

POSITION STATEMENT OF THE
**INTERNATIONAL COUNCIL OF ACADEMIES OF ENGINEERING AND
TECHNOLOGICAL SCIENCES, INC. (CAETS)
NOISE CONTROL TECHNOLOGY COMMITTEE**

On the Australian Senate Community Affairs Committee Inquiry regarding:
The Social and Economic Impact of Rural Wind Farms

2011 February 10

The CAETS committee appreciates the opportunity to comment on the Australian inquiry.

WHAT IS CAETS?

CAETS is an independent nonpolitical, non-governmental international organization of engineering and technological sciences academies, one member academy per country, with the following objectives:

1. Advise governments and international organizations on technical and policy issues related to its areas of expertise;
2. Contribute to the strengthening of engineering and technological activities to promote sustainable economic growth and social welfare throughout the world;
3. Foster a balanced understanding of the applications of engineering and technology by the public;
4. Provide an international forum for discussion and communication of engineering and technological issues of common concern;
5. Foster cooperative international engineering and technological efforts through meaningful contacts for development of programs of bilateral and multilateral interest;
6. Encourage improvement of engineering education and practice internationally; and
7. Foster establishment of additional engineering academies in countries where none exist.

WHAT IS THE CAETS NOISE CONTROL TECHNOLOGY COMMITTEE (NCTC)

In 2010 June the CAETS NCTC was given the mission to redirect its work from noise technology assessments to an active, science-based support for noise policymakers on technological options for a quieter world. The NCTC will provide support in evaluations of the noise control technology for the world's dominant noise sources in cooperation with the International Institute of Noise Control Engineering (I-INCE). The Institute has an agreement with CAETS to provide technical support in the evaluation of studies relating to noise control technology that are undertaken by the CAETS committee. One goal of the CAETS committee is to inform policymakers worldwide on the importance of reducing the noise emissions of noise sources in the environment and at the workplace. The CAETS committee's scope is to focus on the engineering control of the world's dominant noise sources which is

accomplished by design to reduce the noise power emitted by the source and requires detailed understanding of the mechanisms for the generation of such noise power.

The CAETS committee offers a new perspective on the noise policy issue. CAETS, in its independent role representing the world's leading engineering academies, is able to step back and study a technical issue from a fresh viewpoint. The stakeholders in the noise issue are numerous—legislatures, government agencies, local authorities, manufacturers, trade associations, non-governmental organizations, advocacy groups, the public, and others. CAETS is independent of, and not beholden to, any of the stakeholders in the noise issue except possibly the public which the academies are implicitly obligated to serve. The role of the CAETS committee is that of an impartial expert witness without affiliation or bias.

WHY IS CAETS WRITING TO THE AUSTRALIAN SENATE COMMUNITY AFFAIRS COMMITTEE?

The Australian Academy of Technological Science and Engineering (ATSE) is a member Academy of CAETS. The Australian Academy brought the call for submissions to the Senate Enquiry to the attention of CAETS and in particular to the Noise Control Technology Committee of CAETS. CAETS has a goal of informing policy makers throughout the world on matters regarding noise control and is pleased to offer a submission to the Australian Senate enquiry.

THE SITUATION TODAY

There are two sources of noise produced by wind turbines—the noise generated by the turbine blades passing through the air and the noise generated by the gear box and generator in the nacelle of the turbine. The turbine blades, many of which are the size of a jumbo jet's wing and travel at 250 km/hr, make a swooshing sound as they pass by the tower every one to two seconds. This is a unique sound, and at distances from the tower the swooshing becomes a low-frequency pulsing. Proper blade design will reduce the magnitude of the sound it generates, and conventional noise control design will suppress the mechanical noise from the nacelle.

Although the CAETS committee was unable to review all of the literature that has been published on this subject, two differing positions on the issue of rural wind farm development need consideration:

- The American Wind Energy Association (AWEA) and the Canadian Wind Energy Association (CanWEA) jointly published a report dated 2009 December entitled "Wind Turbine Sound and Health Effects—an Expert Panel Review." The panel reached consensus on the following conclusions: [The conclusions are numbered.]
 1. There is nothing unique about the sounds and vibrations emitted by wind turbines.
 2. The body of accumulated knowledge about sound and health is substantial.
 3. The body of accumulated knowledge provides no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.

“The panel also considered the quality of epidemiologic evidence required to prove harm. In epidemiology, initial case reports and uncontrolled observations of disease associations need to be confirmed through controlled studies with case-control or cohort methodology before they can be accepted as reflective of casual connections between wind turbine sound and health effects. In the area of wind turbine health effects, no case-control or cohort studies have been conducted as of this date. Accordingly, allegations of adverse health effects from wind turbines are as yet unproven. Panel members agree that the number and uncontrolled nature of existing case reports of adverse health effects alleged to be associated with wind turbines are insufficient to advocate for funding further studies. In conclusion: [The conclusions are numbered in sequence with the above.]

- 4. Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effect in humans.*
- 5. Sub-audible, low frequency sound and infrasound from wind turbines do not present a risk to human health.*
- 6. Some people may be annoyed at the presence of sound from wind turbines. Annoyance is not a pathological entity.*
- 7. A major cause of concern about wind turbine sound is its fluctuating nature. Some may find this sound annoying, a reaction that depends primarily on personal characteristics as opposed to the intensity of the sound level.”*
[AWEA/CanWEA, 2009]

- The opposing viewpoint is presented by accounts of case histories from many different countries which have operating wind farms. For example, Nina Pierpont, MD, PhD, in her book published in late 2009 entitled “Wind Turbine Syndrome: A report on a Natural Experiment.” [Pierpont, 2009] presents a series of medical case histories of people exposed to wind farm noise. The press release is the following statement: *“Pierpont explains ... how turbine infrasound and low-frequency noise (LFN) create the seemingly incongruous constellation of symptoms she has christened Wind Turbine Syndrome. The core of the book is 66 pages of ... tables wherein the author presents her clinical Case Histories. The hard data.”* The constellation of symptoms is described by the Minnesota Department of Health as follows:

“Pierpont (2009) postulates wind turbine syndrome, consisting of a constellation of symptoms including headache, tinnitus, ear pressure, vertigo, nausea, visual blurring, tachycardia, irritability, cognitive problems and panic episodes associated with sensations of internal pulsation. She proposes that the mechanism for these effects is disturbance of balance due to “discordant” stimulation of the vestibular system, along with visceral sensations, sensations of vibration in the chest and other locations in the body, and stimulation of the visual system by moving shadows. Pierpont does report that her study subjects maintain that their problems are caused by noise and vibration, and the most common symptoms reported are sleep disturbances and headache. However, 16 of the people she studied report symptoms consistent with (but not necessarily caused by) disturbance of equilibrium.”

OTHER REPORTS DOCUMENTING ADVERSE HEALTH EFFECTS ATTRIBUTED TO WIND FARM EXPOSURE

There are literally hundreds of other reports supporting the findings of Pierpont (2009) and almost all are similar to the case histories of Wind Turbine Syndrome (WTS).

It is the WTS that the AWEA and CanWEA has identified in publications as representative of those opposed to wind farm development. Published anecdotal reports and case histories come from countries including France, Denmark, Japan, the U.S., Canada, Australia, and New Zealand. The anecdotal evidence is compelling. Further evidence supporting this viewpoint is presented in a book published in 2010 entitled "Sound, Noise, Flicker and the Human Perception of Wind Farm Activity." [Rapley and Bakker, 2010].

"The explosion of wind farms worldwide has brought with it a rising tide of resistance from residents near them. Complaints about noise and flicker, as well as health problems such as sleep disturbance, headaches, dizziness, anxiety and depression, are all strikingly similar. Developers are advised by experts that the noise levels are virtually undetectable and so low that sound cannot directly cause these symptoms and that these people are naturally anxious.

"Why is there such a disparity between the perception of the issue from the two groups? Part of the problem is that the physics of sound and the human perception of noise are still not well understood by many. There is a great difference between being able to measure something and a person's perception of it and the variation between individuals is never well accounted for by a statistical mean. This can split communities into the affected and the unaffected, the latter group who, due to no fault of their own, cannot understand the views of those who complain. Yet, for those adversely affected by the wind farm placement, there is no doubt about the intrusion into their lives."

The National Academy of Medicine of France noted adverse health effects related to wind turbines in its 2006 report "Repercussions of the Operation of Wind Turbines on the Health of Man." They also recommend an epidemiological investigation into the possible medical effects of wind turbines.

"Noise is the most frequent complaint. It is described as piercing, preoccupying, continually surprising because it is irregular in intensity, but also includes grating and incongruous sounds, which distract the attention or disturb rest. The spontaneous recurrence of these noises disturb the sleep, suddenly awakening the subject when the wind rises, or 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, less well described, and consist of subjective manifestations (headaches, fatigue, temporary feelings of dizziness, nausea), and sometime objective (vomiting, insomnia, palpitations)." [Chouard, 2006]

The Japanese government has announced plans to conduct a 4-year epidemiological study starting in April, 2010, to investigate the influence of wind turbine sound on human health, including low-frequency noise. [Ito and Takeda, 2010]

The situation today as it appears to the committee is as follows:

- The AWEA/CanWEA position that the epidemiologic evidence required to prove harm to individuals from wind farm noise is lacking. This is correct.

- The case that harm is caused to individuals from wind farm noise is based on extensive but anecdotal evidence. While epidemiological investigations are currently in progress, results are not yet available.
- With respect to the seven conclusions of the AWEA/CanWEA panel (See above.), there is objective evidence to demonstrate that:
 1. No other natural or man-made noise source emits sounds and vibrations even remotely resembling those emitted by wind turbines (meaning the “whoosh” or “swoosh”). There are other characteristics which are common to other industrial noise sources.
 2. The body of accumulated knowledge about sound and health is substantial but not specifically concerning the health effects of wind turbine noise.
 3. There is much anecdotal evidence that the audible or sub-audible sounds emitted by wind turbines have direct adverse physiological effects, but these have not yet been confirmed by epidemiological studies.
 4. Sound from wind turbines is unlikely to carry a risk for hearing loss.
 5. It is currently unknown whether sub-audible, low-frequency sound and infrasound from wind turbines will have any adverse effects on humans.
 6. Annoyance is considered by the World Health Organization as a factor affecting the quality of life of humans.
 7. The extent to which the fluctuating nature of wind turbine noise causes annoyance is currently unknown.

SPECIFIC RESPONSES

(a) Any adverse health effects for people living in close proximity to wind farms

The adverse health effects of noise generated by wind farms, particularly low-frequency noise appear to be real and well-documented, but the evidence is, as mentioned above, anecdotal. Wind turbines are a relatively low-level noise source compared to the high noise levels inside many industrial plants, and effects such as hearing impairment and cardiovascular damage are probably the exception. ^[van den Berg, 2011] The definition of health of the World health Organization is “a state of complete physical, mental and social well being and not merely the absence of disease or infirmity.” An adverse health effect can thus be defined as a negative impact on the physical, mental and social well being of a person or group of persons. ^[van den Berg, 2011] The adverse health effects of noise ^[WHO, 2000], in general, include:

- * sleep disturbance
- * mental health effects
- * cardiovascular and physiological effects
- * interference with speech communication
- * hearing impairment

In addition there are other adverse effects on persons who occupy residences in the neighborhood of wind turbines ^[van den Berg, 2011], and they are on:

- * task performance
- * residential behavior and annoyance
- * children’s development and learning

In a report published in 2009 by the World Health Organization entitled “Night Noise Guidelines for Europe” it was concluded that *“Sleep is a biological necessity and disturbed sleep is associated with a number of adverse impacts on health.”* And *“While noise-induced sleep disturbance is viewed as a health problem in itself (environmental insomnia), it also leads to further consequences for health and wellbeing.”* The WHO panel that completed its work in 2006 did not consider sleep disturbance from wind turbine noise.

The most common complaints regarding wind farm noise are annoyance and sleep disturbance. The annoying (irritating, stressful) nature of wind farm noise is exacerbated by the modulating nature of the noise (swooshing). Annoyance and loss of sleep leads to stress reactions and to further adverse health effects. This situation has been described by Dickinson in 2010 as follows:

“Undisturbed sleep is extremely important. The more healthy a person is, the better they can resist illness and injury from any cause including noise. Heart disease, high blood pressure and mental or emotional illness are common complaints and need protection from other stressors such as noise.” ^[Williams 1970] *Rest, relaxation, and undisturbed sleep are essential requirements for maintenance of good health, and such is especially important for those with high blood pressure or trying to recover from illness. Chronic loss of sleep may impair performance and cause psychological distress. In fact, severe disturbances of sleep precede and accompany most acute psychiatric syndromes, and complaints of sleeplessness are among the most frequent symptoms presented to the general medical practitioner [ibid].*

“The rural areas ... are generally extremely quiet most nights. ...on numerous occasions at night the ambient sound has been measured at 20 decibels - the noise floor of the sound level meter to hand. At such background sound levels, a sound even at only 35 decibels outside a residence can be very noticeable, and if continuous and rhythmically modulating up and down three or four decibels for hours on end, as it does for a wind farm, it can be extremely irritating and stressful.

“... most rural people, and it is the rural area where most wind farms are established, have their windows fully open on hot summer nights, and may sleep outside on their deck when it is too hot to sleep inside. The sound they receive from a wind farm will have little or no attenuation at all from that outside.” ^[Dickinson, 2010]

Concerns over excess noise and vibrations emitted by wind farms in close proximity to people’s homes has led to farms being located out to sea in Denmark and to remote areas without habitation in other countries.

“The World Health Organization has accumulated ... the work of the leading experts ... to produce recommendations for all countries to adopt to maintain and protect public health.” ^[Berglund et al 2000] *Of particular concern, for sound propagated at night, the level of steady continuous noise at any sleeping position should be no greater than a time average level of 30 decibels (LAeq). As wind farm sound is steady continuous noise (when in operation) ... the World Health Organization recommendation is a level not to be exceeded - it is not just an average over the entire night time.”* ^[Dickinson, 2010]

The noise generated by wind farms includes low-frequency noise which merits particular attention. Many of the measurement methods for wind farm noise yield only the A-weighted decibel values which do not include the low-frequency components. It is difficult to attenuate these low-frequency components by double-glazing of residences or with noise-canceling earphones or other devices. Low-frequency noise can only be attenuated with very thick and heavy structures having multi-glazed windows designed for maximum attenuation.

The noise of rural wind farms is a subject of intense interest in the developed countries of the world as well as many of the developing countries. China, for example, is seeking a leadership position on this important issue. Many aspects of the noise problems created by rural wind farms are under investigation, including “safe” set-back distances between wind turbines and homes as well as on the effects of wind turbine noise on people. The CAETS committee [See (e) below.] has an active role in monitoring developments in the research on wind turbine noise.

(b) Concerns over the excessive noise and vibrations emitted by wind farms which are in close proximity to people’s homes

The concerns over wind farm emissions are health effects [See (a).] and reduction of property values [See (c).].

(c) The impact of rural wind farms on property values, employment opportunities, and farm income

Because of the noise and vibration emissions of wind farms, property values in the affected areas may be negatively affected. However, if the wind farms provide additional employment to area residents, this could be a positive effect; and the additional cash flow would enhance the area’s economy.

But the most important consideration is the health and welfare of the residents, including the children. This consideration should take priority over any matters related to monetary loss or gain.

(d) The interface between Commonwealth, state, and local planning laws as they pertain to wind farms

As this response to the inquiry is from a committee of a consortium of engineering academies, the details of the interface are unfamiliar to those responding.

(e) Any other relevant matters

This response was prepared by the Noise Control Technology Committee of CAETS, the International Council of Academies and Technological Sciences, which is a consortium of 26 engineering academies in countries around the world, one academy for each country. The Australian Academy of Technological Sciences and Engineering is the CAETS member academy. The Council representing the world’s foremost engineers and applied scientists offers new perspectives on governmental policies. Academicians are able to step back and study technical issues from a fresh viewpoint. CAETS is without affiliation or bias and independent of the stakeholders on policy issues. CAETS brings an independent voice and source of information to the

discussion by policymakers of what is technically feasible. The CAETS committee has 19 members representing eleven CAETS academies that are participating in the program to inform the world's policymakers on the important aspects of the noise issue.

The CAETS committee is planning to offer two services to policymakers around the world at no cost.

- * A service with perspectives and information on key policy issues involving noise control technology worldwide, and
- * A service with access to a global panel of experts for answers to questions on key policy issues involving noise control technology. The details of this service will be finalized during 2011.

RECOMMENDATIONS

Further investigative work needs to be undertaken on the basis of properly controlled experiments, not just examinations of the validity of the complaints of adverse health effects that many residents living in the vicinity of wind farms around the world experience.

This work should include rigorous, third-party epidemiological studies to establish the relationship between exposure to wind farm noise emissions and their impact on human health.

Wind farm development should be sited by adopting known strategies (increased setbacks, home construction modifications, etc.).

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