steadfastly neutral and has been used as a resource by the wind industry. The AEI has commentaries on a number of subject areas apart from wind turbines but has maintained a monthly update on news and publications since December 2007 in addition to annual summaries of evolving news and scientific literature. (http://aeinews.org/archives/category/wind-turbines)

Errors of Commission in references by Knopper and Ollson (2011):

1. Knopper and Ollson state that "…health effects from annoyance have been shown to be mitigated though behavioural and cognitive behavioural interventions…" (p. 8 para 2). This claim cannot be confirmed by review of the peer review literature nor their references. The 2 cited articles do not provide evidence that the Knopper and Ollson hypothesis is supportable. Reference 30 in their article (Coping Strategies for Low Frequency Noise, Geoff Leventhall*, Stephen Benton and Donald Robertson, J Low Freq. Noise VA 2008 27: 35-52) is a study with many weaknesses including selection criteria of the subjects in the study. There were initially 9 then 8 subjects for which the selection criteria are ill-defined. They are vaguely described as long-term complainants from low frequency noise who have not benefitted from standard interventions. There were no control subjects and furthermore the people evaluated were not exposed to wind turbine noise.

The second reference (Tazaki M, Landlaw K. ,Behavioural mechanisms and cognitive-behavioural interventions of somatoform disorders., Int. Rev. Psychiatry, 2006 Feb;18(1):67-73.) There is no peer review scientific evidence that the complainants are suffering from somatoform disorders i.e. a disorder in which the history, physical examination and diagnostic laboratory and imaging tests are normal. On the contrary the existing and evolving evidence suggests a causal relationship through indirect pathogenic pathways between wind turbine noise and the reported adverse health effects. Knopper and Ollson have no training that would enable them to generate nor have they produced sufficient evidence to substantiate their

hypothesis of somatoform disorder nor the hypothesis of complaints explained by "…. the indirect effects of visual and attitudinal cue." (p.9 par.2 Knopper and Ollson)

2. In quoting Eja Pedersen, ("Health aspects associated with wind turbine noise—Results from three field studies", Noise Control Eng. J. 59 (1), Jan-Feb 2011) Knopper and Ollson appear to have been misleading as they stated: "What is more, health effects from annoyance have been shown to be mitigated though behavioural and cognitive behavioural interventions [30,41][3], lending support to Pedersen's [25] ***conclusion*** that health effects can be explained by cognitive stress theory." (emphasis added). The following quote appeared in the "Discussion" section of Pedersen's paper. The wording that Pedersen used was: "This should, however, not be taken as evidence of a causal relationship between wind turbine noise and stress, mediated by annoyance. The finding ***could be explained*** in the light of Lazarus and Folkman's cognitive stress theory, .." (emphasis added) p.52

Pedersen also made an important further statement: "This study has several limitations. All health symptoms were self-reported by the respondents. Health examinations carried out by professionals would have been a better way to assess the prevalence of possible health effects and is desired in future studies". p.52

This is a crucial point as Pedersen has pointed to one of the key weaknesses in her research and that of the literature broadly. There has been "no health examinations carried out by professionals", no diagnostic testing nor longitudinal observations undertaken by clinician scientists of people within the environs of wind turbines. These evaluations should be carried out not only on complainants but a random sample of others including hosts. Insidious chronic diseases such as sleep disorders and hypertension could cause undetected permanent and serious harm with long term exposure. This short coming is being addressed by Health Canada in their new study design announced on February 10 2013. While the study will be cross-sectional, not longitudinal, it is a promising start as human subjects will be evaluated as stated below:

> Health Canada is collaborating with Statistics Canada on an epidemiological study to evaluate measurable health endpoints in people living in 8-12 communities at distances up to 10km from wind turbine installations. Measured endpoints include an automated blood pressure/heart rate assessment, hair cortisol concentrations and sleep actimetry. The seven days of sleep measurement data will be analyzed in relation to synchronized wind turbine operational data, providing the strength of a repeated measures design that incorporates objectively determined health outcome measures.

[3] References from Knopper and Ollson.

> *Health Canada Releases Revised Research Design for the Wind Turbine Noise and Health Study February 10, 2013 12:00 PM http://www.hc-sc.gc.ca/ewh-emt/consult/_2013/wind_turbine-eoliennes/research_recherche-eng.php*

3. Appendix B is a detailed audit performed by Mr. Brett Horner which addresses the use of some references by Knopper and Ollson. In total 6 references are audited as the authors alleged that to be quoting "governmental health agencies" (p.7 para. 6). As Horner concluded the deployment of these references by Knopper and Ollson cannot be substantiated.

4. Other errors of commission are identified in Part I regarding Night Guidelines for Noise in Europe, and regarding the failure to reference the Howe, Chapnick, Gastmeier Report.

Updated literature not considered by the Algonquin Power Company presentation (See also Appendix C)

Study (a): Low-frequency noise from large wind turbines by Henrik Møller and Christian Sejer Pedersen, J. Acoust. Soc. America, 129, 3727 (2011).

> As wind turbines get larger, worries have emerged that the turbine noise would move down in frequency and that the low-frequency noise would cause annoyance for the neighbors. The noise emission from 48 wind turbines with nominal electric power up to 3.6 MW is analyzed and discussed. The relative amount of low-frequency noise is higher for large turbines (2.3–3.6 MW) than for small turbines (< 2 MW), and the difference is statistically significant. The difference can also be expressed as a downward shift of the spectrum of approximately one-third of an octave. A further shift of similar size is suggested for future turbines in the 10-MW range. Due to the air absorption, the higher low-frequency content becomes even more pronounced, when sound pressure levels in relevant neighbor distances are considered. Even when A-weighted levels are considered, a substantial part of the noise is at low frequencies, and for several of the investigated large turbines, the one-third-octave band with the highest level is at or below 250 Hz. It is thus beyond any doubt that the low-frequency part of the spectrum plays an important role in the noise at the neighbors.

Comment: This study was published in June 2011 too late for Knopper and Ollson to be able to comment in their electronic publication of July 2011. The importance of the paper is that it addresses the long-standing dispute between wind energy proponents and health professional experts. This author (RYM) has presented to Prince Edward Municipal Council November 2008 (see Appendix D) and at the Government of Ontario Standing Committee on General Government in April 2009. (see Appendix E) making the point that Infra and Low Frequency Noise (ILFN) should be monitored. To date it appears that the Ministry of Environment (MOE) has no capacity to measure ILFN despite the findings of the Howe, Gastmeier, Chapnik report

for MOE that a “non-trivial percentage” of exposed people will be “highly annoyed”. (see Part I, reference Howe B (2012).

Study (b): Shepherd D, McBride D, Welch D, Dirks KN, Hill EM. Evaluating the impact of wind turbine noise on health-related quality of life, Noise Health 2011, 13,

Abstract:

We report a cross-sectional study comparing the health-related quality of life (HRQOL) of individuals residing in the proximity of a wind farm to those residing in a demographically matched area sufficiently displaced from wind turbines. The study employed a non-equivalent comparison group post-test-only design. Self-administered questionnaires, which included the brief version of the World Health Organization quality of life scale, were delivered to residents in two adjacent areas in semirural New Zealand. Participants were also asked to identify annoying noises, indicate their degree of noise sensitivity, and rate amenity. Statistically significant differences were noted in some HRQOL domain scores, with residents living within 2 km of a turbine installation reporting lower overall quality of life, physical quality of life, and environmental quality of life. Those exposed to turbine noise also reported significantly lower sleep quality, and rated their environment as less restful. Our data suggest that wind farm noise can negatively impact facets of HRQOL.

Comment: This study demonstrates a statistically significant difference between two demographically matched groups based on distance of their residences from wind turbine installations. This study confirms the work of others but is more robust in design as there is a control group and validated questionnaires are deployed. However in common with previous studies this publication is cross-sectional and there are no anthropocentric diagnostic health studies.

Study (c) (Editorial): Hanning C. and Evans A., Wind turbine noise seems to affect health adversely and an independent review of the evidence is needed, BMJ 2012; 344:e1527 doi: 10.1136/bmj.e1527 (Editorial 8 March 2012)

> The evidence for adequate sleep as a prerequisite for human health, particularly child health, is overwhelming. Governments have recently paid much attention to the effects of environmental noise on sleep duration and quality, and to how to reduce such noise [1]. However, governments have also imposed noise from industrial wind turbines on large swathes of peaceful countryside.

The impact of road, rail, and aircraft noise on sleep and daytime functioning (sleepiness and cognitive function) is well established [1]. Shortly after wind turbines began to be erected close to housing, complaints emerged of adverse effects on health. Sleep disturbance was the main complaint.[2] Such reports have been dismissed as being subjective and anecdotal, but experts contend that the quantity, consistency, and ubiquity of the complaints constitute epidemiological evidence of a strong link between wind turbine noise, ill health, and disruption of sleep [3].

The noise emitted by a typical onshore 2.5 MW wind turbine has two main components. A dynamo mounted on an 80 m tower is driven through a gear train by blades as long as 45 m, and this generates both gear train noise and aerodynamic noise as the blades pass through the air, causing vortices to be shed from the edges. Wind constantly changes its velocity and direction, which means that the inflowing airstream is rarely stable. In addition, wind velocity increases with height (wind shear), especially at night, and there may be inflow turbulence from nearby structures—in particular, other turbines. This results in an impulsive noise, which is variously described as “swishing” and “thumping,” and which is much more annoying than other sources of environmental noise and is poorly masked by ambient noise [4,5]. Permitted external noise levels and setback distances vary between countries. UK guidance, ETSU-R-97, published in 1997 and not reviewed since, permits a night time noise level of 42 dBA, or 5 dBA above ambient noise level, whichever is the greater. This means that turbines must be set back by a minimum distance of 350-500 m, depending on the terrain and the turbines, from human habitation. The aerodynamic noise generated by wind turbines has a large low frequency and infrasound component that is attenuated less with distance than higher frequency noise. Current noise measurement techniques and metrics tend to obscure the contribution of impulsive low frequency noise and infrasound [6]. A laboratory study has shown that low frequency noise is considerably more annoying than higher frequency noise and is harmful to health—it can cause nausea, headaches, disturbed sleep, and cognitive and psychological impairment [7]. A cochlear mechanism has been proposed that outlines how infrasound, previously disregarded because it is below the auditory threshold, could affect humans and contribute to adverse effects [8]. Sixteen per cent of surveyed respondents who lived where calculated outdoor turbine noise exposures exceeded 35 dB LAeq (LAeq, the constant sound level that, in a given time period, would convey the same sound energy as the actual time varying sound level, weighted to approximate the response of the human ear) reported disturbed sleep [4]. A questionnaire survey concluded that turbine noise was more annoying at night, and that interrupted

sleep and difficulty in returning to sleep increased with calculated noise level [9]. Even at the lowest noise levels, 20% of respondents reported disturbed sleep at least one night a month. In a meta-analysis of three European datasets (n=1764), [10] sleep disturbance clearly increased with higher calculated noise levels in two of the three studies.

In a survey of people residing in the vicinity of two US wind farms, those living within 375-1400 m reported worse sleep and more daytime sleepiness, in addition to having lower summary scores on the mental component of the short form 36 health survey than those who lived 3-6.6 km from a turbine. Modelled dose-response curves of both sleep and health scores against distance from nearest turbine were significantly related after controlling for sex, age, and household clustering, with a sharp increase in effects between 1 km and 2 km [11]. A New Zealand survey showed lower health related quality of life, especially sleep disturbance, in people who lived less than 2 km from turbines [12].

A large body of evidence now exists to suggest that wind turbines disturb sleep and impair health at distances and external noise levels that are permitted in most jurisdictions, including the United Kingdom. Sleep disturbance may be a particular problem in children,[1] and it may have important implications for public health. When seeking to generate renewable energy through wind, governments must ensure that the public will not suffer harm from additional ambient noise. Robust independent research into the health effects of existing wind farms is long overdue, as is an independent review of existing evidence and guidance on acceptable noise levels.

Competing interests: Both authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; CDH has given expert evidence on the effects of wind turbine noise on sleep and health at wind farm planning inquiries in the UK and Canada but has derived no personal benefit; he is a member of the board of the Society for Wind Vigilance; AE has written letters of objection on health grounds to wind farm planning applications in Ireland

Provenance and peer review: Not commissioned; externally peer reviewed.

[1] WHO. Burden of disease from environmental noise. 2011. www.euro.who.int/__data/ assets/pdf_file/0008/136466/e94888.pdf.

[2] Krogh C, Gillis L, Kouwen N, Aramini J. WindVOiCe, a self-reporting survey: adverse health effects, industrial wind turbines, and the need for vigilance monitoring. Bull Sci Tech Soc 2011;31:334-9.

[3] Phillips C. Properly interpreting the epidemiologic evidence about the health effects of industrial wind turbines on nearby residents. Bull Sci Tech Soc 2011;31:303-8.

[4] Pedersen E, Persson Waye K. Perception and annoyance due to wind turbine noise—a dose-response relationship. J Acoust Soc Am 2004;116:3460-70.

[5] Pedersen E, van den Berg F, Bakker R, Bouma J. Can road traffic mask sound from wind turbines? Response to wind turbine sound at different levels of road traffic sound. Energy Policy 2010;38:2520-7.

[6] Bray W, James R. Dynamic measurements of wind turbine acoustic signals, employing sound quality engineering methods considering the time and frequency sensitivities of human perception. Proceedings of Noise-Con 2011, Portland, Oregon, 25-27 July 2011.Curran Associates, 2011.

[7] Møller M, Pedersen C. Low frequency noise from large wind turbines. J Acoust Soc Am 2010;129:3727-44.

[8] Salt A, Kaltenbach J. Infrasound from wind turbines could affect humans. Bull Sci Tech Soc 2011;31:296-303.

[9] van den Berg G, Pedersen E, Bouma J, Bakker R. Project WINDFARMperception. Visual and acoustic impact of wind turbine farms on residents. FP6-2005-Science-and-Society-20. Specific support action project no 044628, 2008. www.rug.nl/wewi/deWetenschapswinkels/natuurkunde/publicaties/WFp-final-1.pdf.

[10] Pedersen E. Effects of wind turbine noise on humans. Proceedings of the Third International Meeting on Wind Turbine Noise, Aalborg Denmark 17-19 June 2009. www.confweb.org/wtn2009/.

[11] Nissenbaum M, Aramini J, Hanning C. Adverse health effects of industrial wind turbines:a preliminary report. Proceedings of 10th International Congress on Noise as a Public Health Problem (ICBEN), 2011, London, UK. Curran Associates, 2011.

[12] Shepherd D, McBride D, Welch D, Dirks K, Hill E. Evaluating the impact of wind turbine noise on health related quality of life. Noise Health 2011;13:333-9.

Comment: The importance of this editorial is that it published in a top-rank journal (BMJ) and effectively synthesizes the evidence from the perspective of experts who are health care professionals. The Nissenbaum et al. [12] paper in Noise and Health had not yet been published (see below).

Study (d): Effects of industrial wind turbine noise on sleep and health Michael A. Nissenbaum, Jeffery J. Aramini, Christopher D. Hanning Noise & Health, September-October 2012, Volume 14:60, 237-43

Abstract:

Industrial wind turbines (IWTs) are a new source of noise in previously quiet rural environments. Environmental noise is a public health concern, of which sleep disruption is a major factor. To compare sleep and general health outcomes between participants living close to IWTs and those living further away from them, participants living between 375 and 1400 m (n = 38) and 3.3 and 6.6 km (n = 41) from IWTs were enrolled in a stratified cross-sectional study involving two rural sites. Validated questionnaires were used to collect information on sleep quality (Pittsburgh Sleep Quality Index — PSQI), daytime sleepiness (Epworth Sleepiness Score — ESS), and general health (SF36v2), together with psychiatric disorders, attitude, and demographics. Descriptive and multivariate analyses were performed to investigate the effect of the main exposure variable of interest (distance to the nearest IWT) on various health outcome measures. Participants living within 1.4 km of an IWT had worse sleep, were sleepier during the day, and had worse SF36 Mental Component Scores compared to those living further than 1.4 km away. Significant dose-response relationships between PSQI, ESS, SF36 Mental Component Score, and log-distance to the nearest IWT were identified after controlling for gender, age, and household clustering. The adverse event reports of sleep disturbance and ill health by those living close to IWTs are supported.

Comment: This study is a stratified cross-sectional design with a control group comparing groups that are near (375 -1400 m) and far (3.3 – 6.6 km). Once again validated questionnaires are used (3). While the numbers are relatively small, 38 and 41 for the near and far groups respectively, a statistically significant difference between the 2 groups was found regarding sleep disturbance and self-reported ill health.

Study (e): Statement from Society of Occupational and Environmental Medicine (DASAM)

Retrieved from https://www.wind-watch.org/documents/statement-on-the-revision-of-the-executive-order-on-noise-from-wind-turbines/ (No attempt has been made to correct grammar.)

October 15, 2012 • Denmark, Health, Noise, Regulations

Statement on the revision of the executive order on noise from wind turbines

Author: Danish Society for Occupational and Environmental Medicine

DASAM [the Danish Society for Occupational and Environmental Medicine] has with interest read the proposal for a new executive order on noise from wind turbines. DASAM welcomes that low frequency noise from wind turbines are now being subjected to the same limits as low frequency noise from other industries during the night.

DASAM believes however, that the executive order not sufficiently protects against health risks due to noise and therefore recommends:

- The noise limits should be lowered from 39dB (A) to 35 dB (A).
- A health based assessment on the effects of introducing up to 1000 wind turbines in Denmark should be performed.

Based on current knowledge about the relationship between noise from wind turbines and effects on humans, and the raised critic on the quality of the proposed noise measurements, for example from researchers from Aalborg University, we are concerned whether the proposed noise limit values for wind turbines will sufficiently protect the Danish citizens against annoyance of living close to wind turbines.

A number of original papers and several reviews show that between 10% and 40% of citizens living close to wind turbines feel annoyed or extremely annoyed by the noise, and it is shown that the number of annoyed people rises sharply when the noise exceeds 35 dB [1-7]. Generally, it has not been possible to distinguish between nuisances from noise and low frequency noise respectively. Some of the studies also suggest that living near a wind turbine affect sleep quality and the most recent review concluded that “Wind turbine noise is causing noise annoyance and possible also sleep disturbance, which means that one cannot completely rule out effects on the cardiovascular system after prolonged exposure to wind turbine noise, despite moderate levels of exposure” [2].

Some case studies describe vibro-acoustic disease and wind turbine syndrome in persons living close to wind turbines, but these findings have not been confirmed by more systematic studies.

The current noise limits that are unchanged in the new revised proposal is 44 dB(A) at 8 m/s (open land) and 39 dB(A) at 8 m/s (noise sensitive land use). Actually, the noise load can be considerably higher, due to:

1) no enhanced noise limits in the night, even though it is well documented, that the noise reduction can be lowered 3-15 dB at night [8,9] and

2) that the noise level can increase at higher wind speeds.

As something new, an indoor noise limit value of 20 dB for low-frequency noise is proposed, but it is accepted that the noise limit value will be exceeded in 33% of households living close to wind turbines. Basically DASAM finds this approach unacceptable. The Environmental Protection Agency's calculation of the insulation capability of houses against low frequency noise – including the acceptance of the large number of exceedings – and the controversial use of measurement variability in the control measurements for noise has been strongly criticized by international experts in noise and acoustic [10]. In the proposed executive order the noise insulation numbers are increased compared to earlier, resulting in calculated indoor levels of low frequency noise below 20 dB, despite the fact that the real levels are well above 20 dB. We refer to [10] and to the statement on the executive order from Aalborg University for further details.

We estimate that with the current noise limit values for wind turbines, an unacceptable proportion of citizens in the vicinity of wind turbines will be annoyed or strongly annoyed by the noise. In the suggested noise limit values it has not been taken into consideration that susceptible subjects due to e.g. pre-existing disease can be more sensitive to noise compared to the general population .

No studies so far have investigated the magnitude of the problem in Denmark, but based on studies from mainly Sweden and Holland DASAM recommends that the noise limit value is decreased from the current 39 dB (A) so in the future no more than 35 dB is allowed at residences at a wind speed of 8 m/s. It is also recommended to use 35 dB as the noise limit value in noise sensitive land use – today it is covered by the 44 dB noise limit value. By doing this the Danish noise limit values will become comparable to the Swedish [11] and the New Zeelandic [Zealand] [12] noise limit values. Based on present knowledge, this means that less than 10% of citizens living close to wind turbines will be annoyed by the noise.

DASAM finds it relevant that a health-based assessment is made of the effects of introducing as planned up to 1000 wind turbines in Denmark. DASAM can propose a

person capable of performing the task, including suggestions on how effects of wind turbines may be monitored and estimated in the future.

Sincerely

Dr. Vivi Schlünssen
Chairman, Danish Society for Occupational and Environmental Medicine
Associate Professor, MD, specialist in occupational medicine
Department of Public Health, Section for Environmental and Occupational Medicine
Aarhus University, Denmark
E-mail: vs/mil.au.dk.

Comment:

This statement highlights the point that health care professionals internationally are growing increasingly concerned by the exposure of the public to sound energy the level of which has been determined by engineering analysis without anthropocentric or human centred evaluation by health care professionals. DASAM is expressing concern relating to adverse health effects and the failure of current regulations to protect the public. DASAM is based in Denmark, the country recognized as being at the forefront globally of alternative energy deployment generally and the wind industry in particular. Ontario's regulations are less stringent than those of Denmark and as noted earlier to the Ontario Government does not monitor wind turbines for infrasound and low frequency noise.

Study (f): Health Canada Revised Research Design

Health Impacts and Exposure to Sound From Wind Turbines: Updated Research Design and Sound Exposure Assessment

http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/research_recherche-eng.php (accessed February 13, 2013)

Summary

The last decade has seen a sharp increase in wind turbine generated electricity in Canada. As of November 2012, Canada's installed capacity was 5.9 gigawatts, providing 2.3 percent of Canada's current electricity demands. The wind energy industry has set a vision that by 2025 wind energy will supply 20% of Canada's electricity demands. Some public concern has been expressed about the potential health impacts of wind turbine sound (WTS Footnote i). The health effects reported by individuals living in communities in close proximity to wind turbine installations are poorly understood due to limited scientific research in this area. This is coupled

with the many challenges faced in measuring and modeling WTS, including low frequencies, which represent knowledge gaps in this area. The continued success and viability of wind turbine energy in Canada, and around the world, will rely upon a thorough understanding of the potential health impacts and community concerns.

Health Canada is collaborating with Statistics Canada on an epidemiological study to evaluate measurable health endpoints in people living in 8-12 communities at distances up to 10 km from wind turbine installations. Measured endpoints include an automated blood pressure/heart rate assessment, hair cortisol concentrations and sleep actimetry. The seven days of sleep measurement data will be analyzed in relation to synchronized wind turbine operational data, providing the strength of a repeated measures design that incorporates objectively determined health outcome measures.

In addition, self-reported data will be collected during an anticipated 30-35 minute face-to-face computer-assisted interview at participants' homes. The questionnaire instrument includes, but is not limited to, modules that probe endpoints such as noise annoyance, health effects, quality of life, sleep quality, perceived stress, lifestyle behaviours (e.g., cigarette smoking, alcohol consumption), prevalent chronic disease and property value impacts. Following completion of the questionnaire, subjects will be invited to participate in the physical health measures collection portion of the study.

Both self-reported and measured endpoints will be analyzed in relation to modeled WTS levels as a function of frequency (i.e. permitting A- C and G-weighting assessments). Modeled WTS will be validated and adjusted (if necessary) based on measurements taken indoors and outdoors in a sub-sample of dwellings. The targeted sample will consist of 2000 dwellings at setback distances ranging from less than 500 metres to distances of up to 10 km randomly selected from communities in the vicinity of 8 to 12 wind turbine installations. As sleep disturbance is a frequent health complaint associated with WTS in observational and case studies, one of the primary research objectives in the study is to quantify the magnitude of sleep disturbance due to WTS. Statistics Canada's experience in sampling from similar communities is that 20% of the 2000 dwellings that are initially targeted will be unoccupied. With a response rate of approximately 70-75% (among which around 20% will be within the closest distances) there should be sufficient statistical power to detect a 7% difference in the prevalence of sleep disturbances with 80% power and a 5% false positive rate (Type I error). Of course there is uncertainty in the power assessment because Health Canada's study is the first study to implement measured

endpoints to study the impact that exposure to WTS may have on human health. Ultimately the results, while not definitive on their own, will contribute to the body of international peer-reviewed scientific evidence examining the health impact of WTS, and may also lead the way for supporting future studies examining this complex issue.

Comment: This design should result in the most comprehensive evaluation of people exposed to wind turbine noise to date. It is still cross-sectional versus longitudinal but this design does include face-to-face interviews, detailed history taking and physiological monitoring of people directly i.e. it is anthropocentric or human centred design. The study design should enable the development of dose-response curves which are a core element of the goal of evidence – based guidelines for set-backs of wind turbines from residences, hospitals, schools and places of work. The development of evidence-based guidelines is a must for safe deployment of wind turbines. The absence of such guidelines is one of the greatest sources of negative reaction that the advent of wind turbines in Ontario have received in rural Ontario.

Study (g): Carla S. Möller-Levet, Simon N. Archer, Giselda Bucca1, Emma E. Laing, Ana Slak, Renata Kabiljo, June C. Y. Lo, Nayantara Santhi, Malcolm von Schantz, Colin P. Smith, and Derk-Jan Dijk, (2013) Effects of insufficient sleep on circadian rhythmicity and expression amplitude of the human blood transcriptome, www.pnas.org/cgi/doi/10.1073/pnas.1217154110

Abstract

Insufficient sleep and circadian rhythm disruption are associated with negative health outcomes, including obesity, cardiovascular disease, and cognitive impairment, but the mechanisms involved remain largely unexplored. Twenty-six participants were exposed to 1wkof insufficient sleep (sleep-restriction condition 5.70 h, SEM= 0.03 sleep per24h) and 1 wk of sufficient sleep (control condition 8.50 h sleep, SEM = 0.11). Immediately following each condition, 10 whole-blood RNA samples were collected from each participant, while controlling for the effects of light, activity, and food, during a period of total sleep deprivation. Transcriptome analysis revealed that 711 genes were up- or down-regulated by insufficient sleep. Insufficient sleep also reduced the number of genes with a circadian expression profile from 1,855 to 1,481, reduced the circadian amplitude of these genes, and led to an increase in the number of genes that responded to subsequent total sleep deprivation from 122 to 856. Genes affected by insufficient sleep were associated with circadian rhythms (PER1, PER2, PER3, CRY2, CLOCK, NR1D1, NR1D2, RORA, DEC1, CSNK1E), sleep homeostasis (IL6, STAT3, KCNV2, CAMK2D), oxidative stress (PRDX2, PRDX5), and metabolism (SLC2A3, SLC2A5, GHRL, ABCA1). Biological processes affected included chromatin modification, gene-expression regulation, macromolecular

> metabolism, and inflammatory, immune and stress responses. Thus, insufficient sleep affects the human blood transcriptome, disrupts its circadian regulation, and intensifies the effects of acute total sleep deprivation. The identified biological processes may be involved with the negative effects of sleep loss on health, and highlight the interrelatedness of sleep homeostasis, circadian rhythmicity, and metabolism.

Comment: This latest research from the University of Surrey has found that as little as one week of inadequate sleep is enough to alter the activity of hundreds of human genes. The research monitored the activity of all genes of the human genome and found that inadequate sleep (less than 6 hours a night) affects the activity of over 700 of our genes. These included genes which are linked to controlling inflammation, immunity, and the response to stress.

Furthermore, the research shows that inadequate sleep reduced the number of genes that normally peak and wane in expression throughout the 24-hour day from 1,855 to 1,481. The authors found that the number of genes affected by sleep deprivation was seven times higher after a week of insufficient sleep.

Sleep deficiency leads to a host of significant health conditions including obesity, heart disease, and cognitive impairment, but until now scientists were unclear how gene expression patterns were altered by insufficient sleep. These 'gene expression' patterns provide important clues on the potential molecular mechanisms linking sleep and overall health.