

Submission: Declan Lally, [REDACTED]. Offaly County Council, Charleville Road, Tullamore, Co. Offaly. Re: Submission to proposed Offaly County Development Plan 2021 – 2027 Date: 05.10.20 To whom it concerns, I wish to make a submission in relation to the proposed County Development Plan 2021-2027 and Wind Energy Strategy, specifically area 7(see Map No. 10, Page 3) and any submission by speculators to look to extend the already zoned lands deemed suitable for Windfarms in this area, south of Galross Cross for the following reasons: • Wind turbine Saturation: This area is already saturated with wind turbines: o Meenwaun: There are 4 turbines with planning permission for 5, each at a huge height of 169 metres(560 feet) and each generates 2.75 megawatt. This windfarm is already built. o Derrinough: Bord na Mona has submitted planning permission for 21 turbines at an even higher height of 185 metres(610 feet) each. These are 4 megawatt turbines which are typically only sited offshore, given the adverse effect on humans. This application from Bord na Mona applies to an area which is not within the already existing zone deemed suitable for Windfarms. o Note the average size for windfarm turbines is approximately 2.5MW. The Meenwaun wind farms are 2.75MW and Derrinlough will be 4MW. • Impact on Health: Our home is located 1.8KM from the Meenwaun turbines. [REDACTED]

[REDACTED] since the Meenwaun turbines were commissioned in 2018 and was out of work for nine months and will live with this disease for the rest of her life. [REDACTED]

[REDACTED] since these turbines were commissioned. Our autistic son and my wife must take sleeping tablets to get to sleep when there is a north wind, due to the disturbance caused by the turbines. We are concerned about the consolidated noise and ill health impact of the additional 21 turbines (4 megawatt) in Derrinlough will have, not even considering any request to extend the zone for even more wind turbines. Does the county council envisage providing residents/victims with a relocation package like that of victims of flooding? Any more turbines will result in persistent sleep loss due to the noise from the turbines and shadow flicker due to the low winter sun would be like strobe lighting going through our home. I refer to the following recent court cases in Ireland: • Valentine Kelleher Vs Green Energy Supply Ltd February 2020: Three children in County Cork receive €225,000 settlement over alleged illnesses caused by windfarm near family home <https://www.thejournal.ie/high-court-siblings-settle-wind-farm-action-5021713-Feb2020/> • Balz and Heubacher: Thu, Dec 12, 2019 The Supreme Court overturns An Bord Pleanalas permission for Windfarm in failing to consider submissions from a local couple concerning developing knowledge about noise impact from turbines. The couple argued that the windfarm

would result in a quadrupling of perceived loudness in the area.
<https://www.irishtimes.com/news/crime-and-law/courts/supreme-court/supreme-court-overturns-permission-for-cork-windfarm-1.4113344> • Enercon Windfarm Services Ireland Ltd and Carrigcannon Wind Farm Ltd vs The Shivnen family and others: instructed by solicitor Joe Noonan. This was the first case in Ireland where a Wind operator admitted liability for the adverse health effects on the young families living within 1 km of the farm (2017).
<https://www.irishexaminer.com/news/arid-30793550.html>
<https://stopthesethings.com/2016/12/17/irish-high-court-finds-wind-turbine-maker-liable-for-noise-nuisance-7-irish-families-to-get-millions-in-punitive-damages/> <https://www.masterresource.org/wind-turbine-noise-issues/wto-wind-turbine-noise-as-a-health-hazard/> the findings of the Australian Senate Select Committee on Wind Turbines (June 29, 2015). This court established that there is a direct pathway to disease resulting from wind turbine noise. • Professor Alun Evans of Queens University Belfast wrote a paper for the British Medical Journal arguing that wind turbines disturb sleep and impair health. <https://the-law-is-my-oyster.com/2014/11/16/are-windfarms-torture-farms/> I refer to the lived experience of residents living beside Meenwaun Windfarm <https://www.offalyindependent.ie/2018/02/23/windfarm-has-made-our-lives-a-living-hell/> • Impact on LOFAR: The Low Frequency Array (LOFAR) is an international network of state-of-the-art telescopes used to observe the Universe in unprecedented detail at low radio frequencies, LOFAR consists of 12 international stations spread across Germany, Poland, France, UK, Sweden and Ireland, with additional stations and a central hub in The Netherlands, operated by the Netherlands Institute for Radio Astronomy (ASTRON). I-LOFAR is the Irish addition to this network and the 12th international station to be built in Europe. It allows Irish astrophysical research to be integrated into one of the most sophisticated telescopes on the planet. The location of this Irish station is in the centre of the country on the grounds of Birr Castle, Co. Offaly. Any submission to expand zone 7 south of Galross cross will have a potentially negative impact on the Lofar and it is unknown what the consolidated impact of the Derrinlough (21) and Meenwaun turbines (4/5) will be on this lofar installed at Birr Castle in Co Offaly in 2017 to detect low-frequency radio waves travelling across interstellar space. The lofar is of immense importance for Ireland and the EU and the investment to date from Science Foundation Ireland of €1.4 million. The importance of the Lofar for Ireland is referenced in the following articles: Irish Times Article Thu, Sep 24, 2020 <https://www.irishtimes.com/news/science/ireland-ready-to-answer-et-s-call-1.4333148> Irish Times Article Thu, Nov 16, 2017, <https://www.irishtimes.com/news/science/a-new-age-of-radio-astronomy-at->

birr-castle-1.3294360 • Impact on biodiversity: I refer to the objection from The Irish Wildlife Trust (IWT) in 2019 objecting to Bord Na Mona's plans for a 24-turbine windfarm in Longford, the IWT is increasingly concerned that turbines are being inappropriately located, especially on peatland habitats. "In particular, the presence of turbines can be at odds with biodiversity protection, the restoration of which is equally as important as addressing climate change. <https://www.newstalk.com/news/irish-wildlife-trust-objects-bord-na-mona-plan-longford-windfarm-842170>" • Habitats Directive: Can the council confirm that an Appropriate Assessment under the Habitats Directive has been followed in considering any request for extension of zone 7 for Windfarm development? • Amenities: These turbines will scar the line of site for Birr Town and environs, and the visual impact will be seen for many miles. Offaly County Council should prepare a Line of Sight Projection, to truly see the effect across the county. Also, we as a family are very much entitled to enjoy our views of the Slieve Bloom mountains, not wind turbine blades, shadow flicker and industrial noise in a country area. • Tourism: Extending the draft area will impact hugely on the potential tourism market for Offaly and the Midlands. Just as Longford announced a huge tourism venture which resulted in over 500 jobs and 100,000 visitors spending money in the locality, Offaly will become a ghost county with no one coming to visit due to the scarred landscape covered in Windfarms. Offaly county council at a strategic level, have the opportunity to realise that given the aging worldwide population, global warming and other factors, that strategically the county is best placed to offer a Tourism/Independent living offerings as the county is also conveniently located within an hour and a half of many large cities and towns. Should this proposal go ahead, any chance of the Midlands becoming the forefront for leisure tourism for cycling/walking/hiking/trekking/Adventure sports will be most negatively impacted. • Speculators: The same absentee landlords/speculators who recently bought parcels of land adjacent to zone 7 should not be able to state to adjacent landowners that the consultation process is just a "rubber stamping exercise" for them to get the land rezoned in the next draft of the plan. Image below shows the area (marked in green) proposed by these speculators. These actions are fuelling a speculative market. When our homes were granted planning permission, Offaly County council included a condition that the houses could not be sold for a number of years (7-10). This was to prevent property speculation. However, the same planning laws were not applied for "Element Power" who were granted planning permission to build Meenwaun Windfarm beside us and before Element Power had even built the windfarm they had already sold it for 30 million to "Tinc" a Belgian Investment company, making a huge profit and walking away from the families who are left to live in the shadow of their

windfarm for the rest of our lives. Offaly County Council should have provided the same planning restrictions that were imposed on residents (no sale for 7 - 10 years).

- Impact on our property value: John Earley of Property Partners Earley in Roscommon estimates the value of a house located close to a turbine can decrease by 50pc or more. He said: "This has been my experience with properties within half a mile of turbines."
- Right to your views and amenities Sliabh Bloom, right to no industrial noise at night. People are entitled to our amenities i.e. direct views of Sliabh Bloom mountains, not turbine blades.

regards, Declan Lally

Additional Research on Noise and effects of wind turbines on health: World Health Organisation: <http://www.napaw.org/WHO-noise-2015.php>

The European office of the World Health Organisation (WHO) is in the process of developing Environmental Noise Guidelines for the European Region as a regional update to the WHO Community Noise Guidelines. The new Guidelines will be based upon a review of evidence of the health effects of environmental noise in the light of significant research carried out in the last few years. For the first time, the panel is investigating adverse health issues in local residents following the construction of wind turbines, the health benefits of noise mitigation and possible government intervention to decrease noise levels. It will look at adverse effects such as: sleep disturbance, annoyance, cognitive impairment, mental health and wellbeing, cardiovascular diseases, hearing impairment and tinnitus and adverse birth outcomes. A number of experts and concerned individuals who have gained some expertise in this field have sent an Open Letter to members of the panel welcoming the investigation.

(1) Christine Metcalfe, U.K. spokesperson for the group, said today: 'Complaints of adverse health impacts from those forced to live close to wind turbines continue to rise. These involve both audible noise including low frequency noise, and inaudible noise below 20 Hz, known as infrasound. Both audible and inaudible lower frequency noise can cause unpleasant sensations including pressure and vibration, at sound levels which may not be audible. Complaints of severe sleep deprivation, severe chronic stress, and disabling vestibular dysfunction symptoms (dizziness, vertigo etc.,) abound, with problems varying from site to site depending upon local topography, height and number of turbines, inter-turbine distances, and the distance between turbines and homes. The common thread to the reported symptoms (known as "noise annoyance") is the activation of the startle reflex, which can be triggered by acoustic, vestibular, and tactile stimuli – which if activated together can have a synergistic effect (2). To argue that the sleep disturbance, physiological stress and vestibular dysfunction symptoms and their serious long term adverse health consequences don't exist or are caused by scaremonger nor morally or ethically defensible. This is

particularly the case on the part of medical or acoustical professionals, in view of both their training, and their respective professional obligations to protect the health and safety of the public. Despite mounting anecdotal and academic evidence, no health monitoring is underway nor mitigation against adverse health effects following the construction of wind turbines which remains shockingly absent from planning guidelines in many European countries. It is imperative that new guidelines encourage governments better to safeguard the health of their citizens. We remain hopeful that the panel's deliberations will result in tough new European guidelines which in turn will prompt a serious worldwide examination of all aspects of this problem, including the widely-reported effects on animals. Although not part of the current WHO remit, there is an urgent need for governments not to abrogate responsibility for examining rising numbers of reported effects on wildlife and domestic animals. We also trust and hope that the panel will issue stringent guidelines to European governments to ensure that those whose health is currently badly affected can look forward to some workable mitigation or removal of implicated turbines. Only then can future populations be protected from suffering the hell that has been inflicted upon some wind farm neighbours.

Overview of some of the academic reports on human health: A former Consultant in Sleep Disorders Medicine highlighted in his article in the 2014 issue of the British Medical Journal, amongst other warnings, the particular sleep deprivation dangers to children (3): 'Sleep disturbance may be a particular problem in children, 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.' His co-author wrote in Principia Scientific International in 2014 (4): 'The current guideline on -Rseparation-97and is manifestly out of distance date. It is only relevant to the small turbine turbines means that the current recommendation on turbine separation is grossly inadequate. Salt and Lichtenhan of the Washington School of Medicine published an article in the British periodical Acoustics Today in 2014 which concluded: 'Given the present evidence, it seems that risky at infrasound stimulation of the ear stays confined to the ear and has no other effects on the body. For this to be true, all the mechanisms we have outlined (low-frequency-induced amplitude modulation, low frequency sound-induced endolymph volume changes, infrasound stimulation of type II afferent nerves, infrasound exacerbation of noise-induced damage and direct infrasound stimulation of vestibular organs) would have to be insignificant. We know this is highly unlikely and we anticipate novel findings in the coming years that will influence the debate. (5) In Australia in 2013 the Waubra Foundation issued what it described as an explicit warning notice to Planning Authorities, Departments

of Health, Environmental Protection Agencies, Federal, State and Local Governments, Wind Industry Developers and Acoustic Consultants. These included references to the 1985 and 1987 Kelly evidence on wind turbine noise and infrasound, the need for regularly updating latest evidence on dose exposure, plus multidisciplinary acoustic & physiological research needs. (6) At an International Congress on Sound and Vibration in Florence, Italy in 2015, a paper presented by Dr. Christian Koch demonstrated findings on investigations of perception at infrasound frequencies via the use of fMRI and MEG methods. (7) The German Medical Assembly meeting in Frankfurt last year called on the German government to conduct urgent scientific research into reported noise issues. It is crucial to stress the wind turbine's specific noise character. It is already known that the so-called 'annoyance' level at 40 dBA from wind farm noise, and this has recently been attributed in part to amplitude modulation by experienced acousticians such as Dr Geoff Leventhall (UK), (8) Dr Paul Schomer (USA, former Director of Acoustic Standards) and Steven Cooper (Australia). Wind turbine noise emissions comprise a number of features including a complex and vibrant sound mix, cylindrical sound propagation and refraction from the high levels, distinct peaks at the blade pass frequency, high proportion of infrasound and low frequency noise, and the sharp noise level in quiet areas especially during nights and cold seasons. It highlights strongly that wind power sound has a very characteristic sound profile, and that this must be specifically considered in the new regulations.' And on animals: A study of badgers notes the paucity of data existing with which to assess the effects of wind turbines noise on terrestrial wildlife, despite growing concern about the impact of infrasound from wind farms on human health and well-being. It features the stress hormone cortisol levels of badgers living in close proximity to wind turbines: 'We suggest that the higher cortisol levels in affected badgers is caused by the turbines' sound and that these high levels may affect badgers' immune systems, which could result in increased risk of infection and disease in the badger population. (9) Another study on effects on pig-rearing in Poland was conducted to assess the effect of rearing pigs at three different distances from a wind turbine (50, 500 and 1000 m) on the physicochemical properties and fatty acid composition of loin and neck muscles. Avoiding noise-induced stress is important not only for maintaining meat quality but also for improving animal welfare. (10) Professor Mariana Alves-Pereira of the Lusofona University in Portugal has been researching vibroacoustic disease since 1980 initially focussed on the low frequency noise (LFN) that impacted aeronautical technicians. Late in 2013, she presented a case study from Portugal where a family had been exposed for seven years to LFN caused by the operation of nearby wind turbines. Testing showed the

increase in LFN inside the home was associated with turbine operation. Medical tests showed the people who were living inside the home had impaired brain function in relation to responding to stimuli as well as their control of breathing. The syndrome is known as Vibro- Acoustic Disorder.

(11) Notes for Editors For more information contact Christine Metcalfe email luanam@btinternet.com and phone 01866 844220

1. Open Letter to the members of the panel developing the WHO Environmental Noise Guidelines for the European Region. Marie-Eve Héroux Marco Paviotti. Wolfgang Babisch. Göran Pershagen Goran Belojevic. Kerstin Persson Waye. Mark Brink. Anna Preis. Sabine Janssen. Stephen Stansfield. Peter Lercher. Martin van den Berg. Jos Verbeek. Ladies and Gentlemen, We understand that you are currently in the process of developing the WHO Environmental Noise Guidelines for the European Region as a regional update to the WHO Community Noise Guidelines. We also understand that:

1. The new Guidelines will be based upon a review of evidence on the health effects of environmental noise in the light of significant research carried out in the last few years.
2. The guidelines will review evidence on the health benefits of noise mitigation and interventions to decrease noise levels.
3. The evidence will be systematically reviewed to assess likely effects such as: sleep disturbance, annoyance, cognitive impairment, mental health and wellbeing, cardiovascular diseases, hearing impairment and tinnitus and adverse birth outcomes.
4. One of the sources of noise you are investigating is that from wind turbines which was not addressed in previous guidelines. We welcome your review because, despite mounting anecdotal and academic evidence, for too long mitigation against adverse health effects following the construction of wind turbines has been absent from planning guidelines and noise pollution regulations in many European countries, especially with respect to sound below 200 Hz. There is a pressing need for new guidelines to encourage governments better to safeguard the health of their citizens. You will be aware that these problems are not confined to Europe. Neither are they confined to human beings. We are hopeful that your deliberations will result in tough new European guidelines which in turn will prompt a serious worldwide examination of all aspects of this problem, including the widely-reported effects on animals.

Yours sincerely, The undersigned: N.B. 118 and rising, full copy available. Signatories to the letter to the World Health Organisation Expert Panel revising the Environmental Noise guidelines include the following health professionals and scientists: Medical Practitioners: Dr Mauri Johansson & Per Fisker (Denmark), Dr. Sarah Laurie (Australia) Dr. Hakan Enbom (Sweden), Professor Alun Evans (Ireland), Dr Angela Armstrong and Dr Rachel Conner (Scotland), Professor Dr Zuhal Okuyan and Professor Dr Ali Osman Karababa (Turkey), Dr Robert McMurtry

(Canada), and Dr David Lawrence (USA), Osteopath Dr Johannes Meyer (Germany and USA), Psychologist Professor Arline Bronzaft, (USA) Nursing Practitioner Norma Schmidt (Canada), Physiotherapist Virpi Polkolainen (Finland), Audiologist Professor Jerry Punch, (USA), Medical Physicist Dr Mireille Oud (The Netherlands), Professor of Otolaryngology and Neurophysiologist Alec Salt (USA), Physicist Dr John Harrison (Canada) and Scientist Dr Bruce Rapley, (New Zealand). Engineers who signed the Open Letter include Biomedical Engineer Dr Mariana Alves Pereira (Portugal), Acoustical Engineers Sven Johannsen and Erik Brunner (Germany), Steven Cooper (Australia), Emeritus Professor Colin Hansen (Australia) Rick James, Rob Rand, Steven Ambrose and Bill Acker (USA) Nicholas Kouwen, PhD., P.Eng., FASCE. Distinguished Professor Emeritus and Adjunct Professor Department of Civil and Environmental Engineering. University of Waterloo. (Canada) and other engineers including Ove Bjorklund (Sweden) and Peter Mitchell (Australia).

4. _____ 1. See above. 2. *Neurosci Biobehav Rev.* 2002 Jan;26(1):1-11. Tactile, acoustic and vestibular systems sum to elicit the startle reflex. Yeomans JS1, Li L, Scott BW, Frankland PW. <http://www.ncbi.nlm.nih.gov/pubmed/11835980> 3. Wind Turbine Noise, *British Medical Journal*, 3 Oct 12 Authors: Christopher D Hanning, honorary consultant in sleep medicine, Sleep Disorders Service, University Hospitals of Leicester, Leicester General Hospital, Leicester LE5 4PW, UK and Alun Evans, professor emeritus, Centre Belfast, Institute of Clinical Science B, Belfast, UK <http://nieuwerustnoisewatch.org/wp-content/documents/peerreviewed-articles/15-B-M%20J-Noise.pdf> 4. Wind Farms and Health, Principia Scientific International, 3 April 14 Author: Alun Evans Professor Emeritus Belfast University <http://docs.wind-watch.org/Evans-wind-farms-health.pdf> 5. How Does Wind Turbine Noise Affect People?, *Acoustics Today*, winter 2014 Authors: Alec N. Salt and Jeffery T. Lichtenhan, Department of Otolaryngology, Washington University School of Medicine, St. Louis, MO 63110 <http://www.windturbinesyndrome.com/wp-content/uploads/2014/04/Salt-et-al.on-Wind-Turbine-Syndrome.pdf> 6. Explicit warning notice, Waubra Foundation, 22 November 13 http://waubrafoundation.org.au/wp-content/uploads/2013/11/Explicit_Warning_Notice_Final_22_November_2013.pdf 7. http://en.friends-against-wind.org/doc/Full_paper_Koch_V2.pdf 8. http://parlinfo.aph.gov.au/parlInfo/download/committees/commsen/076b72db-0da0-4ca6-bffe-b0a0cea05550/toc_pdf/Senate%20Select%20Committee%20on%20Wind%20Turbines_2015_06_23_3580_Official.pdf;fileType=application%2Fpdf#search=%22committees/commsen/076b72db-0da04ca6-bffe-b0a0cea05550/0000%22 9. Wind

turbines cause chronic stress in badgers (*Meles Meles*) *Journal of Wildlife Diseases*, 52(3), 2016, pp. 000–000 _ Wildlife Disease Association. June 2016 Roseanna C. N. Agnew,^{1,2,4} Valerie J. Smith,³ and Robert C. Fowkes¹ www.jwildlifedis.org/doi/abs/10.7589/2015-09-231 10. The effect of varying distances from the wind turbine on meat quality of growing-finishing pigs. *Ann. Anim. Sci.*, Vol. 15, No. 4 (2015) 1043–1054 DOI: 10.1515/aoas-2015-0051. Malgorzata Karwowska, Jan Mikolajczak, Zbignie, Department of Meat Technology and Food Quality, University of Life Sciences in Lublin, Skromna 8, 20-704 Lublin, Poland www.wind-watch.org/documents/page/ 11. Vibroacoustic disease: Biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling. *Progress in Biophysics and Molecular Biology*, Volume 93, Issues 1–3, January–April 2007, Pages 256-279 Mariana Alves-Pereira, Nuno A.A. Castelo Branco www.sciencedirect.com/science/article/pii/S0079610706000927

Adverse health effects of industrial wind turbines Roy D. Jeffery, MD FCFP Carmen Krogh Brett Horner, CMA Author information ? Copyright and License information ? Cet article est disponible en français. Voyez "Effets indésirables sur la santé des éoliennes industrielles". This article has been cited by other articles in PMC. Canadian family physicians can expect to see increasing numbers of rural patients reporting adverse effects from exposure to industrial wind turbines (IWTs). People who live or work in close proximity to IWTs have experienced symptoms that include decreased quality of life, annoyance, stress, sleep disturbance, headache, anxiety, depression, and cognitive dysfunction. Some have also felt anger, grief, or a sense of injustice. Suggested causes of symptoms include a combination of wind turbine noise, infrasound, dirty electricity, ground current, and shadow flicker.¹ Family physicians should be aware that patients reporting adverse effects from IWTs might experience symptoms that are intense and pervasive and might feel further victimized by a lack of caregiver understanding. Background There is increasing concern that energy generation from fossil fuels contributes to climate change and air pollution. In response to these concerns, governments around the world are encouraging the installation of renewable energy projects including IWTs. In Ontario, the Green Energy Act was designed, in part, to remove barriers to the installation of IWTs.² Noise regulations can be a considerable barrier to IWT development, as they can have a substantial effect on wind turbine spacing, and therefore the cost of wind-generated electricity.³ Industrial wind turbines are being placed in close proximity to family homes in order to have access to transmission infrastructure.⁴ In Ontario and elsewhere,⁵ some individuals have reported experiencing adverse health effects resulting from

living near IWTs. Reports of IWT-induced adverse health effects have been dismissed by some commentators including government authorities and other organizations. Physicians have been exposed to efforts to convince the public of the benefits of IWTs while minimizing the health risks. Those concerned about adverse effects of IWTs have been stereotyped as “NIMBYs” (not in my backyard).^{6,7} Global reports of effects During the past few years there have been case reports of adverse effects. A 2006 Académie Nationale de Médecine working group report notes that noise is the most frequent complaint. The noise is described as piercing, preoccupying, and continually surprising, as it is irregular in intensity. The noise includes grating and incongruous sounds that distract the attention or disturb rest. The spontaneous recurrence of these noises disturbs the sleep, suddenly awakening the subject when the wind rises and preventing the subject from going back to sleep. Wind turbines have been blamed for other problems experienced by people living nearby. These are less precise and less well described, and consist of subjective (headaches, fatigue, temporary feelings of dizziness, nausea) and sometimes objective (vomiting, insomnia, palpitations) manifestations.⁸ A 2009 literature review prepared by the Minnesota Department of Health⁹ summarized case reports by Harry (2007),¹⁰ Phipps et al (2007),¹¹ the Large Wind Turbine Citizens Committee for the Town of Union (2008),¹² and Pierpont (2009).¹³ These case studies catalogued complaints of annoyance, reduced quality of life, and health effects associated with IWTs, such as sleeplessness and headaches.⁹ In 2010, Nissenbaum et al used validated questionnaires in a controlled study of 2 Maine wind energy projects. They concluded that “the noise emissions of IWTs disturbed the sleep and caused daytime sleepiness and impaired mental health in residents living within 1.4 km of the two IWT installations studied.”¹⁴ Reports of adverse health effects¹⁵ and reduced quality of life¹⁶ are also documented in IWT projects in Australia and New Zealand. A 2012 board of health resolution in Brown County in Wisconsin formally requested financial relocation assistance for “families that are suffering adverse health effects and undue hardships caused by the irresponsible placement of industrial wind turbines around their homes and property.”¹⁷ An Ontario community-based self-reporting health survey, WindVOiCe, identified the most commonly reported IWT-induced symptoms as altered quality of life, sleep disturbance, excessive tiredness, headache, stress, and distress. Other reported effects include migraines, hearing problems, tinnitus, heart palpitations, anxiety, and depression.¹⁸ In addition, degraded living conditions and adverse socioeconomic effects have been reported. In some cases the effects were severe enough that individuals in Ontario abandoned their homes or reached financial agreements with wind energy

developers.¹⁹ After considering the evidence and testimony presented by 26 witnesses, a 2011 Ontario environmental review tribunal decision acknowledged IWTs can harm human health: This case has successfully shown that the debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents. The debate has now evolved to one of degree.²⁰ Indirect effects and annoyance

When assessing the adverse effects of IWTs it is important to consider what constitutes human health. The World Health Organization (WHO) defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”²¹ Despite being widely accepted, the WHO definition of health is frequently overlooked when assessing the health effects of IWTs. Literature reviews commenting on the health effects of IWTs have been produced with varying degrees of completeness, accuracy, and objectivity.²² Some of these commentators accept the plausibility of the reported IWT health effects and acknowledge that IWT noise and visual effects might cause annoyance, stress, or sleep disturbance, which can have other consequences. However, these IWT health effects are often discounted because “direct pathological effects” or a “direct causal link” have not been established. In 2010, the Ontario Chief Medical Officer of Health released *The Potential Health Impact of Wind Turbines*, which acknowledged that some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance but concluded “the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects.”²³ The lead author of the report,²³ Dr Gloria Rachamin, acknowledged under oath that the literature review looked only at direct links to human health.²⁴ Focusing on “direct” causal links limits the discussion to a small slice of the potential health effects of IWTs. The 2011 environmental review tribunal decision found that serious harm to human health includes “indirect impacts (e.g., a person being exposed to noise and then exhibiting stress and developing other related symptoms).”²⁰ According to the night noise guidelines for Europe: Physiological experiments on humans have shown that noise of a moderate level acts via an indirect pathway and has health outcomes similar to those caused by high noise exposures on the direct pathway. The indirect pathway starts with noise-induced disturbances of activities such as communication or sleep.²⁵ Pierpont documented symptoms reported by individuals exposed to wind turbines, which include sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal

pulsation or quivering when awake or asleep.¹³ The American Wind Energy Association and the Canadian Wind Energy Association convened a panel literature review that determined these symptoms are the “well-known stress effects of exposure to noise,” or in other words, are “a subset of annoyance reactions.”²⁶ Noise-induced annoyance is acknowledged to be an adverse health effect.^{27–30} Chronic severe noise annoyance should be classified as a serious health risk.³¹ According to the WHO guidelines for community noise, “[t]he capacity of a noise to induce annoyance depends upon many of its physical characteristics, including its sound pressure level and spectral characteristics, as well as the variations of these properties over time.”³² Industrial wind turbine noise is perceived to be more annoying than transportation noise or industrial noise at comparable sound pressure levels.³³ Industrial wind turbine amplitude modulation,³⁴ audible low frequency noise,³⁵ tonal noise, infrasound,³⁶ and lack of nighttime abatement have been identified as plausible noise characteristics that could cause annoyance and other health effects. Health effects in Ontario expected Evidence-based health studies were not conducted to determine adequate setbacks and noise levels for the siting of IWTs before the implementation of the Ontario renewable energy policy. In addition, provision for vigilance monitoring was not made. It is now clear that the regulations are not adequate to protect the health of all exposed individuals. A 2010 report commissioned by the Ontario Ministry of the Environment concludes: The audible sound from wind turbines, at the levels experienced at typical receptor distances in Ontario, is nonetheless expected to result in a non-trivial percentage of persons being highly annoyed [R]esearch has shown that annoyance associated with sound from wind turbines can be expected to contribute to stress related health impacts in some persons.³⁷ Consequently, physicians will likely be presented with patients reporting health effects. Family physicians should be aware that patients reporting adverse effects from IWTs might experience symptoms that are intense and pervasive and that they might feel further victimized by a lack of care-giver understanding. Those adversely affected by IWTs might have already pursued other avenues to mitigate the health effects with little or no success. It will be important to identify the possibility of exposure to IWTs in patients presenting with appropriate clinical symptoms.³⁸ Conclusion Industrial wind turbines can harm human health if sited too close to residents. Harm can be avoided if IWTs are situated at an appropriate distance from humans. Owing to the lack of adequately protective siting guidelines, people exposed to IWTs can be expected to present to their family physicians in increasing numbers. The documented symptoms are usually stress disorder-type diseases acting via indirect pathways and can represent serious harm to human health.

Family physicians are in a position to effectively recognize the ailments and provide an empathetic response. In addition, their contributions to clinical studies are urgently needed to clarify the relationship between IWT exposure and human health and to inform regulations that will protect physical, mental, and social well-being. Footnotes This article has been peer reviewed. La traduction en français de cet article se trouve à www.cfp.ca dans la table des matières du numéro de mai 2013 à la page e218. Competing interests Dr Jeffery, Ms Krogh, and Mr Horner are on the Board of Directors for the Society for Wind Vigilance, an international federation of physicians, acousticians, engineers, and other professionals who share scientific research on the topic of health and wind turbines. The opinions expressed in commentaries are those of the authors. Publication does not imply endorsement by the College of Family Physicians of Canada. References 1. Havas M, Colling D. Wind turbines make waves: why some residents near wind turbines become ill. *Bull Sci Technol Soc*. 2011;31(5):414–26. 2. Government of Ontario [website] Chapter 12. An act to enact the Green Energy Act, 2009 and to build a green economy, to repeal the Energy Conservation Leadership Act, 2006 and the Energy Efficiency Act and to amend other statutes. Toronto, ON: Government of Ontario; 2009. Available from:

www.elaws.gov.on.ca/html/source/statutes/english/2009/elaws_src_s09012_e.htm#. Accessed 2013 Mar 26. 3. Canadian Wind Energy Association [website] Letter to Neil Parish re: sound level limits for wind farms. Ottawa, ON: Canadian Wind Energy Association; 2004. Available from: www.canwea.ca/images/uploads/File/Wind_Energy_Policy/Environmental_Issues/SoundLevels.pdf. Accessed 2013 Mar 26. 4. Hornung R. Business of green: wind energy and budget expectations [video] Toronto, ON: Business News Network; 2010. Available from: <http://watch.bnn.ca/clip272347>. Accessed 2013 Apr 4. 5. Hanning CD, Evans A. Wind turbine noise. *BMJ*. 2012;344:e1527. [PubMed] 6. Martin C. NIMBY mentality unacceptable when it comes to green-energy projects, McGuinty says. *London Free Press*. 2009 Feb 12. 7. Schliesmann P. Wind turbine debate swirls. *Kingston Whig-Standard*. 2010 Jan 2; Available from: www.thewhig.com/ArticleDisplay.aspx?e=2244137&archive=true. Accessed 2013 Mar 26. 8. Académie Nationale de Médecine Groupe de Travail . Le retentissement du fonctionnement des éoliennes sur la santé de l'homme. Paris, France: Académie Nationale de Médecine; 2006. Available from: www.academiemedecine.fr/sites_thematiques/EOLIENNES/chouard_rapp_14mars_2006.htm. Accessed 2013 Mar 26. 9. Minnesota Department of Health [website] Public health impacts of wind turbines. St Paul, MN: Minnesota Department of Health; 2009. Available

from: www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf. Accessed 2013 Mar 26.

10. Harry A. Wind turbines, noise and health. Rowe, MA: National Wind Watch; 2007. Available from: http://docs.windwatch.org/wtnoise_health_2007_a_harry.pdf. Accessed 2013 Mar 26.

11. Phipps R, Amati M, McCoard S, Fisher R. Visual and noise effects reported by residents living close to Manawatu wind farms: preliminary survey results. Rowe, MA: National Wind Watch; 2007. Available from: <http://docs.windwatch.org/phipps-visualnoiseeffects.pdf>. Accessed 2013 Mar 26.

12. Large Wind Turbine Citizens Committee for the Town of Union . Setback recommendations report. Rowe, MA: National Wind Watch; 2008. Available from: http://docs.wind-watch.org/LWTCC-Town-of-Union_FinalReport_01-14-08.pdf. Accessed 2013 Mar 26.

13. Pierpont N. Wind turbine syndrome: a report on a natural experiment. Santa Fe, NM: K-Selected Books; 2009.

14. Nissenbaum MA, Aramini JJ, Hanning CD. Effects of industrial wind turbine noise on sleep and health. *Noise Health*. 2012;14(60):237–43. [PubMed]

15. Thorne B. The problems with “noise numbers” for wind farm noise assessment. *Bull Sci Technol Soc*. 2011;31(4):262–90.

16. 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(54):333–9. [PubMed]

17. Brown County board of health resolution requesting emergency state aid for families suffering around industrial wind turbines. Rowe, MA: National Wind Watch; 2012. Available from: <http://docs.windwatch.org/Brown%20County%20Board%20of%20Health%20Resolution%20011012.pdf>. Accessed 2013 Mar 28.

18. Krogh CME, 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 Technol Soc*. 2011;31(4):334–45.

19. Krogh CME. Industrial wind turbine development and loss of social justice? *Bull Sci Technol Soc*. 2011;31(4):321–33.

20. Erickson v. Director, Ministry of the Environment. 2011. Environmental Review Tribunal Nos. 10-121 and 10-122. Available from: www.ert.gov.on.ca/files/201108/00000300-AKT5757C7CO026-BHH51C7A7SO026.pdf. Accessed 2013 Mar 28.

21. World Health Organization . Preamble to the Constitution of the World Health Organization. Geneva, Switz: World Health Organization; 1948. Definition of health. Available from: www.who.int/about/definition/en/print.html. Accessed 2013 Mar 28.

22. Horner B, Jeffery RD, Krogh CME. Literature reviews on wind turbines and health: are they enough? *Bull Sci Technol Soc*. 2011;31(5):399–413.

23. Chief Medical Officer of Health . The potential health impact of wind turbines. Toronto, ON: Ministry of Health and Long-Term Care; 2010. Available

from:http://health.gov.on.ca/en/common/ministry/publications/reports/wind_turbine/wind_turbine.pdf. Accessed 2013 Mar 27. 24. Erickson v. Director, Ministry of the Environment. Environmental Review Tribunal Nos. 10-121 and 10-122. Transcript of Dr G. Rachamin. 2011 Mar 4. 25. World Health Organization Europe . Night noise guidelines for Europe. Copenhagen, Denmark: World Health Organization Europe; 2009. Available from:www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf. Accessed 2013 Mar 27. 26. Colby WD, Dobie R, Leventhall G, Lipscomb DM, McCunney RJ, Seilo MT, et al. Wind turbine sound and health effects. An expert panel review. Washington, DC: American Wind Energy Association, Canadian Wind Energy Association; 2009. Available from:www.canwea.ca/pdf/talkwind/Wind_Turbine_Sound_and_Health_Effects.pdf. Accessed 2013 Mar 27. 27. Health Canada [website] Community noise annoyance. Ottawa, ON: Health Canada; 2005. Available from:www.hcsc.gc.ca/hl-vs/iyh-vsv/life-vie/community-urbain-eng.php. Accessed 2013 Mar 27. 28. Suter AH. Noise and its effects. Washington, DC: Administrative Conference of the United States; 1991. Available from:www.nonoise.org/library/suter/suter.htm. Accessed 2013 Mar 27. 29. Michaud DS, Keith SE, McMurchy D. Noise annoyance in Canada. *Noise Health*. 2005;7(27):39–47.[PubMed] 30. Pedersen E, Persson Wayne K. Wind turbine noise, annoyance and self-reported health and well-being in different living environments. *Occup Environ Med*. 2007;64(7):480–6. Epub 2007 Mar 1. [PMC free article] [PubMed] 31. Maschke C, Niemann A. Health effects of annoyance induced by neighbour noise. *Noise Control Eng J*. 2007;55(3):348– 56. 32. Berglund B, Lindvall T, Schwela DH, editors. *Guidelines for community noise*. Geneva, Switz: World Health Organization; 1999. 33. 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. [PubMed] 34. Leventhall G. Infrasound from wind turbines—fact, fiction or deception. *Can Acoust*. 2006;34(2):29–36. 35. Møller H, Pedersen CS. Low-frequency noise from large wind turbines. *J Acoust Soc Am*. 2011;129(6):3727– 44. [PubMed] 36. Salt AN, Kaltenbach JA. Infrasound from wind turbines could affect humans. *Bull Sci Technol Soc*. 2011;31(4):296–302. 37. Howe Gastmeier Chapnik Limited . Low frequency noise and infrasound associated with wind turbine generator systems. A literature review. Toronto, ON: Ontario Ministry of the Environment; 2010. Available from:www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_092086.pdf. Accessed 2013 Mar 27. 38. McMurtry RY. Toward a case definition of adverse health effects in the environs of industrial wind turbines: facilitating a clinical diagnosis. *Bull Sci Technol Soc*.

2011;31(4):316–20. Industrial wind turbines and adverse health effects. Jeffery RD¹, Krogh CM², Horner B². Author information Erratum in • Can J Rural Med. 2014 Spring;19(2):56. Abstract INTRODUCTION: Some people living in the environs of industrial wind turbines (IWTs) report experiencing adverse health and socioeconomic effects. This review considers the hypothesis that annoyance from audible IWTs is the cause of these adverse health effects. METHODS: We searched PubMed and Google Scholar for articles published since 2000 that included the terms "wind turbine health," "wind turbine infrasound," "wind turbine annoyance," "noise annoyance" or "low frequency noise" in the title or abstract. RESULTS: Industrial wind turbines produce sound that is perceived to be more annoying than other sources of sound. Reported effects from exposure to IWTs are consistent with well-known stress effects from persistent unwanted sound. CONCLUSION: If placed too close to residents, IWTs can negatively affect the physical, mental and social well-being of people. There is sufficient evidence to support the conclusion that noise from audible IWTs is a potential cause of health effects. Inaudible low-frequency noise and infrasound from IWTs cannot be ruled out as plausible causes of health effects. Proposed Wind Turbine Siting Sound Limits October 24, 2008 1. Establishing Long-Term Background Noise Level a. Instrumentation: ANSI or IEC Type 1 Precision Integrating Sound Level Meter plus meteorological instruments to measure wind velocity, temperature and humidity near the sound measuring microphone. Measurement procedures must meet ANSI S12.9, Part 3. b. Measurement location(s): Nearest property line(s) from proposed wind turbines representative of all non-participating residential property within 2.0 miles. c. Time of measurements and prevailing weather: The atmosphere must be classified as stable with no vertical heat flow to cause air mixing. Stable conditions occur in the evening and middle of the night with a clear sky and very little wind near the surface. Sound measurements are only valid when the measured wind speed at the microphone does not exceed 2 m/s (4.5 mph). d. Long-Term Background sound measurements: All data recording shall be a series of contiguous ten (10) minute measurements. The measurement objective is to determine the quietest ten minute period at each location of interest. Nighttime test periods are preferred unless daytime conditions are quieter. The following data shall be recorded simultaneously for each ten (10) minute measurement period: dBA data includes LA90, LA10, LAeq and dBC data includes LC90, LC10, LCeq, plus maximum wind speed at the microphone during the ten minutes and a single measurement of temperature and humidity at the microphone for each new location or each hour whichever is oftener. A ten minute measurement contains valid data provided: Both LA10 minus LA90 and

LC10 minus LC90 are not greater than 10 dB and the maximum wind speed at the microphone did not exceed 2 m/s during the same ten minute period as the acoustic data.

2. Wind Turbine Sound Immission Limits No wind turbine or group of turbines shall be located so as to cause wind turbine sound immission at any location on nonparticipating property containing a residence in excess of the limits in the following table:

Noise Immission Limits ¹	Criteria	dBA	dBC	A
Immission above preconstruction background: $LA_{eq} = LA_{90} + 5$ $LC_{eq} = LC_{90} + 5$				
B Maximum immission: 35 LA_{eq} 55 LC_{eq} for quiet ² rural environment ⁶⁰ LC_{eq} for rural-suburban environment				
C Immission spectra imbalance LC_{eq} (immission) minus $LA_{90} + 5$ (background) = 20 dB				
D Prominent tone penalty: 5 dB				5 dB

Notes 1 Each Test is independent and exceedance of any test establishes non-compliance. Sound "immission" is the wind turbine noise emission as received at a property. 2 A "Quiet rural environment" is a location 2 miles from a state road or other major transportation artery without high traffic volume during otherwise quiet periods of the day or night. 3 Prominent tone as defined in IEC 61400-11. This Standard is not to be used for any other purpose. 1 Procedures provided in Section 7. Measurement Procedures (Appendix to Ordinance) of the most recent version of "The How To Guide To Siting Wind Turbines To Prevent Health Risks From Sound" by Kamperman and James apply to this table. 3. Wind Farm Noise Compliance Testing All of the measurements outlined above in 1. Establishing Long-Term Background Noise Level must be repeated to determine compliance with 2. Wind Turbine Sound Immission Limits. The compliance test location is to be the pre-turbine background noise measurement location nearest to the home of the complainant in line with the wind farm and nearer to the wind farm. The time of day for the testing and the wind farm operating conditions plus wind speed and direction must replicate the conditions that generated the complaint. Procedures of ANSI S12.9- Part 3 apply. The effect of instrumentation limits for wind and other factors must be recognized and followed. —George W. Kamperman & Richard R. James Wind turbine collisions killing hundreds of UK bats each month, study finds Nicola Davis @NicolaKSDavis The Guardian/Environment: Monday 7 November 2016 17.00 GMT Last modified on Friday 10 February 2017 10.39 GMT Research suggests ecological impact assessments carried out for windfarms are not adequately predicting bat activity or risks Using sniffer dogs, scientists at the University of Exeter report that they hunted for bat carcasses at 46 windfarms across the UK, 29 of which had ecological impact assessments available. Photograph: Mark Ferguson/Alamy Stock Photo Hundreds of bats are being killed in collisions with wind turbines in the UK each month, despite ecological impact assessments predicting that many windfarms were unlikely

to affect such animals, according to a new study. All UK species of bats are protected by law, and ecological impact assessments - carried out before construction of windfarms or other sites - should weigh up the risks for local habitats and wildlife. But new research suggests that such assessments are simply not up to scratch. Using sniffer dogs, scientists at the University of Exeter report that they hunted for bat carcasses at 46 windfarms across the UK, 29 of which had ecological impact assessments available. For 18 of the sites the assessment reported that a windfarm would be unlikely to affect protected species, or an investigation into bat activity was unnecessary. However the researchers found that nearly all of the 29 sites showed evidence of bat activity, while half had seen collisions between bats and wind turbines with estimated death rates of up to 64 fatalities per month, taking into account factors such as possible removal of carcasses by predators. Among the sites flagged as posing a high risk to bats, the authors found that efforts to reduce the impact of wind turbines had had little effect. "The sorts of mitigation that have been used, like moving the turbine a bit further away from woodland, just wasn't doing the job," said Dr Fiona Mathews, lead author of the research that was published in the journal *Current Biology*. The authors conclude that ecological impact assessments do not adequately predict the risk of windfarms to bats. But it is not clear whether the failings are down to changes in the behaviour of bats after windfarm construction, or are simply down to poor surveying of the area beforehand. Advertisement "That is something that really needs urgent attention," said Mathews. "At the moment tens if not hundreds of thousands of pounds are paid on infrastructure projects all the time to do ecological surveys with nobody actually doing any followups to see whether they're effective or not." As well as improving pre-construction surveys, the authors say that assessments should be carried out after windfarms have been built, while better approaches should be developed to reduce the chances of collisions - such as re-positioning the turbine blades out of the wind at night during periods in the year when bats are most active. More research is also needed into why the bats are flying so close to the turbines, said Mathews. But, she adds, wind turbines remain an important source of clean energy. "What we want is something that actually works for conservation rather than it just being a box-ticking exercise," she said. Bat Fatalities at Wind Turbines: Investigating the Causes and Consequences Wind energy is one of the fastest-growing industries in the world and represents an important step toward reducing dependence on non-renewable sources of power. However, widespread deployment of industrial wind turbines is having unprecedented adverse effects on certain species of bats that roost in trees and migrate. Bats are beneficial consumers of agricultural insect pests and migratory species of

bats provide free pest-control services across ecosystems and international borders. Bats are being found beneath wind turbines all over the world. Bat fatalities have now been documented at most wind facilities in the U.S. and Canada and it is estimated that tens to hundreds of thousands die at wind turbines in North America each year. This unanticipated issue has moved to the forefront of conservation and management efforts directed toward this poorly understood group of mammals, particularly due to the concurrent effects of a new bat disease, whitenose syndrome. The mystery of why bats die at industrial wind turbines remains unsolved. Is it a simple case of flying in the wrong place at the wrong time? Are bats attracted to the spinning turbine blades? Why are so many bats colliding with turbines compared to their infrequent crashes with other tall, human-made structures? Are there ways to predict and minimize risk to bats before turbines are built? Although these questions remain mostly unanswered, potential clues can be found in the patterns of fatalities. Foremost, the majority of bat fatalities at industrial turbines are species that migrate long distances and rely on trees as roosts throughout the year, some of which migrate long distances; we call these "tree bats." Tree bats compose more than three quarters of the bat fatalities observed at wind energy sites. The other striking pattern is that the vast majority of bat fatalities at wind turbines occur during late summer and autumn. This seasonal peak in fatalities coincides with periods of both autumn migration and mating behavior of tree bats. Seasonal involvement of species with shared behaviors indicates that behaviour plays a key role in the susceptibility of bats to wind turbines, and that migratory tree bats might actually be attracted to turbines. Over the past decade USGS scientists and their research partners have been studying bat deaths at wind turbines, with the ultimate goal of understanding why they are happening so solutions can be developed to avoid or fix the problem. In addition to synthesizing existing information, USGS research has focused on better understanding aspects of tree bat ecology that might offer important clues to their susceptibility (see Paul Cryan publications). This work has shed new light on the migratory movements, mating behaviours, and feeding habits of migratory tree bats, which may help explain their disproportionate representation among turbine fatalities. For example, analysis of distribution records, as documented in the following links, hint at where these bats might occur at any given time of year: Download Seasonal Distribution Videos ••• Seasonal distribution of : hoary bats (*Lasiurus cinereus*) [WMV format 1.8 MB], Seasonal distribution of haired bats) [WMV Seasonal distribution of red bats (*Lasiurus* and *L.*) [WMV format: silver- (*Lasionycteris noctivagans* format: 1.7 KB *borealis* *blossevillei* 1.9 KB] Continuing on the same research trajectory, USGS scientists at the Fort Collins Science Center have built an active research program to

investigate the causes and consequences of bat fatalities at wind turbines. In collaboration with scientists at 4 other USGS science centers, as well as universities and conservation organizations, our specific focus is to (1) better identify the seasonal distributions, habitat needs, and migration patterns of species showing greatest susceptibility, (2) continue to assess the potential roles of mating and feeding behaviors in turbine collisions, (3) develop new videobased methods for studying and monitoring bats and birds flying around wind turbines at night, and (4) test whether bats are attracted to turbines. With a proven track record of studying bat migration and behavior, combined with an existing infrastructure that promotes collaboration between disciplines, the USGS is well-equipped to effectively address the problem of bat mortality at wind power facilities. Only through further research will we make progress toward minimizing the impact of this new form of sustainable energy on our Nation's wildlife. Wind turbines may be killing bats by 'exploding' their lungs

Appendix 6:
<http://www.telegraph.co.uk/news/earth/energy/renewableenergy/10307646/Wind-turbines-may-be-killing-bats-byexploding-their-lungs.html> WIND farms may be killing legally protected bats by causing internal organs to "explode", according to wildlife experts. Conservationists believe bats are dying while hunting insects that are attracted by the heat generated by turbine blades By Auslan Cramb, Scottish Correspondent 3:43PM BST 13 Sep 2013 The Bat Conservation Trust says it has evidence that pressure caused by turbine blades causes the animals' lungs to "pop", causing immediate death. Bats are a protected species in the UK, and deliberately injuring or killing them carries the threat of six months in jail and a fine of up to £5,000. Conservationists believe bats are dying while hunting insects that are attracted by the heat generated by turbine blades. They have suggested that even if the bats avoid the turbines, the change in pressure created by the spinning blades is capable of bursting their lungs. Anne Youngman, Scottish officer of the Bat Conservation Trust, said: "People think that the danger is the bats getting hit by the blade, which does happen. "But the danger to them is really barotrauma, were they are literally popped from the inside. "It is reported a lot that birds of prey are dying because of wind turbines, but lots of bats are too." She said a dead bat was found under a turbine close to where she lives and had no obvious sign of external trauma, adding: "There are many risks to bats in Scotland, such as cats and other animals attacking them, as well as the weather. But when you add the wind turbines it could be the final nail in the coffin." In the United States, several studies have suggested bats suffer from barotrauma – a condition that can affect divers - when they get too close to the turbine blades. Melissa Behr, a vet at the University of Wisconsin, said she had dealt with a number of bats that had

no physical signs of trauma, but had suffered damage to the ears and lungs. She added: "There are bats with no broken bones or other evidence of blunt trauma, that have pulmonary and middle ear haemorrhages which implies that they had suffered barotrauma. "In one case 46% per cent of the bats that were seen had no physical sign of trauma, but 100% had pulmonary haemorrhage. The conclusion is that a large percentage must have died of barotrauma." Christine Metcalfe, an anti-wind farm campaigner who recently won an appeal at the UN, arguing that the UK Government had failed to fully inform the public about the negative effects of turbines, said: "People don't realise that the turbine tips move up to speeds of 200 miles an hour. This obviously will have a massive effect on wildlife such as birds and bats." Scotland has nine species of bat, the most common of which is the pipistrelle, which is just 2in long. The wind farm industry is currently involved with the Department for Environment, Food and Rural Affairs on a project to determine the impact of turbines on bats, with the research due to be published next year. Jenny Hogan, director of policy for Scottish Renewables, said: "Whenever a developer applies to build a wind farm, a thorough environmental impact assessment is carried out to ensure that any effect on wildlife, including bats, is reduced to an absolute minimum and is acceptable."

Appendix 8: Wind turbines and low frequency noise: Implications for human health Author: Papadopoulos, George

Low frequency noise (LFN) First of all, what is low frequency noise? It is noise, as the name suggests, at the lower frequencies of the audible range. It is generally accepted to be within 20 to 200 hertz. Less than about 20 hertz is termed infrasound, because it is not usually audible to the human ear. ILFN (Infrasound–low frequency noise) is another abbreviation I shall use, as in some instances infrasound is comparable to LFN. Noise that can be felt Unlike higher frequency noise, ILFN is not just audible – it is also perceptible!

[1] The human ear can hear infrasound down to a frequency of 12 hertz, after which it is perceived as single cycles of the sounds along with a sensation of pressure at the eardrums. [2] ILFN is also a useful tool in the military in the form of long range acoustic devices. [3] Various parts of the human body resonate to differing frequencies of ILFN. [4] Likewise any building structure can respond in a similar way causing annoyance and distress to the occupants. In the worst case scenario structures can collapse. [5] As such it is not a benign phenomenon which is restricted to the aesthetics of noise – it can be very intrusive and distressing in other ways. Noise that is selective in who it disturbs I quote directly from the words of Dr Geoff Levanthall in a report prepared for DEFRA in 2003: LFN causes EXTREME distress to a number of people who are sensitive to its effects... Such sensitivity may be a result of heightened sensory response within the whole or part of the

auditory range or may be acquired. The noise levels are often low, occurring in the region of the hearing threshold, where there are considerable individual differences. The World Health Organization is one of the bodies which recognizes the special place of low frequency noise as an environmental problem. [6] Noise that can alter human mood ILFN affects brain activity. According to a study done in Britain in 2003, people were exposed to an ILFN frequency of 17 hertz during a concert: The presence of the tone resulted in a significant number (22%) of respondents reporting anxiety, uneasiness, extreme sorrow, nervous feelings of revulsion or fear, chills down the spine and feelings of pressure on the chest. [30,31] In presenting the evidence to British Association for the Advancement of Science, Professor Richard Wiseman said, "These results suggest that low frequency sound can cause people to have unusual experiences even though they cannot consciously detect infrasound. [6] The story doesn't end here. There are other research papers that link wind turbine infrasound with perceptions of ghosts [7] and anxiety. [8] Noise that travels through walls and terrain Again from Levanthall: "Infrasound is difficult to stop or absorb. Attenuation by an enclosure requires extremely heavy walls, whilst absorption requires a thickness of absorbing material up to about a quarter wavelength thick ..." [9] Consider that the wavelength of 1 hertz is 340m, 10 hertz is 34m, and 25 hertz 13.6m, there is therefore no reasonable way of affording protection to people against even 25 hertz: one will need walls that are over 6 meters thick! Noise that travels very long distances Whilst it would be expected that the ILFN would rapidly dissipate like other forms of noise over distance, one must be careful to put this into context. According to Levanthall: The attenuation of sound in air... is very low at low frequencies. Other attenuating factors, such as absorption by the ground and shielding by barriers, are also low at low frequencies. The net result is that the very low frequencies of infrasound are not attenuated during propagation as much as higher frequencies. [10] Under conditions of 20 degrees Celcius at 70% humidity, Levanthall states that noise at 63Hz will dissipate at only 0.1dB/km – i.e. negligible losses. However, there is another factor to consider: noise dilution over distance. The loss according to Levanthall is about 6dB for each doubling of distance. However, what happens when dealing with 140 wind turbines in the region each producing ILFN? How does this noise energy "dilute" out over distance? It clearly doesn't follow a simple model of dissipation and instead interacts with the ILFN from other wind turbines (and other industrial sources such as open-cycle gas plants, one of which is due to be built just outside the village at Dalton). What produces ILFN? Again I quote from Levanthall: Low frequency noise and infrasound are produced by machinery, both rotational and reciprocating, all forms of transport and

turbulence. For example, typical sources might be, pumps, compressors, diesel engines, aircraft, shipping, combustion, air turbulence, wind and fans. [11] What about wind turbines? Wind turbines certainly do produce ILFN. They are reverse fan mega machinery of unprecedented proportions. Such rotating machinery moves at up to 290km/h on the outer tip of the blade. The span is the same as that of a jumbo jet, and the surface area of their blades is extensive (hundreds if not over one thousand square metres in larger models). Their generator weighs tens of tonnes. Although the larger wind turbines are “quieter” machines in terms of audible noise, they instead produce more ILFN. [12] Quiet backgrounds are associated with more noise annoyance. The lack of background noise makes a dominant noise source more noticeable. Whilst this appears self-explanatory to any person living in rural area, it has also been the subject of investigation. [13] The Capital and Southern Tablelands regions have no major industrial sources of noise, save traffic noise in Canberra, and the large wind turbine installations started in late 2008. But isn't the noise level within the “guidelines”? The question is: what guidelines? There are no current guidelines on low frequency noise that I am aware of that are being applied to the wind turbine industry. In fact some wind industry proponents suggest on online sites that wind turbines do not produce infrasound, even when there is evidence to the contrary. The character of wind turbine noise is known to make it especially intrusive, arising from amplitude modulation associated with blade passage past the tower, and the dominance of low frequencies in the received sound spectrum. These are implicated in sleep disturbance and deprivation, and the resultant adverse health effects. [14] Moreover, the A-frequency weighted sound pressure level or “sound level” is the most common sound descriptor. However, the A-weighting has a significant restriction in that it does not permit measurement or assessment of low frequency sound. Noise standards need to include appropriate measures to calculate the impact of low frequency noise and vibrations indoors at impacted dwellings. What's been happening in the Capital/Southern Tablelands regional environment since 2009? If I was asked this question before June 2011, I wouldn't know what you were talking about. Given my bitter experience, now I do. Since late 2008 the first large industrial wind turbines were being installed in the region at Cullerin Range and at Lake George. Then in 2010 more large wind turbines started going up at Walwa, and in 2011 even more out at Lake George at Woodlawn. As with everything in life, some are more sensitive than others to unhealthy environmental factors. Already one family had moved out of the region, either in late 2010 or early 2011 because this strange noise was extremely stressful. Some of their neighbours also noticed the noise, but no one knew what it was. In early 2011 it was my turn. Swarms

of scarab beetles? Invisible mosquitoes? Grumbling Mother Earth? And plenty of anxious, sleepless nights! By June 2011 the time for guesswork was over – this weird noise was so loud and terrifying that it was making my ear drums resonate. Then my enquiries started and one of my neighbours already believed they had worked it out: wind turbines and ground vibrations. Then on July 21st and 22nd 2011, there was another climax here on the hills north of Yass – for two nights, I couldn't sleep much at all. There was this horrible distressing resonance in my ears. I struggled to get more than three or four hours of sleep. I performed more enquiries with people in the region. Several neighbours were hearing the noise. Many people in Northern Canberra are also hearing the noise. A few are having their health destroyed – they just can't get a decent sleep on some nights. They find the noise at times unbearable and highly distressing. One doctor mentioned to me a case of a woman in northern Canberra who was very distressed by a humming noise and a feeling of thrusting pulses in her house. This same doctor also started noticing the strange hum a few months later. Some dog owners are at a loss as to why their dogs behave so weirdly on some nights – they become unsocial, vegetative beings that avoid affection or attention. The startling coincidence was that of the many people I spoke to with regards to the nocturnal noise on the 21st and 22nd July 2011, 50% didn't sleep well, but only 10% noticed the hum on those days. To date the descriptions of the noise that I have received include: "V8 engine noise", "diesel engine noise", "lawn mower noise". A smaller number also feel thrusts of air pressure hitting around at their head, much like when one slams a door. It is worse indoors than outdoors. When I have been able to track the stories of several individuals simultaneously, the descriptions of time and intensity are very similar. More importantly NONE of these cases started prior to 2009 – most started in 2011. Isn't this just hearsay? Where is the evidence? There is plenty of evidence that wind turbines are "noisy" both in audible noise but also ILFN. But the most profound and far reaching claims come from the military. In Eskdalemuir, Scotland, the Ministry of Defence initially put a blanket ban on wind turbines within 80km of the United Kingdom seismic monitoring site because of concerns that wind turbines would interfere with the detection of nuclear explosions. [15] Clearly, wind turbines create significant amounts of ILFN and ground vibrations that spread over long distances, meaning that currently recommended setback distances for turbines are out of touch with reality. What's happening in Warrnambool, Victoria? There have been two reports from Warrnambool, Victoria, [16,17] which include details very similar to what I describe above. The closest turbines appear to be about 35-50km away with many more about 70km away. The descriptions of the noise have included: "A mystery noise is

driving several Warrnambool residents to despair one even selling her house to escape the incessant drone. Two residents in Mitchell Street and two others, less than a kilometre away in Alice Place, have aired their annoyance over what they describe as a low, turbine-like noise in their north-east neighbourhood.” “Three other residents also said they too found it hard to sleep, especially on calm nights when the sound was more noticeable. ‘It’s not excessive, just irritating and sometimes it keeps me awake night after night,’ one retired woman said.” “I thought I was going mad until I read that others had also heard the noise,” said 85-year-old Mavis Campbell of Cherlin Drive. “It’s been affecting my health and blood pressure and has been going on for a few years. “I would describe it as a pulsating sound like a diesel engine.” The best hint in this situation is that it has been going on for “a few years”. But most people have been noticing it more recently. Note that most wind turbines around Warrnambool had been installed over the last three to five years. The most recent addition has been the massive turbines at Glenthompson last year about 70km away. The pumping station at Warrnambool may be just another source of ILFN added to the existing load of noise, and not the primary cause of the problem. But isn’t this just tinnitus? The fact that one cannot locate the source noise does not mean it’s all in the head. According to the Renewable Energy Research Laboratory of the University of Massachusetts, “Because of long wavelengths, infrasound may not appear to be coming from a specific location.” [18] All those who describe the noise, at a distance of 30km and beyond, agree it is external to their head, and some can even feel the pulsing sensation of infrasound on their body or hear or feel the subtle rattling of home structures. Where does the problem stop? This is a difficult question to answer. On two occasions when the ILFN nuisance was at its worst, I travelled out west. On one occasion I discovered that it appeared to have dissipated at Wee Jasper, 70km away from the closest turbines. On another occasion, and by far the worst of all days, the problem had dissipated when arriving at Young about 100km from the closest turbines. Truly these figures appear subjective, outrageous, and for most, impossible to believe. However, I am reporting my findings that have taken hours and days to determine. I’m not just plucking figures out of the air. What are the peculiarities of wind turbine ILFN? Empirically, wind turbine ILFN travels upwind almost as well as it does downwind. (NASA has confirmed this observation with smaller wind turbine models). [19] It is also more intense during atmospheric inversions (consistent with the phenomenon described by Van den Berg [20,21]) and becomes dramatically worse when the atmosphere is moist, particularly prior to major rain events. Where are we heading to with ever increasing numbers of wind turbines? That is precisely what I wish you to think about. If you feel that you are one

amongst the majority that doesn't hear the ILFN from the wind turbines, then it is a case of guesswork over how many more wind turbines it will take before you start the same problem. You may also want to ask how many more turbines it will take to drive those already suffering into a total state of despair and be forced to move out of the region. What should any politician or official be doing? Research is required to establish the nature of the problem and its solutions. Meanwhile the only responsible position is to call for a moratorium on all wind developments. It is also necessary to ask questions about giving respite to the existing sufferers, particularly those who live at close range to the wind turbines where the problem is at its worst. Wind turbines should at least be SWITCHED OFF during sleeping hours, and particularly during weather conditions which are conducive to ILFN such as inversions, or pre-rain events. Wind turbines are not "farms". They are industrial zones that create much ILFN and consequent grief. And my final warning is that wind turbines are just one unique piece of recent mega machinery. Careful consideration should be to other new regional industry arrivals e.g. gas plants that may create similar problems and add the "ILFN load" of the region. By George Papadopoulos, September 2012.

1. The Sixteenth International Congress on Sound and Vibration, Krakow, 5-9 July 2009: "Hearing with your body: the influence of whole-body vibrations on loudness perception"
2. Olson, Harry F. (1967). Music, Physics and Engineering. Dover Publications. p. 249.
3. <http://www.globalsecurity.org/military/systems/munitions/acoustic.htm>
4. Wind Turbines, Noise and Health, February 2007. By Dr Amanda Harry M.B.Ch.B. P.G.Dip.E.N.T.
5. http://en.wikipedia.org/wiki/Resonant_frequency
6. Same as [2]
7. "Wind Turbines and Ghost Stories: The Effects of Infrasound on the Human Auditory System" Hsuan-hsiu Annie Chen and Peter Narins, Acoustics Today, Volume 8, Issue 2, April 2012; <http://www.library.ucla.edu/pdf/Chen.Paper.pdf>
8. The Bruce McPherson infrasound and low frequency noise study. December 14, 2011 by Stephen E. Ambrose, INCE (Brd. Cert.) and Robert W. Rand, INCE Member. The link to the paper is found at: <http://randacoustics.com/wind-turbinesound/wind-turbines-published-articles/the-bruce-mcpherson-ilfn-study/>
9. "A Review of Published Research on Low Frequency Noise and its Effects": Report for Defra by Dr Geoff Leventhall. p.8. <http://archive.defra.gov.uk/environment/quality/noise/research/lowfrequency/documents/lowfreqnoise.pdf>
10. Same as [9]. p.8.
11. Same as [9]. p.7.
12. http://asadl.org/jasa/resource/1/jasman/v129/i6/p3727_s1 "Low-frequency noise from large wind turbines" H. Moller and C.S. Pedersen: J. Acoust. Soc. Am. Volume 129, Issue 6, pp. 3727-3744 (2011)
- 13.

http://www.maine.gov/dep/ftp/bep/ch375citizen_petition/pre-hearing/AR-20%20chapter%20375%20-%20r%20brown%20hearing%20submission%20-%20Pedersen%20Health%20Aspects.pdf “Health aspects associated with wind turbine noise—Results from three field studies”, Eja Pedersen. 14.

Harrison, J. P. (2011). Wind turbine noise. *Bulletin of Science, Technology & Society*, 31(4), 256-261 15.

<http://www.keele.ac.uk/geophysics/appliedseismology/wind/> 16.

<http://www.standard.net.au/story/153226/mystery-noise-causing-sleepless-nights-in-north-east-warrnambool/> 17.

<http://www.standard.net.au/story/153262/more-warrnambool-residents-hear-noise-but-source-remains-a-mystery/> 18.

<http://old.nationalwind.org/events/siting/presentations/rogers-infrasound.pdf> 19. “Noise Radiation Characteristics Of The Westinghouse Wwg-0600 (600kw) Wind Turbine Generator”: NASA Technical Memorandum 101576. [//docs.wind-watch.org/Noise-Westinghouse-600kw-windturbine.pdf](http://docs.wind-watch.org/Noise-Westinghouse-600kw-windturbine.pdf) 20.

“Effects of the wind profile at night on wind turbine sound” G.P. van den Berg: *Journal Of Sound And Vibration*; 277 (2004) 955–970. [//docs.wind-watch.org/vandenBerg_turbinesnight_JSV2004.pdf](http://docs.wind-watch.org/vandenBerg_turbinesnight_JSV2004.pdf) 21. “The sound of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise”: G.P. van den Berg. [//docs.wind-watch.org/vandenBerg-SoundOfHighWinds.pdf](http://docs.wind-watch.org/vandenBerg-SoundOfHighWinds.pdf)

Has Offaly County Council considered the scientific evidence of the impacts of Wind Turbines in residential areas. Note the evidence below regarding the effects on brain development. “This review summarises the increasing evidence ... that chronic disturbances of sleep adversely affect brain development ... Paediatric neurologists, the scientific community and the public must be aware of these recent scientific developments. Further studies are urgently required.” [Jan JE, Review article, Long-term sleep disturbances in children: a cause of neuronal loss. *European Journal of Paediatric Neurology* 14 (2010) 380-390] The World Health Organization (WHO) acknowledges that noise is an “underestimated threat that can cause a number of short- and long-term health problems ...” [World Health Organization Noise Facts and Figures, Sited December 23, 2012, <http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/noise/facts-and-figures>]. Research indicates children’s ear damage, cognitive function and learning are affected by noise and there could be lifelong effects on academic achievement and health. Excerpts from The World Health Organization’s Training Package for the Health Sector on Children and Noise identify vulnerable groups of children at risk including the foetus and babies; preterm; children with dyslexia and hyperactivity. [World Health Organization, Children and Noise, Children’s Health and the

Environment, WHO Training Package for the Health Sector, www.who.int/ceh] Children with pre-existing medical conditions such as autism, asthma, migraine, bronchitis, and epilepsy can be vulnerable to the effects of noise and/or stress and/or sleep disturbance. [See references below] There is a risk of noise-induced harm to children when industrial wind turbine facilities are sited in close proximity to family homes and schools.

References: [1] Cristina Becchio, Morena Mari, Umberto Castiello, (2010). Perception of Shadows in Children with Autism Spectrum Disorders PLoS ONE | May 2010 | Volume 5 | Issue 5 | e10582. Retrieved from www.plosone.org [2] Catherine Purple Cherry and Lauren Underwood. The ideal home for the autistic child: physiological rationale for design strategies. Autism Science Digest: The Journal Of Autismone, Issue 03 Retrieved from www.purplecherry.com. [3] Flavia Cortesi, Flavia Giannotti, Anna Ivanenko, Kyle Johnson (2010). Sleep in children with autistic spectrum disorder, Sleep Medicine 11 (2010) 659–664 Retrieved from www.elsevier.com/locate/sleep [4] Hartmut Ising, Martin Ising (2002), Chronic cortisol increases in the first half of the night caused by road traffic noise. Noise and Health 2002,4:16:p13-21 Retrieved from <http://www.noiseandhealth.org/article.asp?issn=1463-1741;year=2002;volume=4;issue=16;spage=13;epage=21;aulast=Ising> [5] Bockelbrink A, Willich SN, Dirzus I, Reich A, Lau S, Wahn U, Keil T. (2008) Environmental noise and asthma in children: sex-specific differences J Asthma.2008 Nov;45(9):770-3.Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/18972293> [6] Neut D, Fily A, Cuvellier JC, Valle´e L (2011),. The prevalence of triggers in paediatric migraine: a questionnaire study in 102 children and adolescents. J Headache Pain. 2011 Nov 1. [Epub ahead of print] Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/22042255> [7] Doreen Wagner, Velitchko Manahilov, Gunter Loffler, Gael E. Gordon, and Gordon N. Dutton, Visual Noise Selectively Degrades Vision in Migraine Investigative Ophthalmology & Visual Science, April 2010, Vol. 51, No. 4 Retrieved from <http://www.iovs.org/content/51/4/2294.full.pdf> [8] Ising H, Lange-Asschenfeldt H, Moriske HJ, Born J, Eilts M., Low frequency noise and stress: bronchitis and cortisol in children, Noise Health. 2004 Apr-Jun;6(23):21-8 [9] Gilboa T. Epilepsia. 2011 Dec 9. Emotional stress-induced seizures: Another reflex epilepsy? doi: 10.1111/j.1528-1167.2011.03342.x. [Epub ahead ofprint] Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/22150553> [10] Epilepsy Facts - Epilepsy Canada Cited March 2012, Retrieved from www.epilepsy.ca See also - "Infrasound from wind turbines:An overlooked health hazard," Läkartidningen, vol. 110 (2013), pp. 1388-89. .— Håkan Enbom, MD, PhD,

Ear/Nose/Throat specialist, otoneurology and specialist in dizziness disorders, and Inga Marcus Enbom, Ear/Nose/Throat specialist and specialist in allergy and hypersensitivity reactions. Both authors are employed at the City Health ENT, Ängelholm. For full text - http://waubrafoundation.org.au/wp-content/uploads/2013/08/Enbom-H-I.-Infrasound-an-Overlooked-Health-Hazard_.pdf

Submission: Declan Lally, [REDACTED].

Offaly County Council,
Charleville Road,
Tullamore,
Co. Offaly.

Re: Submission to proposed Offaly County Development Plan 2021 – 2027

Date: 05.10.20

To whom it concerns, I wish to make a submission in relation to the proposed County Development Plan 2021-2027 and Wind Energy Strategy, specifically area 7(see Map No. 10, Page 3) and any submission by speculators to look to extend the already zoned lands deemed suitable for Windfarms in this area, south of Galross Cross for the following reasons:

- **Wind turbine Saturation:** This area is already saturated with wind turbines:
 - Meenwaun: There are 4 turbines with planning permission for 5, each at a huge height of 169 metres(560 feet) and each generates 2.75 megawatt. This windfarm is already built.
 - Derrinlough: Bord na Mona has submitted planning permission for 21 turbines at an even higher height of 185 metres(610 feet) each. These are 4 megawatt turbines which are typically only sited offshore, given the adverse effect on humans. This application from Bord na Mona applies to an area which is not within the already existing zone deemed suitable for Windfarms.
 - Note the average size for windfarm turbines is approximately 2.5MW. The Meenwaun wind farms are 2.75MW and Derrinlough will be 4MW.
- **Impact on Health:** Our home is located 1.8KM from the Meenwaun turbines. [REDACTED]
[REDACTED] since the Meenwaun turbines were commissioned in 2018 and was out of work for nine months and will live with this disease for the rest of her life. [REDACTED]
[REDACTED] Our autistic son and my wife must take sleeping tablets to get to sleep when there is a north wind, due to the disturbance caused by the turbines. We are concerned about the consolidated noise and ill health impact of the additional 21 turbines (4 megawatt) in Derrinlough will have, not even considering any request to extend the zone for even more wind turbines. Does the county council envisage providing residents/victims with a relocation package like that of victims of flooding? Any more turbines will result in persistent sleep loss due to the noise from the turbines and shadow flicker due to the low winter sun would be like strobe lighting going through our home.

I refer to the following recent court cases in Ireland:

- **Valentine Kelleher Vs Green Energy Supply Ltd** February 2020: Three children in County Cork receive €225,000 settlement over alleged illnesses caused by windfarm near family home
<https://www.thejournal.ie/high-court-siblings-settle-wind-farm-action-5021713-Feb2020/>

- **Balz and Heubacher:** Thu, Dec 12, 2019 The Supreme Court *overturns* An Bord Pleanála's permission for Windfarm in failing to consider submissions from a local couple concerning developing knowledge about noise impact from turbines. The couple argued that the windfarm would result in a quadrupling of perceived loudness in the area.

<https://www.irishtimes.com/news/crime-and-law/courts/supreme-court/supreme-court-overturns-permission-for-cork-windfarm-1.4113344>

- **Enercon Windfarm Services Ireland Ltd and Carrigcannon Wind Farm Ltd vs The Shiven family and others:** instructed by solicitor *Joe Noonan*. This was the first case in Ireland where a Wind operator admitted liability for the adverse health effects on the young families living within 1 km of the farm (2017).

<https://www.irishtimes.com/news/arid-30793550.html>

<https://stopthesethings.com/2016/12/17/irish-high-court-finds-wind-turbine-maker-liable-for-noise-nuisance-7-irish-families-to-get-millions-in-punitive-damages/>

<https://www.masterresource.org/wind-turbine-noise-issues/wto-wind-turbine-noise-as-a-health-hazard/> the findings of the [Australian Senate Select Committee on Wind Turbines](#) (June 29, 2015). This court established that there is a direct pathway to disease resulting from wind turbine noise.

- Professor Alun Evans of Queens University Belfast wrote a paper for the British Medical Journal arguing that wind turbines disturb sleep and impair health. <https://the-law-is-my-oyster.com/2014/11/16/are-windfarms-torture-farms/>

I refer to the lived experience of residents living beside Meenwaun Windfarm

<https://www.offalyindependent.ie/2018/02/23/windfarm-has-made-our-lives-a-living-hell/>

- **Impact on LOFAR:** The Low Frequency Array (LOFAR) is an international network of state-of-the-art telescopes used to observe the Universe in unprecedented detail at low radio frequencies, LOFAR consists of 12 international stations spread across Germany, Poland, France, UK, Sweden and Ireland, with additional stations and a central hub in The Netherlands, operated by the Netherlands Institute for Radio Astronomy (ASTRON). I-LOFAR is the Irish addition to this network and the 12th international station to be built in Europe. It allows Irish astrophysical research to be integrated into one of the most sophisticated telescopes on the planet. The location of this Irish station is in the centre of the country on the grounds of Birr Castle, Co. Offaly. Any submission to expand zone 7 south of Galross cross will have a potentially negative impact on the Lofar and it is unknown what the consolidated impact of the Derrinlough (21) and Meenwaun turbines (4/5) will be on this lofar installed at Birr Castle in Co Offaly in 2017 to detect low-frequency radio waves travelling across interstellar space. The lofar is of immense importance for Ireland and the EU and the investment to date

from Science Foundation Ireland of €1.4 million. The importance of the Lofar for Ireland is referenced in the following articles:

Irish Times Article Thu, Sep 24, 2020

<https://www.irishtimes.com/news/science/ireland-ready-to-answer-et-s-call-1.4333148>

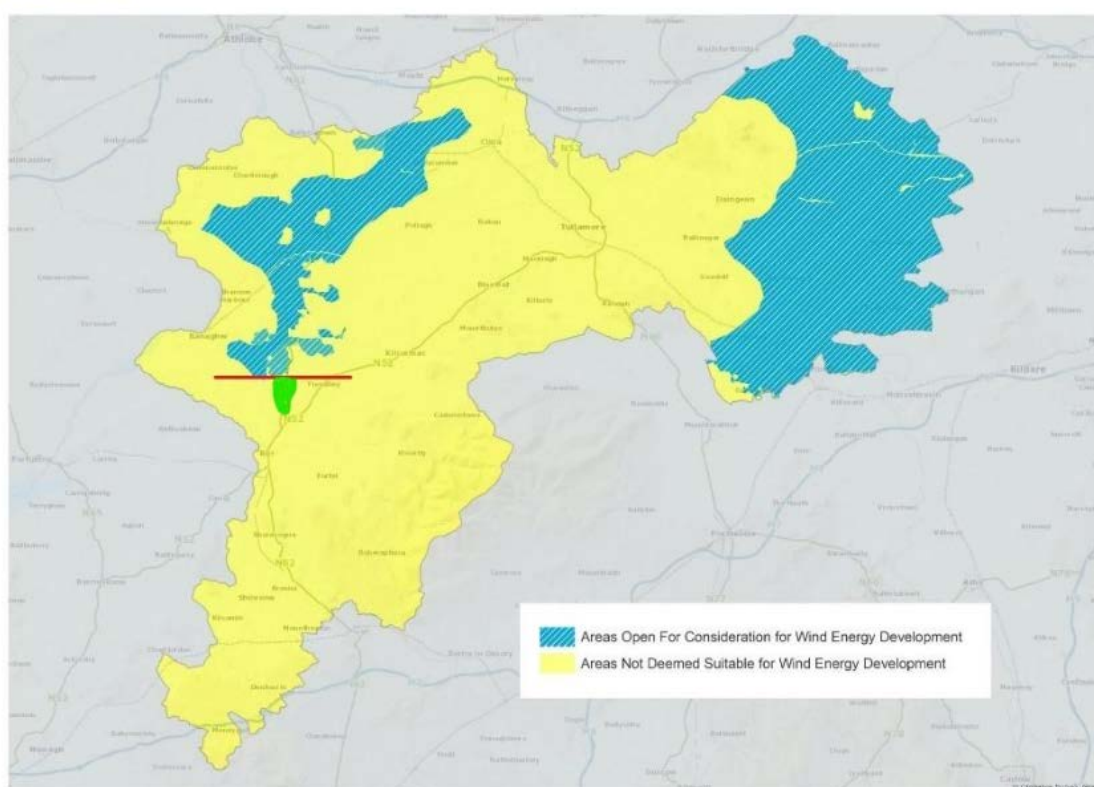
Irish Times Article Thu, Nov 16, 2017, <https://www.irishtimes.com/news/science/a-new-age-of-radio-astronomy-at-birr-castle-1.3294360>

- **Impact on biodiversity:** I refer to the objection from The Irish Wildlife Trust (IWT) in 2019 objecting to Bord Na Mona's plans for a 24-turbine windfarm in Longford, the IWT is increasingly concerned that turbines are being inappropriately located, especially on peatland habitats. "In particular, the presence of turbines can be at odds with biodiversity protection, the restoration of which is equally as important as addressing climate change. <https://www.newstalk.com/news/irish-wildlife-trust-objects-bord-na-mona-plan-longford-windfarm-842170>"
- **Habitats Directive:** Can the council confirm that an Appropriate Assessment under the Habitats Directive has been followed in considering any request for extension of zone 7 for Windfarm development?
- **Amenities:** These turbines will scar the line of site for Birr Town and environs, and the visual impact will be seen for many miles. Offaly County Council should prepare a Line of Sight Projection, to truly see the effect across the county. Also, we as a family are very much entitled to enjoy our views of the Slieve Bloom mountains, not wind turbine blades, shadow flicker and industrial noise in a country area.
- **Tourism:** Extending the draft area will impact hugely on the potential tourism market for Offaly and the Midlands. Just as Longford announced a huge tourism venture which resulted in over 500 jobs and 100,000 visitors spending money in the locality, Offaly will become a ghost county with no one coming to visit due to the scarred landscape covered in Windfarms. Offaly county council at a strategic level, have the opportunity to realise that given the aging worldwide population, global warming and other factors, that strategically the county is best placed to offer a Tourism/Independent living offerings as the county is also conveniently located within an hour and a half of many large cities and towns. Should this proposal go ahead, any chance of the Midlands becoming the forefront for leisure tourism for cycling/walking/hiking/trekking/Adventure sports will be most negatively impacted.
- **Speculators:** The same absentee landlords/speculators who recently bought parcels of land adjacent to zone 7 should not be able to state to adjacent landowners that the consultation process is just a "rubber stamping exercise" for them to get the land rezoned

in the next draft of the plan. Image below shows the area (marked in green) proposed by these speculators.

These actions are fuelling a speculative market. When our homes were granted planning permission, Offaly County council included a condition that the houses could not be sold for a number of years (7-10). This was to prevent property speculation. However, the same planning laws were not applied for “Element Power” who were granted planning permission to build Meenwaun Windfarm beside us and before Element Power had even built the windfarm they had already sold it for 30 million to “Tinc” a Belgian Investment company, making a huge profit and walking away from the families who are left to live in the shadow of their windfarm for the rest of our lives. Offaly County Council should have provided the same planning restrictions that were imposed on residents (no sale for 7 - 10 years).

Offaly County Development Plan 2021-2027: Draft Stage
County Wind Energy Strategy



Map No. 10: Wind Energy Strategy Designations

- **Impact on our property value:** John Earley of Property Partners Earley in Roscommon estimates the value of a house located close to a turbine can decrease by 50pc or more. He said: "This has been my experience with properties within half a mile of turbines."
- **Right to your views and amenities** Sliabh Bloom, right to no industrial noise at night. People are entitled to our amenities i.e. direct views of Sliabh Bloom mountains, not turbine blades.

regards,
Declan Lally

Additional Research on Noise and effects of wind turbines on health:

World Health Organisation: <http://www.na-paw.org/WHO-noise-2015.php>

The European office of the World Health Organisation (WHO) is in the process of developing Environmental Noise Guidelines for the European Region as a regional update to the WHO Community Noise Guidelines. The new Guidelines will be based upon a review of evidence of the health effects of environmental noise in the light of significant research carried out in the last few years. For the first time, the panel is investigating adverse health issues in local residents following the construction of wind turbines, the health benefits of noise mitigation and possible government intervention to decrease noise levels. It will look at adverse effects such as: sleep disturbance, annoyance, cognitive impairment, mental health and wellbeing, cardiovascular diseases, hearing impairment and tinnitus and adverse birth outcomes. A number of experts and concerned individuals who have gained some expertise in this field have sent an Open Letter to members of the panel welcoming the investigation. (1) Christine Metcalfe, U.K. spokesperson for the group, said today: *'Complaints of adverse health impacts from those forced to live close to wind turbines continue to rise. These involve both audible noise including low frequency noise, and inaudible noise below 20 Hz, known as **infrasound**. Both audible and inaudible lower frequency noise can cause unpleasant sensations including pressure and vibration, at sound levels which may not be audible. Complaints of severe sleep deprivation, severe chronic stress, and disabling vestibular dysfunction symptoms (dizziness, vertigo etc.,) abound, with problems varying from site to site depending upon local topography, height and number of turbines, inter-turbine distances, and the distance between turbines and homes. The common thread to the reported symptoms (known as "noise annoyance") is the activation of the **startle reflex**, which can be triggered by acoustic, vestibular, and tactile stimuli – which if activated together can have a synergistic effect (2). To argue that the sleep disturbance, physiological stress and vestibular dysfunction symptoms and their serious long term adverse health consequences don't exist or are caused by scaremonger nor morally or ethically defensible. This is particularly the case on the part of medical or acoustical professionals, in view of both their training, and their respective professional obligations to protect the health and safety of the public. Despite mounting anecdotal and academic evidence, no health monitoring is underway nor mitigation against adverse health effects following the construction of wind turbines which remains shockingly absent from planning guidelines in many European countries. It is imperative that new guidelines encourage governments better to safeguard the health of their citizens. We remain hopeful that the panel's deliberations will result in tough new European guidelines which in turn will prompt a serious worldwide examination of all aspects of this problem, including the widely-reported effects on animals. Although not part of the current WHO remit, there is an urgent need for governments not to abrogate responsibility for examining rising numbers of reported effects on wildlife and domestic animals. We also trust and hope that the panel will issue stringent guidelines to European governments to ensure that those whose health is currently badly affected can look forward to some workable mitigation or removal of implicated turbines. Only then*

can future populations be protected from suffering the hell that has been inflicted upon some wind farm neighbours.

Overview of some of the academic reports on human health: A former Consultant in Sleep Disorders Medicine highlighted in his article in the 2014 issue of the *British Medical Journal*, amongst other warnings, the particular sleep deprivation dangers to children (3): *'Sleep disturbance may be a particular problem in children, 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.'* His co-author wrote in *Principia Scientific International* in 2014 (4): *'The current guideline on -Rseparation-97and is manifestly out of distance date. It is only relevant to the small turbine turbines means that the current recommendation on turbine separation is grossly inadequate.* Salt and Lichtenhan of the Washington School of Medicine published an article in the British periodical *Acoustics Today* in 2014 which concluded:

'Given the present evidence, it seems that risky at infrasound stimulation of the ear stays confined to the ear and has no other effects on the body. For this to be true, all the mechanisms we have outlined (low-frequency-induced amplitude modulation, low frequency sound-induced endolymph volume changes, infrasound stimulation of type II afferent nerves, infrasound exacerbation of noise-induced damage and direct infrasound stimulation of vestibular organs) would have to be insignificant. We know this is highly unlikely and we anticipate novel findings in the coming years that will influence the debate.

(5) In Australia in 2013 the Waubra Foundation issued what it described as an *explicit warning notice* to Planning Authorities, Departments of Health, Environmental Protection Agencies, Federal, State and Local Governments, Wind Industry Developers and Acoustic Consultants. These included references to the 1985 and 1987 Kelly evidence on wind turbine noise and infrasound, the need for regularly updating latest evidence on dose exposure, plus multidisciplinary acoustic & physiological research needs.

(6) At an International Congress on Sound and Vibration in Florence, Italy in 2015, a paper presented by Dr. Christian Koch demonstrated findings on investigations of perception at infrasound frequencies via the use of fMRI and MEG methods.

(7) The German Medical Assembly meeting in Frankfurt last year called on the German government to conduct urgent scientific research into reported noise issues.

It is crucial to stress the wind turbine's specific noise character. It is already known that the so-called 'annoyance' level at 40 dBA from wind farm noise, and this has recently been attributed in part to amplitude modulation by experienced acousticians such as Dr Geoff Leventhall (UK), (8) Dr Paul Schomer (USA, former Director of Acoustic Standards) and Steven Cooper (Australia). Wind turbine noise emissions comprise a number of features including a complex and vibrant sound mix, cylindrical sound propagation and refraction from the high levels, distinct peaks at the blade pass frequency, high proportion of infrasound and low frequency noise, and the sharp noise level in quiet areas especially during nights and cold seasons. *It highlights strongly that wind power sound has a very characteristic sound profile, and that this must be specifically considered in the new regulations.'*

And on animals:

A study of badgers notes the paucity of data existing with which to assess the effects of wind turbines noise on terrestrial wildlife, despite growing concern about the impact of

infrasound from wind farms on human health and well-being. It features the stress hormone cortisol levels of badgers living in close proximity to wind turbines:

'We suggest that the higher cortisol levels in affected badgers is caused by the turbines' sound and that these high levels may affect badgers' immune systems, which could result in increased risk of infection and disease in the badger population. (9)

Another study on effects on pig-rearing in Poland was conducted to assess the effect of rearing pigs at three different distances from a wind turbine (50, 500 and 1000 m) on the physicochemical properties and fatty acid composition of loin and neck muscles. Avoiding noise-induced stress is important not only for maintaining meat quality but also for improving animal welfare. (10)

Professor Mariana Alves-Pereira of the Lusofona University in Portugal has been researching vibroacoustic disease since 1980 initially focussed on the low frequency noise (LFN) that impacted aeronautical technicians. Late in 2013, she presented a case study from Portugal where a family had been exposed for seven years to LFN caused by the operation of nearby wind turbines. Testing showed the increase in LFN inside the home was associated with turbine operation. Medical tests showed the people who were living inside the home had impaired brain function in relation to responding to stimuli as well as their control of breathing. The syndrome is known as Vibro-Acoustic Disorder. (11)

Notes for Editors

For more information contact Christine Metcalfe email luanam@btinternet.com and phone 01866 844220

1. Open Letter to the members of the panel developing the WHO Environmental Noise Guidelines for the European Region.

Marie-Eve Héroux Marco Paviotti. Wolfgang Babisch. Göran Pershagen Goran Belojevic. Kerstin Persson Waye. Mark Brink. Anna Preis. Sabine Janssen. Stephen Stansfield. Peter Lercher. Martin van den Berg. Jos Verbeek.

Ladies and Gentlemen,

We understand that you are currently in the process of developing the WHO Environmental Noise Guidelines for the European Region as a regional update to the WHO Community Noise Guidelines. We also understand that:

1. The new Guidelines will be based upon a review of evidence on the health effects of environmental noise in the light of significant research carried out in the last few years.
2. The guidelines will review evidence on the health benefits of noise mitigation and interventions to decrease noise levels.
3. The evidence will be systematically reviewed to assess likely effects such as: sleep disturbance, annoyance, cognitive impairment, mental health and wellbeing, cardiovascular diseases, hearing impairment and tinnitus and adverse birth outcomes.
4. One of the sources of noise you are investigating is that from wind turbines which was not addressed in previous guidelines.

We welcome your review because, despite mounting anecdotal and academic evidence, for too long mitigation against adverse health effects following the construction of wind turbines has been absent from planning guidelines **and noise pollution regulations** in many European countries, **especially with respect to sound below 200 Hz.**

There is a pressing need for new guidelines to encourage governments better to safeguard the health of their citizens.

You will be aware that these problems are not confined to Europe. Neither are they confined to human beings.

We are hopeful that your deliberations will result in tough new European guidelines which in turn will prompt a serious worldwide examination of all aspects of this problem, including the widely-reported effects on animals.

Yours sincerely,

The undersigned:

N.B. 118 and rising, full copy available. Signatories to the letter to the World Health Organisation Expert Panel revising the Environmental Noise guidelines include the following health professionals and scientists: **Medical Practitioners:** Dr Mauri Johansson & Per Fisker (Denmark), Dr. Sarah Laurie (Australia) Dr. Hakan Enbom (Sweden), Professor Alun Evans (Ireland), Dr Angela Armstrong and Dr Rachel Conner (Scotland), Professor Dr Zuhal Okuyan and Professor Dr Ali Osman Karababa (Turkey), Dr Robert McMurtry (Canada), and Dr David Lawrence (USA), **Osteopath** Dr Johannes Meyer (Germany and USA), **Psychologist** Professor Arline Bronzaft, (USA) **Nursing Practitioner** Norma Schmidt (Canada), **Physiotherapist** Virpi Polkolainen (Finland), **Audiologist** Professor Jerry Punch, (USA), **Medical Physicist** Dr Mireille Oud (The Netherlands), Professor of Otolaryngology and **Neurophysiologist** Alec Salt (USA), **Physicist** Dr John Harrison (Canada) and **Scientist** Dr Bruce Rapley, (New Zealand).

Engineers who signed the Open Letter include **Biomedical Engineer** Dr Mariana Alves Pereira (Portugal), **Acoustical Engineers** Sven Johannsen and Erik Brunner (Germany), Steven Cooper (Australia), Emeritus Professor Colin Hansen (Australia) Rick James, Rob Rand, Steven Ambrose and Bill Acker (USA) Nicholas Kouwen, PhD., P.Eng., FASCE. Distinguished Professor Emeritus and Adjunct Professor Department of Civil and Environmental Engineering. University of Waterloo. (Canada) and other engineers including Ove Bjorklund (Sweden) and Peter Mitchell (Australia). 4

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1. See above.
 2. [Neurosci Biobehav Rev.](#) 2002 Jan;26(1):1-11. Tactile, acoustic and vestibular systems sum to elicit the startle reflex. [Yeomans JS¹](#), [Li L](#), [Scott BW](#), [Frankland PW](#). <http://www.ncbi.nlm.nih.gov/pubmed/11835980>
 3. *Wind Turbine Noise, British Medical Journal*, 3 Oct 12 Authors: Christopher D Hanning, honorary consultant in sleep medicine, Sleep Disorders Service, University Hospitals of Leicester, Leicester General Hospital, Leicester LE5 4PW, UK and Alun Evans, professor emeritus, Centre Belfast, Institute of Clinical Science B, Belfast, UK <http://nieuwerustnoisewatch.org/wp-content/documents/peerreviewed-articles/15-B-M%20J-Noise.pdf>
 4. *Wind Farms and Health, Principia Scientific International*, 3 April 14 Author: Alun Evans Professor Emeritus Belfast University <http://docs.wind-watch.org/Evans-wind-farms-health.pdf>
 5. *How Does Wind Turbine Noise Affect People?*, *Acoustics Today*, winter 2014 Authors: Alec N. Salt and Jeffery T. Lichtenhan, Department of Otolaryngology, Washington University School of Medicine, St. Louis, MO 63110 <http://www.windturbinesyndrome.com/wp-content/uploads/2014/04/Salt-et-al.on-Wind-Turbine-Syndrome.pdf>
 6. *Explicit warning notice*, Waubra Foundation, 22 November 2013 http://waubrafoundation.org.au/wp-content/uploads/2013/11/Explicit_Warning_Notice_Final_22_November_2013.pdf

7. http://en.friends-against-wind.org/doc/Full_paper_Koch_V2.pdf
8. http://parlinfo.aph.gov.au/parlInfo/download/committees/commsen/076b72db-0da0-4ca6-b0a0cea05550/toc_pdf/Senate%20Select%20Committee%20on%20Wind%20Turbines_2015_06_23_3580_Official.pdf;fileType=application%2Fpdf#search=%22committees/commsen/076b72db-0da04ca6-bffe-b0a0cea05550/0000%22
9. *Wind turbines cause chronic stress in badgers (Meles Meles)* Journal of Wildlife Diseases, 52(3), 2016, pp. 000–000 _ Wildlife Disease Association. June 2016 Roseanna C. N. Agnew,1,2,4 Valerie J. Smith,3 and Robert C. Fowkes1
www.jwildlifedis.org/doi/abs/10.7589/2015-09-231
10. The effect of varying distances from the wind turbine on meat quality of growing-finishing pigs. Ann. Anim. Sci., Vol. 15, No. 4 (2015) 1043–1054 DOI: 10.1515/aoas-2015-0051. Małgorzata Karwowska, Jan Mikołajczak, Zbigniew, Department of Meat Technology and Food Quality, University of Life Sciences in Lublin, Skromna 8, 20-704 Lublin, Poland www.wind-watch.org/documents/page/
11. Vibroacoustic disease: Biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling. *Progress in Biophysics and Molecular Biology, Volume 93, Issues 1–3, January–April 2007, Pages 256-279* Mariana Alves-Pereira, Nuno A.A. Castelo Branco www.sciencedirect.com/science/article/pii/S0079610706000927

Adverse health effects of industrial wind turbines

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Cet article est disponible en français. Voyez "[Effets indésirables sur la santé des éoliennes industrielles](#)".

This article has been [cited by](#) other articles in PMC.

Canadian family physicians can expect to see increasing numbers of rural patients reporting adverse effects from exposure to industrial wind turbines (IWTs). People who live or work in close proximity to IWTs have experienced symptoms that include decreased quality of life, annoyance, stress, sleep disturbance, headache, anxiety, depression, and cognitive dysfunction. Some have also felt anger, grief, or a sense of injustice. Suggested causes of symptoms include a combination of wind turbine noise, infrasound, dirty electricity, ground current, and shadow flicker.¹ Family physicians should be aware that patients reporting adverse effects from IWTs might experience symptoms that are intense and pervasive and might feel further victimized by a lack of caregiver understanding.

Background

There is increasing concern that energy generation from fossil fuels contributes to climate change and air pollution. In response to these concerns, governments around the world are encouraging the installation of renewable energy projects including IWTs. In Ontario, the Green Energy Act was designed, in part, to remove barriers to the installation of

IWTs.² Noise regulations can be a considerable barrier to IWT development, as they can have a substantial effect on wind turbine spacing, and therefore the cost of wind-generated electricity.³ Industrial wind turbines are being placed in close proximity to family homes in order to have access to transmission infrastructure.⁴

In Ontario and elsewhere,⁵ some individuals have reported experiencing adverse health effects resulting from living near IWTs. Reports of IWT-induced adverse health effects have been dismissed by some commentators including government authorities and other organizations. Physicians have been exposed to efforts to convince the public of the benefits of IWTs while minimizing the health risks. Those concerned about adverse effects of IWTs have been stereotyped as “NIMBYs” (not in my backyard).^{6,7}

Global reports of effects

During the past few years there have been case reports of adverse effects. A 2006 Académie Nationale de Médecine working group report notes that noise is the most frequent complaint. The noise is described as piercing, preoccupying, and continually surprising, as it is irregular in intensity. The noise includes grating and incongruous sounds that distract the attention or disturb rest. The spontaneous recurrence of these noises disturbs the sleep, suddenly awakening the subject when the wind rises and preventing the subject from going back to sleep. Wind turbines have been blamed for other problems experienced by people living nearby. These are less precise and less well described, and consist of subjective (headaches, fatigue, temporary feelings of

dizziness, nausea) and sometimes objective (vomiting, insomnia, palpitations) manifestations.⁸

A 2009 literature review prepared by the Minnesota Department of Health⁹ summarized case reports by Harry (2007),¹⁰ Phipps et al (2007),¹¹ the Large Wind Turbine Citizens Committee for the Town of Union (2008),¹² and Pierpont (2009).¹³ These case studies catalogued complaints of annoyance, reduced quality of life, and health effects associated with IWTs, such as sleeplessness and headaches.⁹

In 2010, Nissenbaum et al used validated questionnaires in a controlled study of 2 Maine wind energy projects. They concluded that “the noise emissions of IWTs disturbed the sleep and caused daytime sleepiness and impaired mental health in residents living within 1.4 km of the two IWT installations studied.”¹⁴

Reports of adverse health effects¹⁵ and reduced quality of life¹⁶ are also documented in IWT projects in Australia and New Zealand.

A 2012 board of health resolution in Brown County in Wisconsin formally requested financial relocation assistance for “families that are suffering adverse health effects and undue hardships caused by the irresponsible placement of industrial wind turbines around their homes and property.”¹⁷

An Ontario community-based self-reporting health survey, WindVOiCe, identified the most commonly reported IWT-induced symptoms as altered quality of life, sleep disturbance, excessive tiredness, headache, stress, and distress. Other reported effects include migraines, hearing problems, tinnitus, heart palpitations, anxiety, and depression.¹⁸ In addition, degraded living conditions and adverse socioeconomic effects have been reported. In some cases the effects were severe enough that individuals in Ontario abandoned their homes or reached financial agreements with wind energy developers.¹⁹

After considering the evidence and testimony presented by 26 witnesses, a 2011 Ontario environmental review tribunal decision acknowledged IWTs can harm human health:

*This case has successfully shown that the debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents. The debate has now evolved to one of degree.*²⁰

Indirect effects and annoyance

When assessing the adverse effects of IWTs it is important to consider what constitutes human health. The World Health Organization (WHO) defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”²¹

Despite being widely accepted, the WHO definition of health is frequently overlooked when assessing the health effects of IWTs. Literature reviews commenting on the health effects of IWTs have been produced with varying degrees of completeness, accuracy, and objectivity.²² Some of these commentators accept the plausibility of the reported IWT health effects and acknowledge that IWT noise and visual effects might cause annoyance, stress, or sleep disturbance, which can have other consequences. However, these IWT health effects are often discounted because “direct pathological effects” or a “direct causal link” have not been established. In 2010, the Ontario Chief Medical

Officer of Health released *The Potential Health Impact of Wind Turbines*, which acknowledged that some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance but concluded “the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects.”²³ The lead author of the report,²³ Dr Gloria Rachamin, acknowledged under oath that the literature review looked only at direct links to human health.²⁴

Focusing on “direct” causal links limits the discussion to a small slice of the potential health effects of IWTs. The 2011 environmental review tribunal decision found that *serious harm to human health* includes “indirect impacts (e.g., a person being exposed to noise and then exhibiting stress and developing other related symptoms).”²⁰

According to the night noise guidelines for Europe:

*Physiological experiments on humans have shown that noise of a moderate level acts via an indirect pathway and has health outcomes similar to those caused by high noise exposures on the direct pathway. The indirect pathway starts with noise-induced disturbances of activities such as communication or sleep.*²⁵

Pierpont documented symptoms reported by individuals exposed to wind turbines, which include sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering when awake or asleep.¹³ The American Wind Energy Association and the Canadian Wind Energy Association convened a panel literature review that determined these symptoms are the “well-known stress effects of exposure to noise,” or in other words, are “a subset of annoyance reactions.”²⁶

Noise-induced annoyance is acknowledged to be an adverse health effect.^{27–30} Chronic severe noise annoyance should be classified as a serious health risk.³¹ According to the WHO guidelines for community noise, “[t]he capacity of a noise to induce annoyance depends upon many of its physical characteristics, including its sound pressure level and spectral characteristics, as well as the variations of these properties over time.”³² Industrial wind turbine noise is perceived to be more annoying than transportation noise or industrial noise at comparable sound pressure levels.³³ Industrial wind turbine amplitude modulation,³⁴ audible low frequency noise,³⁵ tonal noise, infrasound,³⁶ and lack of nighttime abatement have been identified as plausible noise characteristics that could cause annoyance and other health effects.

Health effects in Ontario expected

Evidence-based health studies were not conducted to determine adequate setbacks and noise levels for the siting of IWTs before the implementation of the Ontario renewable energy policy. In addition, provision for vigilance monitoring was not made. It is now clear that the regulations are not adequate to protect the health of all exposed individuals.

A 2010 report commissioned by the Ontario Ministry of the Environment concludes:

The audible sound from wind turbines, at the levels experienced at typical receptor distances in Ontario, is nonetheless expected to result in a non-trivial percentage of persons being highly annoyed [R]esearch has shown that annoyance associated with sound from wind turbines can be expected to contribute to stress related health impacts

*in some persons.*³⁷ Consequently, physicians will likely be presented with patients reporting health effects.

Family physicians should be aware that patients reporting adverse effects from IWTs might experience symptoms that are intense and pervasive and that they might feel further victimized by a lack of care-giver understanding. Those adversely affected by IWTs might have already pursued other avenues to mitigate the health effects with little or no success. It will be important to identify the possibility of exposure to IWTs in patients presenting with appropriate clinical symptoms.³⁸

Conclusion

Industrial wind turbines can harm human health if sited too close to residents. Harm can be avoided if IWTs are situated at an appropriate distance from humans. Owing to the lack of adequately protective siting guidelines, people exposed to IWTs can be expected to present to their family physicians in increasing numbers. The documented symptoms are usually stress disorder–type diseases acting via indirect pathways and can represent serious harm to human health. Family physicians are in a position to effectively recognize the ailments and provide an empathetic response. In addition, their contributions to clinical studies are urgently needed to clarify the relationship between IWT exposure and human health and to inform regulations that will protect physical, mental, and social well-being.

Footnotes

This article has been peer reviewed.

La traduction en français de cet article se trouve à www.cfp.ca dans la table des matières du numéro de **mai 2013** à la page [e218](#).

Competing interests

Dr Jeffery, Ms Krogh, and Mr Horner are on the Board of Directors for the Society for Wind Vigilance, an international federation of physicians, acousticians, engineers, and other professionals who share scientific research on the topic of health and wind turbines.

The opinions expressed in commentaries are those of the authors. Publication does not imply endorsement by the College of Family Physicians of Canada.

References

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1. Havas M, Colling D. Wind turbines make waves: why some residents near wind turbines become ill. *Bull Sci Technol Soc*. 2011;31(5):414–26.
 2. Government of Ontario [website] Chapter 12. An act to enact the Green Energy Act, 2009 and to build a green economy, to repeal the Energy Conservation Leadership Act, 2006 and the Energy Efficiency Act and to amend other statutes. Toronto, ON: Government of Ontario; 2009. Available from: www.elaws.gov.on.ca/html/source/statutes/english/2009/elaws_src_s09012_e.htm#. Accessed 2013 Mar 26.
 3. Canadian Wind Energy Association [website] Letter to Neil Parish re: sound level limits for wind farms. Ottawa, ON: Canadian Wind Energy Association; 2004. Available from: www.canwea.ca/images/uploads/File/Wind_Energy_Policy/Environmental_Issues/SoundLevels.pdf. Accessed 2013 Mar 26.

4. Hornung R. Business of green: wind energy and budget expectations [video] Toronto, ON: Business News Network; 2010. Available from: <http://watch.bnn.ca/clip272347>. Accessed 2013 Apr 4.
5. Hanning CD, Evans A. Wind turbine noise. *BMJ*. 2012;344:e1527. [PubMed]
6. Martin C. NIMBY mentality unacceptable when it comes to green-energy projects, McGuinty says. *London Free Press*. 2009 Feb 12.
7. Schliesmann P. Wind turbine debate swirls. *Kingston Whig-Standard*. 2010 Jan 2; Available from: www.thewhig.com/ArticleDisplay.aspx?e=2244137&archive=true. Accessed 2013 Mar 26.
8. Académie Nationale de Médecine Groupe de Travail . Le retentissement du fonctionnement des éoliennes sur la santé de l'homme. Paris, France: Académie Nationale de Médecine; 2006. Available from: www.academiemedecine.fr/sites_thematiques/EOLIENNES/chouard_rapp_14_mars_2006.htm. Accessed 2013 Mar 26.
9. Minnesota Department of Health [website] Public health impacts of wind turbines. St Paul, MN: Minnesota Department of Health; 2009. Available from: www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf. Accessed 2013 Mar 26.
10. Harry A. Wind turbines, noise and health. Rowe, MA: National Wind Watch; 2007. Available from: http://docs.windwatch.org/wtnoise_health_2007_a_harry.pdf. Accessed 2013 Mar 26.
11. Phipps R, Amati M, McCoard S, Fisher R. Visual and noise effects reported by residents living close to Manawatu wind farms: preliminary survey results. Rowe, MA: National Wind Watch; 2007. Available from: <http://docs.windwatch.org/phipps-visualnoiseeffects.pdf>. Accessed 2013 Mar 26.
12. Large Wind Turbine Citizens Committee for the Town of Union . Setback recommendations report. Rowe, MA: National Wind Watch; 2008. Available from: http://docs.wind-watch.org/LWTCC-Town-of-Union_FinalReport_01-14-08.pdf. Accessed 2013 Mar 26.
13. Pierpont N. Wind turbine syndrome: a report on a natural experiment. Santa Fe, NM: K-Selected Books; 2009.
14. Nissenbaum MA, Aramini JJ, Hanning CD. Effects of industrial wind turbine noise on sleep and health. *Noise Health*. 2012;14(60):237–43. [PubMed]
15. Thorne B. The problems with “noise numbers” for wind farm noise assessment. *Bull Sci Technol Soc*. 2011;31(4):262–90.
16. 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(54):333–9. [PubMed]
17. Brown County board of health resolution requesting emergency state aid for families suffering around industrial wind turbines. Rowe, MA: National Wind Watch; 2012. Available from: <http://docs.windwatch.org/Brown%20County%20Board%20of%20Health%20Resolution%20011012.pdf>. Accessed 2013 Mar 28.
18. Krogh CME, 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 Technol Soc*. 2011;31(4):334–45.

19. Krogh CME. Industrial wind turbine development and loss of social justice? Bull Sci Technol Soc. 2011;31(4):321–33.
20. Erickson v. Director, Ministry of the Environment. 2011. Environmental Review Tribunal Nos. 10-121 and 10-122. Available from: www.ert.gov.on.ca/files/201108/00000300-AKT5757C7CO026-BHH51C7A7SO026.pdf. Accessed 2013 Mar 28.
21. World Health Organization . Preamble to the Constitution of the World Health Organization. Geneva, Switz: World Health Organization; 1948. Definition of health. Available from: www.who.int/about/definition/en/print.html. Accessed 2013 Mar 28.
22. Horner B, Jeffery RD, Krogh CME. Literature reviews on wind turbines and health: are they enough? Bull Sci Technol Soc. 2011;31(5):399–413.
23. Chief Medical Officer of Health . The potential health impact of wind turbines. Toronto, ON: Ministry of Health and Long-Term Care; 2010. Available from: http://health.gov.on.ca/en/common/ministry/publications/reports/wind_turbine/wind_turbine.pdf. Accessed 2013 Mar 27.
24. Erickson v. Director, Ministry of the Environment. Environmental Review Tribunal Nos. 10-121 and 10-122. Transcript of Dr G. Rachamin. 2011 Mar 4.
25. World Health Organization Europe . Night noise guidelines for Europe. Copenhagen, Denmark: World Health Organization Europe; 2009. Available from: www.euro.who.int/data/assets/pdf_file/0017/43316/E92845.pdf. Accessed 2013 Mar 27.
26. Colby WD, Dobie R, Leventhall G, Lipscomb DM, McCunney RJ, Seilo MT, et al. Wind turbine sound and health effects. An expert panel review. Washington, DC: American Wind Energy Association, Canadian Wind Energy Association; 2009. Available from: [www.canwea.ca/pdf/talkwind/Wind Turbine Sound and Health Effects.pdf](http://www.canwea.ca/pdf/talkwind/Wind_Turbine_Sound_and_Health_Effects.pdf). Accessed 2013 Mar 27.
27. Health Canada [website] Community noise annoyance. Ottawa, ON: Health Canada; 2005. Available from: www.hcsc.gc.ca/hl-vs/iyh-vsv/life-vie/community-urbain-eng.php. Accessed 2013 Mar 27.
28. Suter AH. Noise and its effects. Washington, DC: Administrative Conference of the United States; 1991. Available from: www.nonoise.org/library/suter/suter.htm. Accessed 2013 Mar 27.
29. Michaud DS, Keith SE, McMurchy D. Noise annoyance in Canada. Noise Health. 2005;7(27):39–47. [PubMed]
30. 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. Epub 2007 Mar 1. [PMC free article] [PubMed]
31. Maschke C, Niemann A. Health effects of annoyance induced by neighbour noise. Noise Control Eng J. 2007;55(3):348– 56.
32. Berglund B, Lindvall T, Schwela DH, editors. Guidelines for community noise. Geneva, Switz: World Health Organization; 1999.
33. 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. [PubMed]
34. Leventhall G. Infrasound from wind turbines—fact, fiction or deception. Can Acoust. 2006;34(2):29–36.
35. Møller H, Pedersen CS. Low-frequency noise from large wind turbines. J Acoust Soc Am. 2011;129(6):3727– 44. [PubMed]

36. Salt AN, Kaltenbach JA. Infrasound from wind turbines could affect humans. Bull Sci Technol Soc. 2011;31(4):296–302.
37. Howe Gastmeier Chapnik Limited . Low frequency noise and infrasound associated with wind turbine generator systems. A literature review. Toronto, ON: Ontario Ministry of the Environment; 2010. Available from:www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_092086.pdf. Accessed 2013 Mar 27.
38. McMurtry RY. Toward a case definition of adverse health effects in the environs of industrial wind turbines: facilitating a clinical diagnosis. Bull Sci Technol Soc. 2011;31(4):316–20.

Industrial wind turbines and adverse health effects.

[Jeffery RD](#)¹, [Krogh CM](#)², [Horner B](#)².

[Author](#)

[information](#)

Erratum in

- Can J Rural Med. 2014 Spring;19(2):56.

Abstract

INTRODUCTION:

Some people living in the environs of industrial wind turbines (IWTs) report experiencing adverse health and socioeconomic effects. This review considers the hypothesis that annoyance from audible IWTs is the cause of these adverse health effects.

METHODS:

We searched PubMed and Google Scholar for articles published since 2000 that included the terms "wind turbine health," "wind turbine infrasound," "wind turbine annoyance," "noise annoyance" or "low frequency noise" in the title or abstract.

RESULTS:

Industrial wind turbines produce sound that is perceived to be more annoying than other sources of sound. Reported effects from exposure to IWTs are consistent with well-known stress effects from persistent unwanted sound.

CONCLUSION:

If placed too close to residents, IWTs can negatively affect the physical, mental and social well-being of people. There is sufficient evidence to support the conclusion that noise from audible IWTs is a potential cause of health effects. Inaudible low-frequency noise and infrasound from IWTs cannot be ruled out as plausible causes of health effects.

Proposed Wind Turbine Siting Sound Limits

October 24, 2008

1. Establishing Long-Term Background Noise Level

a. Instrumentation: ANSI or IEC Type 1 Precision Integrating Sound Level Meter plus meteorological instruments to measure wind velocity, temperature and humidity near the sound measuring microphone. Measurement procedures must meet ANSI S12.9, Part 3.

b. Measurement location(s): Nearest property line(s) from proposed wind turbines representative of all non-participating residential property within 2.0 miles.

c. Time of measurements and prevailing weather: The atmosphere must be classified as stable with no vertical heat flow to cause air mixing. Stable conditions occur in the evening and middle of the night with a clear sky and very little wind near the surface. Sound measurements are only valid when the measured wind speed at the microphone does not exceed 2 m/s

(4.5 mph).

d. Long-Term Background sound measurements: All data recording shall be a series of contiguous ten (10) minute measurements. The measurement objective is to determine the quietest ten minute period at each location of interest. Nighttime test periods are preferred unless daytime conditions are quieter. The following data shall be recorded simultaneously for each ten (10) minute measurement period: dBA data includes L_{A90},

L_{A10} , L_{Aeq} and dBC data includes L_{C90} , L_{C10} , L_{Ceq} , plus maximum wind speed at the microphone during the ten minutes and a single measurement of temperature and humidity at the microphone for each new location or each hour whichever is oftener. A ten minute measurement contains valid data provided: Both L_{A10} minus L_{A90} and L_{C10} minus L_{C90} are not greater than 10 dB and the maximum wind speed at the microphone did not exceed 2 m/s during the same ten minute period as the acoustic data.

2. Wind Turbine Sound Immission Limits

No wind turbine or group of turbines shall be located so as to cause wind turbine sound immission at any location on nonparticipating property containing a residence in excess of the limits in the following table:

Table of Property Line Noise Immission Limits ¹			
Criteria		dBA	dBC
A	Immission above preconstruction background:	$L_{Aeq} = L_{A90} + 5$	$L_{Ceq} = L_{C90} + 5$
B	Maximum immission:	$35 L_{Aeq}$	$55 L_{Ceq}$ for quiet ² rural environment $60 L_{Ceq}$ for rural-suburban environment
C	Immission spectra imbalance	L_{Ceq} (immission) minus $L_{A90} + 5$ (background) ≤ 20 dB	
D	Prominent tone penalty:	5 dB	5 dB
Notes			
1	Each Test is independent and exceedance of any test establishes non-compliance.Sound “immission” is the wind turbine noise emission as received at a property.		
2	A “Quiet rural environment” is a location 2 miles from a state road or other major transportation artery without high traffic volume during otherwise quiet periods of the day or night.		
3	Prominent tone as defined in IEC 61400-11. This Standard is not to be used for any other purpose.		
¹ Procedures provided in Section 7. Measurement Procedures (Appendix to Ordinance) of the most recent version of “The How To Guide To Siting Wind Turbines To Prevent Health Risks From Sound” by Kamperman and James apply to this table.			

3. Wind Farm Noise Compliance Testing

All of the measurements outlined above in 1. Establishing Long-Term Background Noise Level must be repeated to determine compliance with 2. Wind Turbine Sound Immission Limits. The compliance test location is to be the pre-turbine background noise measurement location nearest to the home of the complainant in line with the wind farm and nearer to the wind farm. The time of day for the testing and the wind farm operating conditions plus wind speed and direction must replicate the conditions that generated the complaint. Procedures of ANSI S12.9- Part 3 apply. The effect of instrumentation limits for wind and other factors must be recognized and followed.

—George W. Kamperman & Richard R. James

Wind turbine collisions killing hundreds of UK bats each

month, study finds [Nicola Davis @NicolaKSDavis](#)

[The Guardian/Environment](#): Monday 7 November 2016 17.00 GMTLast modified on Friday 10 February 2017 10.39 GMT

Research suggests ecological impact assessments carried out for windfarms are not adequately predicting bat activity or risks

Using sniffer dogs, scientists at the University of Exeter report that they hunted for bat carcasses at 46 windfarms across the UK, 29 of which had ecological impact assessments available. Photograph: Mark Ferguson/Alamy Stock Photo

Hundreds of bats are being killed in collisions with wind turbines in the UK each month, despite ecological impact assessments predicting that many windfarms were unlikely to affect such animals, according to a new study.

All UK species of bats are [protected by law](#), and ecological impact assessments - carried out before construction of windfarms or other sites - should weigh up the risks for local habitats and wildlife. But new research suggests that such assessments are simply not up to scratch.

Using sniffer dogs, scientists at the University of Exeter report that they hunted for bat carcasses at 46 windfarms across the UK, 29 of which had ecological impact assessments available. For 18 of the sites the assessment reported that a windfarm would be unlikely to affect protected species, or an investigation into bat activity was unnecessary. However the researchers found that nearly all of the 29 sites showed evidence of bat activity, while half had seen collisions between bats and wind turbines with estimated death rates of up to 64 fatalities per month, taking into account factors such as possible removal of carcasses by predators.

Among the sites flagged as posing a high risk to bats, the authors found that efforts to reduce the impact of wind turbines had had little effect.

"The sorts of mitigation that have been used, like moving the turbine a bit further away from woodland, just wasn't doing the job," said Dr Fiona Mathews, lead author of the research that was published in the journal [Current Biology](#).

The authors conclude that ecological impact assessments do not adequately predict the risk of windfarms to bats. But it is not clear whether the failings are down to changes in the behaviour of bats after windfarm construction, or are simply down to poor surveying of the area beforehand.

Advertisement

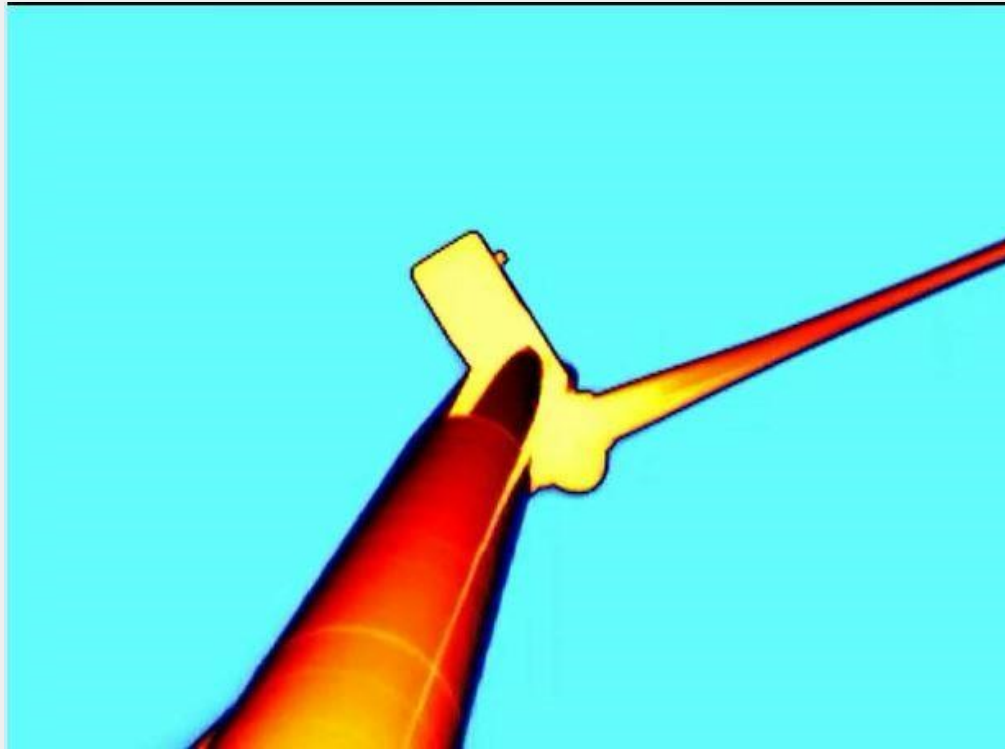
"That is something that really needs urgent attention," said Mathews. "At the moment tens if not hundreds of thousands of pounds are paid on infrastructure projects all the time to do ecological surveys with nobody actually doing any followups to see whether they're effective or not."

As well as improving pre-construction surveys, the authors say that assessments should be carried out after windfarms have been built, while better approaches should be developed to reduce the chances of collisions - such as re-positioning the turbine blades out of the wind at night during periods in the year when bats are most active. More research is also needed into why the bats are flying so close to the turbines, said Mathews.

But, she adds, wind turbines remain an important source of clean energy. “What we want is something that actually works for conservation rather than it just being a box-ticking exercise,” she said.

Bat Fatalities at Wind Turbines: Investigating the Causes and Consequences

[Movie Clip of a Hoary Bat Investigating a Wind Turbine](#)



A hoary bat (*Lasiurus cinereus*) makes multiple approaches to a wind turbine at night. This video image was recorded in the dark using a camera that images heat rather than visible light. The turbine tower rises approximately 80 meters above the ground and is about the height of a 26-story building. USGS scientists and their research partners are breaking new ground in our understanding of bat susceptibility to turbines by putting new technology to work in studying this difficult problem.

Wind energy is one of the fastest-growing industries in the world and represents an important step toward reducing dependence on non-renewable sources of power. However, widespread deployment of industrial wind turbines is having unprecedented adverse effects on certain species of bats that roost in trees and migrate. Bats are beneficial consumers of agricultural insect pests and migratory species of bats provide free pest-control services across ecosystems and international borders.

Bats are being found beneath wind turbines all over the world. Bat fatalities have now been documented at most wind facilities in the U.S. and Canada and it is estimated that tens to hundreds of thousands die at wind turbines in North America each year. This unanticipated issue has moved to the forefront of conservation and management efforts directed toward this poorly understood group of mammals, particularly due to the concurrent effects of a new bat disease, [whitenose syndrome](#). The mystery of why bats die at industrial wind turbines remains unsolved. Is it a simple case of flying in the wrong place at the wrong time? Are bats attracted to the spinning turbine blades? Why are so many bats colliding with turbines compared to their infrequent crashes with

other tall, human-made structures? Are there ways to predict and minimize risk to bats before turbines are built?


Although these questions remain mostly unanswered, potential clues can be found in the patterns of fatalities. Foremost, the majority of bat fatalities at industrial turbines are species that migrate long distances and rely on trees as roosts throughout the year, some of which migrate long distances; we call these “tree bats.” Tree bats compose more than three quarters of the bat fatalities observed at wind energy sites. The other striking pattern is that the vast majority of bat fatalities at wind turbines occur during late summer and autumn. This seasonal peak in fatalities coincides with periods of both autumn migration and mating behavior of tree bats. Seasonal involvement of species with shared behaviors indicates that behaviour plays a key role in the susceptibility of bats to wind turbines, and that migratory tree bats might actually be attracted to turbines.

Over the past decade USGS scientists and their research partners have been studying bat deaths at wind turbines, with the ultimate goal of understanding why they are happening so solutions can be developed to avoid or fix the problem. In addition to synthesizing existing information, USGS research has focused on better understanding aspects of tree bat ecology that might offer important clues to their susceptibility (see [Paul Cryan publications](#)). This work has shed new light on the migratory movements, mating behaviours, and feeding habits of migratory tree bats, which may help explain their disproportionate representation among turbine fatalities. For example, analysis of distribution records, as documented in the following links, hint at where these bats

might occur at any given time of year:

Continuing on the same research trajectory, USGS scientists at the Fort Collins Science Center have built an [active research program](#) to investigate the causes and consequences of bat fatalities at wind turbines. In collaboration with scientists at 4 other USGS science centers, as well as universities and conservation organizations, our specific focus is to (1) better identify the seasonal distributions, habitat

Download Seasonal Distribution Videos



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- [hoary bats \(*Lasiurus*](#)
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needs, and migration patterns of species showing greatest susceptibility, (2) continue to assess the potential roles of mating and feeding behaviors in turbine collisions, (3)

develop new videobased methods for studying and monitoring bats and birds flying around wind turbines at night, and (4) test whether bats are attracted to turbines. With a proven track record of studying bat migration and behavior, combined with an existing infrastructure that promotes collaboration between disciplines, the USGS is well-equipped to effectively address the problem of bat mortality at wind power facilities. Only through further research will we make progress toward minimizing the impact of this new form of sustainable energy on our Nation's wildlife.

Wind turbines may be killing bats by 'exploding' their lungs

Appendix 6:

<http://www.telegraph.co.uk/news/earth/energy/renewableenergy/10307646/Wind-turbines-may-be-killing-bats-byexploding-their-lungs.html>

WIND farms may be killing legally protected bats by causing internal organs to “explode”, according to wildlife experts.



Conservationists believe bats are dying while hunting insects that are attracted by the heat generated by turbine blades

By [Auslan Cramb](#), Scottish Correspondent

3:43PM BST 13 Sep 2013

The Bat Conservation Trust says it has evidence that pressure caused by turbine blades causes the animals' lungs to "pop", causing immediate death.

Bats are a protected species in the UK, and deliberately injuring or killing them carries the threat of six months in jail and a fine of up to £5,000.

Conservationists believe bats are dying while hunting insects that are attracted by the heat generated by turbine blades.

They have suggested that even if the bats avoid the turbines, the change in pressure created by the spinning blades is capable of bursting their lungs.

Anne Youngman, Scottish officer of the Bat Conservation Trust, said: "People think that the danger is the bats getting hit by the blade, which does happen.

"But the danger to them is really barotrauma, were they are literally popped from the inside. "It is reported a lot that birds of prey are dying because of wind turbines, but lots of bats are too." She said a dead bat was found under a turbine close to where she lives and had no obvious sign of external trauma, adding: "There are many risks to bats in Scotland, such as cats and other animals attacking them, as well as the weather. But when you add the wind turbines it could be the final nail in the coffin."

In the United States, several studies have suggested bats suffer from barotrauma – a condition that can affect divers - when they get too close to the turbine blades.

Melissa Behr, a vet at the University of Wisconsin, said she had dealt with a number of bats that had no physical signs of trauma, but had suffered damage to the ears and lungs.

She added: "There are bats with no broken bones or other evidence of blunt trauma, that have pulmonary and middle ear haemorrhages which implies that they had suffered barotrauma.

"In one case 46% per cent of the bats that were seen had no physical sign of trauma, but 100% had pulmonary haemorrhage. The conclusion is that a large percentage must have died of barotrauma."

Christine Metcalfe, an anti-wind farm campaigner who recently won an appeal at the UN, arguing that the UK Government had failed to fully inform the public about the negative effects of turbines, said: "People don't realise that the turbine tips move up to speeds of 200 miles an hour. This obviously will have a massive effect on wildlife such as birds and bats." Scotland has nine species of bat, the most common of which is the pipistrelle, which is just 2in long.

The wind farm industry is currently involved with the Department for Environment, Food and Rural Affairs on a project to determine the impact of turbines on bats, with the research due to be published next year.

Jenny Hogan, director of policy for Scottish Renewables, said: "Whenever a developer applies to build a wind farm, a thorough environmental impact assessment is carried out to ensure that any effect on wildlife, including bats, is reduced to an absolute minimum and is acceptable." Appendix 8:

Wind turbines and low frequency noise: Implications for human health

Author: [Papadopoulos, George](#)

Low frequency noise (LFN)

First of all, what is low frequency noise? It is noise, as the name suggests, at the lower frequencies of the audible range. It is general accepted to be within 20 to 200 hertz. Less than about 20 hertz is termed infrasound, because it is not usually audible to the human ear. ILFN (Infrasound–low frequency noise) is another abbreviation I shall use, as in some instances infrasound is comparable to LFN.

Noise that can be felt

Unlike higher frequency noise, ILFN is not just audible – it is also perceptible! [1] The human ear can hear infrasound down to a frequency of 12 hertz, after which it is perceived as single cycles of the sounds along with a sensation of pressure at the eardrums. [2] ILFN is also a useful tool in the military in the form of long range acoustic devices. [3] Various parts of the human body resonate to differing frequencies of ILFN. [4] Likewise any building structure can respond in a similar way causing annoyance and distress to the occupants. In the worst case scenario structures can collapse. [5]

As such it is not a benign phenomenon which is restricted to the aesthetics of noise – it can be very intrusive and distressing in other ways.

Noise that is selective in who it disturbs

I quote directly from the words of Dr Geoff Levanthall in a report prepared for DEFRA in 2003:

LFN causes EXTREME distress to a number of people who are sensitive to its effects... Such sensitivity may be a result of heightened sensory response within the whole or part of the auditory range or may be acquired. The noise levels are often low, occurring in the region of the hearing threshold, where there are considerable individual differences.

The World Health Organization is one of the bodies which recognizes the special place of low frequency noise as an environmental problem. [6]

Noise than can alter human mood

ILFN affects brain activity. According to a study done in Britain in 2003, people were exposed to an ILFN frequency of 17 hertz during a concert:

The presence of the tone resulted in a significant number (22%) of respondents reporting anxiety, uneasiness, extreme sorrow, nervous feelings of revulsion or fear, chills down the spine and feelings of pressure on the chest. [30,31] In presenting the evidence to British Association for the Advancement of Science, Professor Richard Wiseman said, “These results suggest that low frequency sound can cause people to have unusual experiences even though they cannot consciously detect infrasound. [6]

The story doesn’t end here. There are other research papers that link wind turbine infrasound with perceptions of ghosts [7] and anxiety. [8]

Noise that travels through walls and terrain

Again from Levanthall: “Infrasound is difficult to stop or absorb. Attenuation by an enclosure requires extremely heavy walls, whilst absorption requires a thickness of absorbing material up to about a quarter wavelength thick ...” [9] Consider that the wavelength of 1 hertz is 340m, 10 hertz is 34m, and 25 hertz 13.6m, there is therefore no reasonable way of affording protection to people against even 25 hertz: one will need walls that are over 6 meters thick!

Noise that travels very long distances

Whilst it would be expected that the ILFN would rapidly dissipate like other forms of noise over distance, one must be careful to put this into context. According to Levanthall:

The attenuation of sound in air... is very low at low frequencies. Other attenuating factors, such as absorption by the ground and shielding by barriers, are also low at low frequencies. The net result is that the very low frequencies of infrasound are not attenuated during propagation as much as higher frequencies. [10]

Under conditions of 20 degrees Celcius at 70% humidity, Levanthall states that noise at 63Hz will dissipate at only 0.1dB/km – i.e. negligible losses.

However, there is another factor to consider: noise dilution over distance. The loss according to Levanthall is about 6dB for each doubling of distance. However, what happens when dealing with 140 wind turbines in the region each producing ILFN? How does this noise energy “dilute” out over distance? It clearly doesn’t follow a simple model of dissipation and instead interacts with the ILFN from other wind turbines (and other industrial sources such as open-cycle gas plants, one of which is due to be built just outside the village at Dalton).

What produces ILFN?

Again I quote from Levanthall:

Low frequency noise and infrasound are produced by machinery, both rotational and reciprocating, all forms of transport and turbulence. For example, typical sources might be, pumps, compressors, diesel engines, aircraft, shipping, combustion, air turbulence, wind and fans. [11]

What about wind turbines?

Wind turbines certainly do produce ILFN. They are reverse fan mega machinery of unprecedented proportions. Such rotating machinery moves at up to 290km/h on the outer tip of the blade. The span is the same as that of a jumbo jet, and the surface area of their blades is extensive (hundreds if not over one thousand square metres in larger models). Their generator weighs tens of tonnes.

Although the larger wind turbines are “quieter” machines in terms of audible noise, they instead produce more ILFN. [12]

Quiet backgrounds are associated with more noise annoyance

The lack of background noise makes a dominant noise source more noticeable. Whilst this appears self-explanatory to any person living in rural area, it has also been the subject of investigation. [13] The Capital and Southern Tablelands regions have no major industrial sources of noise, save traffic noise in Canberra, and the large wind turbine installations started in late 2008.

But isn’t the noise level within the “guidelines”?

The question is: what guidelines? There are no current guidelines on low frequency noise that I am aware of that are being applied to the wind turbine industry. In fact some wind industry proponents suggest on online sites that wind turbines do not produce infrasound, even when there is evidence to the contrary. The character of wind turbine noise is known to make it especially intrusive, arising from amplitude modulation associated with blade passage past the tower, and the dominance of low frequencies in the received sound spectrum. These are implicated in sleep disturbance and deprivation, and the resultant adverse health effects. [14]

Moreover, the A-frequency weighted sound pressure level or “sound level” is the most common sound descriptor. However, the A-weighting has a significant restriction in that it does not permit measurement or assessment of low frequency sound. Noise standards need to include appropriate measures to calculate the impact of low frequency noise and vibrations indoors at impacted dwellings.

What’s been happening in the Capital/Southern Tablelands regional environment since 2009?

If I was asked this question before June 2011, I wouldn’t know what you were talking about. Given my bitter experience, now I do.

Since late 2008 the first large industrial wind turbines were being installed in the region at Cullerin Range and at Lake George. Then in 2010 more large wind turbines started going up at Walwa, and in 2011 even more out at Lake George at Woodlawn.

As with everything in life, some are more sensitive than others to unhealthy environmental factors. Already one family had moved out of the region, either in late 2010 or early 2011 because this strange noise was extremely stressful. Some of their neighbours also noticed the noise, but no one knew what it was.

In early 2011 it was my turn. Swarms of scarab beetles? Invisible mosquitoes? Grumbling Mother Earth? And plenty of anxious, sleepless nights!

By June 2011 the time for guesswork was over – this weird noise was so loud and terrifying that it was making my ear drums resonate. Then my enquiries started and one of my neighbours already believed they had worked it out: wind turbines and ground vibrations.

Then on July 21st and 22nd 2011, there was another climax here on the hills north of Yass – for two nights, I couldn’t sleep much at all. There was this horrible distressing resonance in my ears. I struggled to get more than three or four hours of sleep. I performed more enquiries with people in the region.

Several neighbours were hearing the noise. Many people in Northern Canberra are also hearing the noise. A few are having their health destroyed – they just can’t get a decent sleep on some nights. They find the noise at times unbearable and highly distressing.

One doctor mentioned to me a case of a woman in northern Canberra who was very distressed by a humming noise and a feeling of thrusting pulses in her house. This same doctor also started noticing the strange hum a few months later.

Some dog owners are at a loss as to why their dogs behave so weirdly on some nights – they become unsocial, vegetative beings that avoid affection or attention.

The startling coincidence was that of the many people I spoke to with regards to the nocturnal noise on the 21st and 22nd July 2011, 50% didn’t sleep well, but only 10% noticed the hum on those days.

To date the descriptions of the noise that I have received include: “V8 engine noise”, “diesel engine noise”, “lawn mower noise”. A smaller number also feel thrusts of air pressure hitting around at their head, much like when one slams a door.

It is worse indoors than outdoors. When I have been able to track the stories of several individuals simultaneously, the descriptions of time and intensity are very similar.

More importantly NONE of these cases started prior to 2009 – most started in 2011.

Isn’t this just hearsay? Where is the evidence?

There is plenty of evidence that wind turbines are “noisy” both in audible noise but also ILFN. But the most profound and far reaching claims come from the military.

In Eskdalemuir, Scotland, the Ministry of Defence initially put a blanket ban on wind turbines within 80km of the United Kingdom seismic monitoring site because of concerns that wind turbines would interfere with the detection of nuclear explosions. [15]

Clearly, wind turbines create significant amounts of ILFN and ground vibrations that spread over long distances, meaning that currently recommended setback distances for turbines are out of touch with reality.

What's happening in Warrnambool, Victoria?

There have been two reports from Warrnambool, Victoria, [16,17] which include details very similar to what I describe above. The closest turbines appear to be about 35-50km away with many more about 70km away.

The descriptions of the noise have included:

"A mystery noise is driving several Warrnambool residents to despair one even selling her house to escape the incessant drone.

Two residents in Mitchell Street and two others, less than a kilometre away in Alice Place, have aired their annoyance over what they describe as a low, turbine-like noise in their north-east neighbourhood."

"Three other residents also said they too found it hard to sleep, especially on calm nights when the sound was more noticeable. 'It's not excessive, just irritating and sometimes it keeps me awake night after night,' one retired woman said."

"I thought I was going mad until I read that others had also heard the noise," said 85-year-old Mavis Campbell of Cherlin Drive.

"It's been affecting my health and blood pressure and has been going on for a few years.

"I would describe it as a pulsating sound like a diesel engine."

The best hint in this situation is that it has been going on for "a few years". But most people have been noticing it more recently. Note that most wind turbines around Warrnambool had been installed over the last three to five years. The most recent addition has been the massive turbines at Glenthompson last year about 70km away. The pumping station at Warrnambool may be just another source of ILFN added to the existing load of noise, and not the primary cause of the problem.

But isn't this just tinnitus?

The fact that one cannot locate the source noise does not mean it's all in the head. According to the Renewable Energy Research Laboratory of the University of Massachusetts, "Because of long wavelengths, infrasound may not appear to be coming from a specific location." [18]

All those who describe the noise, at a distance of 30km and beyond, agree it is external to their head, and some can even feel the pulsing sensation of infrasound on their body or hear or feel the subtle rattling of home structures.

Where does the problem stop?

This is a difficult question to answer. On two occasions when the ILFN nuisance was at its worst, I travelled out west. On one occasion I discovered that it appeared to have dissipated at Wee Jasper, 70km away from the closest turbines. On another occasion, and by far the worst of all days, the problem had dissipated when arriving at Young about 100km from the closest turbines.

Truly these figures appear subjective, outrageous, and for most, impossible to believe. However, I am reporting my findings that have taken hours and days to determine. I'm not just plucking figures out of the air.

What are the peculiarities of wind turbine ILFN?

Empirically, wind turbine ILFN travels upwind almost as well as it does downwind. (NASA has confirmed this observation with smaller wind turbine models). [19] It is also more intense during atmospheric inversions (consistent with the phenomenon described by Van den Berg [20,21]) and becomes dramatically worse when the atmosphere is moist, particularly prior to major rain events.

Where are we heading to with ever increasing numbers of wind turbines?

That is precisely what I wish you to think about. If you feel that you are one amongst the majority that doesn't hear the ILFN from the wind turbines, then it is a case of guesswork over how many more wind turbines it will take before you start the same problem. You may also want to ask how many more turbines it will take to drive those already suffering into a total state of despair and be forced to move out of the region.

What should any politician or official be doing?

Research is required to establish the nature of the problem and its solutions.

Meanwhile the only responsible position is to call for a moratorium on all wind developments. It is also necessary to ask questions about giving respite to the existing sufferers, particularly those who live at close range to the wind turbines where the problem is at its worst. Wind turbines should at least be SWITCHED OFF during sleeping hours, and particularly during weather conditions which are conducive to ILFN such as inversions, or pre-rain events.

Wind turbines are not "farms". They are industrial zones that create much ILFN and consequent grief.

And my final warning is that wind turbines are just one unique piece of recent mega machinery. Careful consideration should be to other new regional industry arrivals e.g. gas plants that may create similar problems and add the "ILFN load" of the region.

By George Papadopoulos, September 2012.

1. The Sixteenth International Congress on Sound and Vibration, Krakow, 5-9 July 2009: "Hearing with your body: the influence of whole-body vibrations on loudness perception"
2. Olson, Harry F. (1967). Music, Physics and Engineering. Dover Publications. p. 249.
3. <http://www.globalsecurity.org/military/systems/munitions/acoustic.htm>
4. Wind Turbines, Noise and Health, February 2007. By Dr Amanda Harry M.B.Ch.B. P.G.Dip.E.N.T.
5. http://en.wikipedia.org/wiki/Resonant_frequency
6. Same as [2]
7. "Wind Turbines and Ghost Stories: The Effects of Infrasound on the Human Auditory System" Hsuan-hsiu Annie Chen and Peter Narins, Acoustics Today, Volume 8, Issue 2, April 2012; <http://www.library.ucla.edu/pdf/Chen.Paper.pdf>
8. The Bruce McPherson infrasound and low frequency noise study. December 14, 2011 by Stephen E. Ambrose, INCE (Brd. Cert.) and Robert W. Rand, INCE Member. The link to the paper is found at: <http://randacoustics.com/wind-turbinesound/wind-turbines-published-articles/the-bruce-mcpherson-ilfn-study/>
9. "A Review of Published Research on Low Frequency Noise and its Effects": Report for Defra by Dr Geoff Leventhall. p.8. <http://archive.defra.gov.uk/environment/quality/noise/research/lowfrequency/documents/lowfreqnoise.pdf>
10. Same as [9]. p.8.

11. Same as [9]. p.7.
12. http://asadl.org/jasa/resource/1/jasman/v129/i6/p3727_s1 "Low-frequency noise from large wind turbines" H. Moller and C.S. Pedersen: J. Acoust. Soc. Am. Volume 129, Issue 6, pp. 3727-3744 (2011)
13. http://www.maine.gov/dep/ftp/bep/ch375citizen_petition/pre-hearing/AR-20%20chapter%20375%20-%20r%20brown%20hearing%20submission%20-%20Pedersen%20Health%20Aspects.pdf "Health aspects associated with wind turbine noise—Results from three field studies", Eja Pedersen.
14. Harrison, J. P. (2011). Wind turbine noise. Bulletin of Science, Technology & Society, 31(4), 256-261
15. <http://www.keele.ac.uk/geophysics/appliedseismology/wind/>
16. <http://www.standard.net.au/story/153226/mystery-noise-causing-sleepless-nights-in-north-east-warrnambool/>
17. <http://www.standard.net.au/story/153262/more-warrnambool-residents-hear-noise-but-source-remains-a-mystery/>
18. <http://old.nationalwind.org/events/siting/presentations/rogers-infrasound.pdf>
19. "Noise Radiation Characteristics Of The Westinghouse Wwg-0600 (600kw) Wind Turbine Generator": NASA Technical Memorandum 101576. [//docs.wind-watch.org/Noise-Westinghouse-600kw-windturbine.pdf](http://docs.wind-watch.org/Noise-Westinghouse-600kw-windturbine.pdf)
20. "Effects of the wind profile at night on wind turbine sound" G.P. van den Berg: Journal Of Sound And Vibration; 277 (2004) 955–970. [//docs.wind-watch.org/vandenBerg_turbinesnight_JSV2004.pdf](http://docs.wind-watch.org/vandenBerg_turbinesnight_JSV2004.pdf)
21. "The sound of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise": G.P. van den Berg. [//docs.wind-watch.org/vandenBerg-SoundOfHighWinds.pdf](http://docs.wind-watch.org/vandenBerg-SoundOfHighWinds.pdf)

Has Offaly County Council considered the scientific evidence of the impacts of Wind Turbines in residential areas. Note the evidence below regarding the effects on brain development.

"This review summarises the increasing evidence ... that chronic disturbances of sleep adversely affect brain development ... Paediatric neurologists, the scientific community and the public must be aware of these recent scientific developments. Further studies are urgently required." [Jan JE, Review article, Long-term sleep disturbances in children: a cause of neuronal loss. European Journal of Paediatric Neurology 14 (2010) 380-390] The World Health Organization (WHO) acknowledges that noise is an "underestimated threat that can cause a number of short- and long-term health problems ..." [World Health Organization Noise Facts and Figures, Sited December 23, 2012, <http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/noise/facts-and-figures>]. Research indicates children's ear damage, **cognitive function and learning** are affected by noise and there could be lifelong effects on academic achievement and health. Excerpts from The World Health Organization's Training Package for the Health Sector on Children and Noise identify vulnerable groups of children at risk

including the foetus and babies; preterm; children with dyslexia and hyperactivity. [World Health Organization, Children and Noise, Children's Health and the Environment, WHO Training Package for the Health Sector, www.who.int/ceh] Children with pre-existing medical conditions such as **autism**, asthma, **migraine**, bronchitis, and epilepsy can be vulnerable to the effects of noise and/or stress and/or sleep disturbance. [See references below] There is a risk of noise-induced harm to children when industrial wind turbine facilities are sited in close proximity to family homes and schools.

References:

- [1] Cristina Becchio, Morena Mari, Umberto Castiello, (2010). Perception of Shadows in Children with Autism Spectrum Disorders PLoS ONE | May 2010 | Volume 5 | Issue 5 | e10582. Retrieved from www.plosone.org
- [2] Catherine Purple Cherry and Lauren Underwood. The ideal home for the autistic child: physiological rationale for design strategies. Autism Science Digest: The Journal Of Autismone, Issue 03 Retrieved from www.purplecherry.com.
- [3] Flavia Cortesi, Flavia Giannotti, Anna Ivanenko, Kyle Johnson (2010). Sleep in children with autistic spectrum disorder, Sleep Medicine 11 (2010) 659–664 Retrieved from www.elsevier.com/locate/sleep
- [4] Hartmut Ising, Martin Ising (2002), Chronic cortisol increases in the first half of the night caused by road traffic noise. Noise and Health 2002,4:16:p13-21 Retrieved from <http://www.noiseandhealth.org/article.asp?issn=1463-1741;year=2002;volume=4;issue=16;spage=13;epage=21;aulast=Ising>
- [5] Bockelbrink A, Willich SN, Dirzus I, Reich A, Lau S, Wahn U, Keil T. (2008) Environmental noise and asthma in children: sex-specific differences J Asthma.2008 Nov;45(9):770-3.Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/18972293>
- [6] Neut D, Fily A, Cuvellier JC, Vallée L (2011),. The prevalence of triggers in paediatric migraine: a questionnaire study in 102 children and adolescents. J Headache Pain. 2011 Nov 1. [Epub ahead of print] Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/22042255>
- [7] Doreen Wagner, Velitchko Manahilov, Gunter Loffler, Gael E. Gordon, and Gordon N. Dutton, Visual Noise Selectively Degrades Vision in Migraine Investigative Ophthalmology & Visual Science, April 2010, Vol. 51, No. 4 Retrieved from <http://www.iovs.org/content/51/4/2294.full.pdf>
- [8] Ising H, Lange-Asschenfeldt H, Moriske HJ, Born J, Eilts M., Low frequency noise and stress: bronchitis and cortisol in children, Noise Health. 2004 Apr-Jun;6(23):21-8
- [9] Gilboa T. Epilepsia. 2011 Dec 9. Emotional stress-induced seizures: Another reflex epilepsy? doi: 10.1111/j.1528-1167.2011.03342.x. [Epub ahead ofprint] Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/22150553>
- [10] Epilepsy Facts - Epilepsy Canada Cited March 2012, Retrieved from www.epilepsy.ca

See also - "Infrasound from wind turbines:An overlooked health hazard,"
Läkartidningen, vol. 110 (2013), pp. 1388-89.

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