"The only mitigation of sleep disturbance from industrial wind turbine noise is a setback of at least 1.5 km," Christopher Hanning, MD

Posted By admin On July 2, 2009 @ 6:00 am

"In my expert opinion, from my knowledge of sleep physiology and a review of the available research, I have no doubt that wind turbine noise emissions cause sleep disturbance and ill health."


[1]

Christopher Hanning, MD

Leading British sleep specialist, Dr. Christopher Hanning [2], explains the profound repercussions of wind turbines disrupting sleep—a matter the wind turbine salesman at your last town meeting, along with the wind industry in general, refuse to acknowledge, much less address in any realistic manner. Having reviewed a considerable body of clinical evidence (note: wind salesmen and acousticians are not clinicians), Hanning calls for setbacks of *at least* 1.5 km (1 mile). (Nina Pierpont, MD, PhD, would consider that inadequate. She calls for 2 km = 1.24 mi):

"The only mitigation of sleep disturbance from industrial wind turbine noise is a setback of at least 1.5km, and probably greater. This estimate is based on data from present installations, many of which have a much smaller rated capacity than those proposed by Nuon Renewables [3] [a wind developer proposing a wind plant in Swinford, UK]"—Christopher Hanning, MD, "*Sleep Disturbance and Wind Turbine Noise* [4]" (June 14, 2009), p. 27.

» From Hanning's report [4]:

Sleep is a universal phenomenon. Every living organism contains, within its DNA, genes for a body clock which regulates an activity-inactivity cycle. In mammals, including humans, this is expressed as one or more sleep periods per 24 hours. Sleep was previously thought to be a period of withdrawal from the world designed to allow the body to recuperate and repair itself. However, modern research has shown that sleep is primarily by the brain and for the brain. The major purpose of sleep seems to be the proper laying down and storage of memories, hence the need for adequate sleep in children to facilitate learning and the poor memory and cognitive function in adults with impaired sleep from whatever cause.

Inadequate sleep has been associated not just with fatigue, sleepiness and cognitive impairment but also with an increased risk of obesity, impaired glucose tolerance (risk of diabetes), high blood pressure, heart disease, cancer and depression. Sleepy people have an increased risk of road traffic accidents.

Humans have two types of sleep, slow wave (SWS) and rapid eye movement (REM). SWS is the deep sleep which occurs early in the night while REM or dreaming sleep occurs mostly in the second half of the night. Sleep is arranged in a succession of cycles, each lasting about 90 minutes. We commonly wake between cycles, particularly between the second and third, third and fourth and fourth and fifth cycles. Awakenings are not remembered if they are less than 30 seconds in duration. As we age, awakenings become more likely and longer so we start to remember them.

Noise interferes with sleep in several ways. Firstly, it may be sufficiently loud or annoying to prevent the onset of sleep or the return to sleep following an awakening. It is clear also that some types of noise are more annoying than others. Constant noise is less annoying than irregular noise which varies in frequency and loudness, for example, snoring, particularly if accompanied by the snorts of sleep apnoea (breath holding). The swishing or thumping noise associated with wind turbines seems to be particularly annoying as the frequency and loudness varies with changes in wind speed and local atmospheric conditions. While there is no doubt of the occurrence of these noises and their audibility over long distances, up to 3-4km in some reports, the actual cause has not yet been fully elucidated (Bowdler 2008). Despite recommendations by the Government's own Noise Working Group, UK research in this area has been stopped.

Secondly, noise experienced during sleep may arouse or awaken the sleeper. A sufficiently loud or prolonged noise will result in full awakening which may be long enough to recall. Short awakenings are not recalled as, during the transition from sleep to wakefulness, one of the last functions to recover is memory (strictly, the transfer of information from short term to long term memory). The reverse is true for the transition from wakefulness to sleep. Thus only awakenings of longer than 20-30 seconds are subsequently recalled. Research that relies on recalled awakenings alone may underestimate the effect.

Noise insufficient to cause awakening may cause an arousal. An arousal is brief, often only a few seconds long, with the sleeper moving from a deep level of sleep to a lighter level and back to a deeper level. Because full wakefulness is not reached, the sleeper has no memory of the event but the sleep has been disrupted just as effectively as if wakefulness had occurred. It is possible for several hundred arousals to occur each night without the sufferer being able to recall any of them. The sleep, because it is broken, is unrefreshing, resulting in sleepiness, fatigue, headaches and poor memory and concentration (Martin 1997)—many of the symptoms of "wind turbine syndrome." Arousals are associated not just with an increase in brain activity but also with physiological changes, an increase in heart rate and blood pressure, which are thought to be responsible for the increase in cardiovascular risk. Arousals occur naturally during sleep and increase with age (Boselli 1998), which may make the elderly more vulnerable to wind turbine noise. Arousals may be caused by sound events as low as 32 dBA and awakenings with events of 42dBA (Muzet and Miedema 2005), well within the measured noise levels of current "wind farms" and the levels permitted by ETSU-R-97. Arousals in SWS may trigger a parasomnia (sleep walking, night terrors etc.). Pierpont (2009 and personal communication) notes that parasomnias developed in some of the children in her study group when exposed to turbine noise.

Arousals are caused by aircraft, railway and traffic noise. In one study of aircraft noise, arousals were four times more likely to result than awakenings (Basner 2008a&b). Freight trains are more likely to cause arousals than passenger trains, presumably because they are slower, generating more low frequency noise and taking longer to pass (Saremi 2008). The noise of wind turbines has been likened to a "passing train that never passes," which may explain why wind turbine noise is prone to cause sleep disruption.

It is often claimed that continual exposure to a noise results in habituation, i.e., one gets used to the noise. There is little research to confirm this assertion, and a recent small study (Pirrera et al. 2009) looking at the effects of traffic noise on sleep efficiency suggests that it is not so.

Sleep disturbance and impairment of the ability to return to sleep is not trivial, as almost all of us can testify. In the short term, the resulting deprivation of sleep results in daytime fatigue and sleepiness, poor concentration and memory function. Accident risks increase. In the longer term, sleep deprivation is linked to depression, weight gain,

diabetes, high blood pressure and heart disease. There is a very large body of literature, but please see Meerlo et al., 2008, Harding and Feldman, 2008 and Hart et al., 2008 for recent work on this subject. A more general review can found on Wikipedia: http://en.wikipedia.org/wiki/Sleep_deprivation [5]

In weighing the evidence, I find that, on the one hand, there is a large number of reported cases of sleep disturbance and, in some cases, ill health as a result of exposure to noise from wind turbines, supported by a number of research reports that tend to confirm the validity of the anecdotal reports and provide a reasonable basis for the complaints. On the other, we have badly designed industry and government reports which seek to show that there is no problem. I find the latter unconvincing.

In my expert opinion, from my knowledge of sleep physiology and a review of the available research, I have no doubt that wind turbine noise emissions cause sleep disturbance and ill health.

Table 1. Recommendations for setback of residential properties from industrial wind turbines

Note 1. The 2km limit from edges of towns and villages seems to have been set more for visual than noise reasons

Authority	Year	Notes	Recommendation	
			Miles	Kilometres
Frey & Hadden	2007	Scientists. Turbines >2MW	>1.24	>2
Frey & Hadden	2007	Scientists. Turbines <2MW	1.24	2
Harry	2007	UK Physician	1.5	2.4
Pierpont	2008	US Physician	1.5	2.4
Welsh Affairs Select Committee	1994	Recommendation for smaller turbines	0.93	1.5
Scottish Executive	2007	See note 1.	1.24	2
Adams	2008	US Lawyer	1.55	2.5
Bowdler	2007	UK Noise engineer	1.24	2
French National Academy of Medicine	2006	French physicians	0.93	1.5
The Noise Association	2006	UK scientists	1	1.6
Kamperman & James	2008	US Noise engineers	>.62	>1
Kamperman	2008	US Noise engineer	>1.24	>2
Bennett	2008	NZ Scientist	>0.93	>1.5
Acoustic Ecology Institute	2009	US Noise engineers	0.93	1.5

[6]

Christopher Hanning, MD, "Sleep Disturbance and Wind Turbine Noise" (June 14, 2009), p. 33

» Click here [4] to read the entire report (PDF)

URLs in this post:

[1] Image: **http://www.windturbinesyndrome.com/wp-content/uploads/2009/07/chris-hanning-350x466.jpg**
[2] Leading British sleep specialist, Dr. Christopher Hanning: **http://images.google.com/imgres?imgurl=http://www.intushealthcare.eu/uploads/images/christopher_hanning.jpg&imgrefurl=http://www.intushealthcare.eu/medical-advisory-board.html&usg=__fhVlavLCnxTAebvjYPh0b5zG9Rw=&h=200&w=150&sz=7&hl=en&start=20&sig2=Z-kMn-QRU5gDFqQntSswrw&tbnid=w9S1GtS2YNfDrM:&tbnh=104&tbnw=78&prev=/images%3Fq%3DChris%2BHanning%26gbv%3D2%26ndsp%3D18%26hl%3Den%26safe%3Doff%26sa%3DN%26start%3D18&ei=YVhNSte1L8yFmAfLhYm0BA**
[3] Nuon Renewables: **http://www.nuonrenewables.com/home.htm**
[4] Sleep Disturbance and Wind Turbine Noise: **http://www.windturbinesyndrome.com/wp-content/uploads/2009/07/wind-turbine-noise-and-sleep.pdf**
[5] http://en.wikipedia.org/wiki/Sleep_deprivation: **http://en.wikipedia.org/wiki/Sleep_deprivation**
[6] Image: **http://www.windturbinesyndrome.com/wp-content/uploads/2009/07/hanning-447x756.jpg**

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