# Noise levels of wind farms

energy
Department:
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REPUBLIC OF SOUTH AFRICA

EMBASSY OF DENMARK

POWERED BY WIND

Wind turbines consist of rotating machinery, which means there is some noise. Early wind turbines were designed for maximum generation and emissions savings, and reduction of noise was not a priority. By comparison, today's turbines make less noise for up to 50 times more electrical power[1].

As wind farms have become more plentiful, they have also attracted greater regulatory scrutiny; quiet operation is now an important design criterion for success. It is quite possible to carry out a normal conversation at the base of a turbine running at maximum power, without having to raise one's voice.

For an 'industrial' noise, wind also has some unique characteristics. The sound turbines produce is predominantly aerodynamic, and is generally perceived as more natural than most sources of industrial noise.

In addition, the noise tends to be at a lower level when wind speed is low and rises as the wind speed increases. As wind speed increases so does wind-generated background noise from trees and bushes at neighboring houses, which tends to mask the sound of the turbine.

Table 1 below contains various noise sources with levels for comparison with wind turbines. Measurements of environmental noise are usually made in dB(A)[1], which includes a correction for the sensitivity of the human ear.

## Comparative table

Table 1 Various noise sources with levels for comparison with wind turbines[2]

| Source/Activity | Indicative noise level dB (A) |
|---|---|
| Threshold of hearing | 0 |
| Rural night-time background | 20-40 |
| Quiet bedroom | 35 |
| Wind farm at 350m | 35-45 |
| Busy road at 5km | 35-45 |
| Car at 65 km/h at 100m | 55 |
| Busy general office | 60 |
| Conversation | 60 |
| Truck at 50km/h at 100m | 65 |
| City traffic | 90 |
| Pneumatic drill at 7m | 95 |
| Jet aircraft at 250m | 105 |
| Threshold of pain | 140 |

## Sources of noise from wind turbines

The two main sources of wind turbine noise are mechanical noise from components, such as gearboxes and generators, and aerodynamic noise from the blades.

Standing next to the turbine, it is usually possible to hear a swishing sound as the blades rotate; the whirr of the gearbox and generator may also be audible. However, as distance from the turbine increases, these effects are reduced.

Quiet operation has become an important design criterion for successful wind turbine manufacture. Great attention is given to ensuring that both mechanical and aerodynamic noises are as low as possible.

Mechanical components are acoustically isolated from the tower and blades using anti-vibration mounts, and the nacelle is insulated to minimize airborne noise radiation.

The noise emanating from the blades has also been reduced by careful design and manufacture.

## Impact on neighbouring populations

**Noise**

In order to be economically viable, wind farms must be built in relatively close proximity to electrical infrastructure so that they can supply the electricity they produce to the end user.

In practice this means that wind farms are usually built in areas where people live. The design of most wind farm projects must take this into consideration.

The level of noise emissions from any industrial source permitted at neighboring residences – including wind turbines – is very strictly regulated in most countries.

The actual level permitted usually depends on the existing noise environment before the noise source is created. The noise level is usually assessed outside rather than inside houses. This ensures that the amenity of outdoor recreation areas such as gardens is protected. Noise levels inside the house from any external source can be expected to be much lower, even with all the windows open.

The sorts of places where wind turbines are usually placed tend to be in rural environments where the ambient noise is very low. Indeed, peace and quiet are often an important part of the amenity of the area.

Noise limits are therefore usually set at a fairly low level such as 35 or 40 dB(A)[1].

In a paper published in December 2009, an expert panel concluded that "there is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects[3]."

**Property value**

A study financed by the United States Department of Energy concluded in 2009 that, overall, property values were unaffected by nearby wind turbines[4]. The research collected data on almost 7,500 sales of single family homes situated within 10 miles of 24 existing wind facilities in nine different US states. Although the analysis cannot dismiss the possibility that individual homes or small numbers of homes have been or could be negatively impacted, the study finds that if these impacts do exist, they are either too small and/or too infrequent to result in any widespread, statistically observable impact.

1 Wind farms and noise, AWEA
2 Winds farms and noise, AustralianWEA
3 Wind Turbine Sound and Health Effects An Expert Panel Review, AWEA, CANWEA, December 2009
4 The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis, ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY, December 2009

## IEC 61400-11

Turbine manufacturers may provide noise characteristic certificates, based on measurements by independent test organizations to agreed standards. The internationally recognized standard that is typically referred to is the International Electrotechnical Commission (IEC) standard 61400, Part 11 of 2002 'wind turbine generator systems: acoustic noise measurement techniques'.

The purpose of this section of IEC 61400 is to provide a uniform methodology that will ensure consistency and accuracy in the measurement and analysis of acoustical emissions by wind turbine generator systems. This standard provides guidance in the measurement, analysis and reporting of complex acoustic emissions from wind turbine generator systems. IEC 61400-11 has been adopted by the South African Bureau of Standards.

## Background noise and audibility

Most limits on wind turbines allow the wind turbines to exceed the limit of 35 or 40 dB(A) as long as they don't exceed the level of background noise at neighboring areas by more than a specified amount, often 5 dB(A).

## Perceptions of noise

Human perception of any noise source is influenced by many factors, including the acoustic characteristics of the noise (whether it has audible tones or other characteristics that may annoy the hearer), and how much louder the noise is than the existing noise environment.

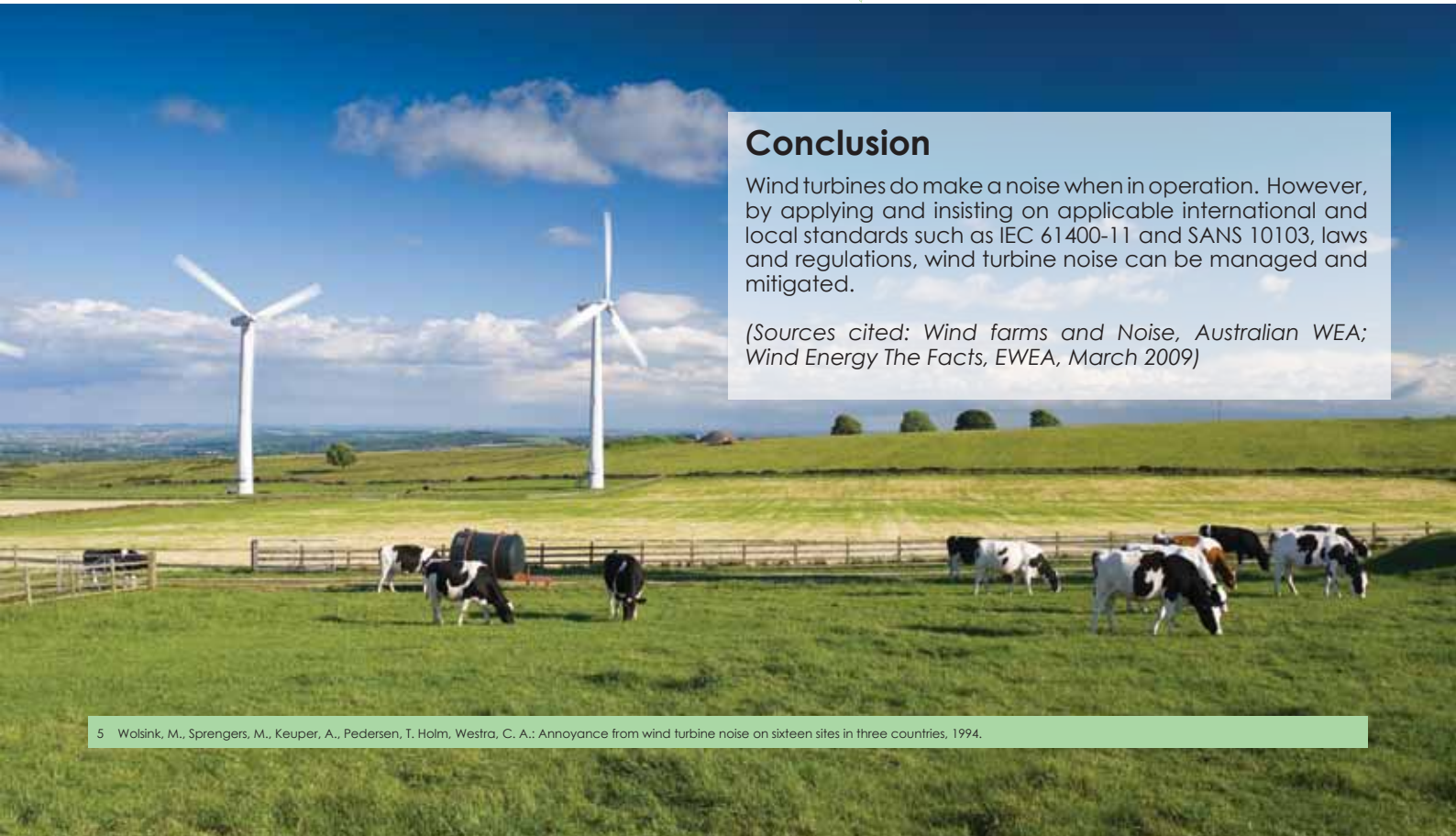
Importantly, the perception of a noise is also often influenced by the hearer's attitude towards the noise source. One person may find the morning chorus delightful, while another may find the same sound aggravating. It is certainly true that a hearer who for some reason has a negative attitude towards a noise source is much more likely to view the noise itself negatively, however low its level.

## Annoyance factor study

A mid-1990s' European study on the annoyance factor of wind turbine noise at sixteen sites in three countries (Denmark, the Netherlands and Germany) involved interviews with residents who lived in proximity to wind turbines. The main finding was that "... the number of people actually indicating annoyance by wind turbine noise was fairly small. It appeared that the degree of annoyance was not related to an objective level of sound[5]. "

## South African applicable noise regulating

- National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004).
  Incorporating: SANS 10103 of 2004: "The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication."
  SANS 10103 sets a general limit of 55dB for residential areas during the day with night-time noise levels which should be restricted to 45dB in urban residential areas and 35dB ceiling for night-time rural sound levels.
- Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).



## Conclusion

Wind turbines do make a noise when in operation. However, by applying and insisting on applicable international and local standards such as IEC 61400-11 and SANS 10103, laws and regulations, wind turbine noise can be managed and mitigated.

*(Sources cited: Wind farms and Noise, Australian WEA; Wind Energy The Facts, EWEA, March 2009)*

5 Wolsink, M., Sprengers, M., Keuper, A., Pedersen, T. Holm, Westra, C. A.: Annoyance from wind turbine noise on sixteen sites in three countries, 1994.