Lesson 2: The Problem with Wind Turbine Noise

The EPA allows for wind turbines to be audible in a rural environment, but only up to a certain statistical level as defined by the New Zealand Standard (NZS). The NZS is supposed to protect people from sleep disturbance.

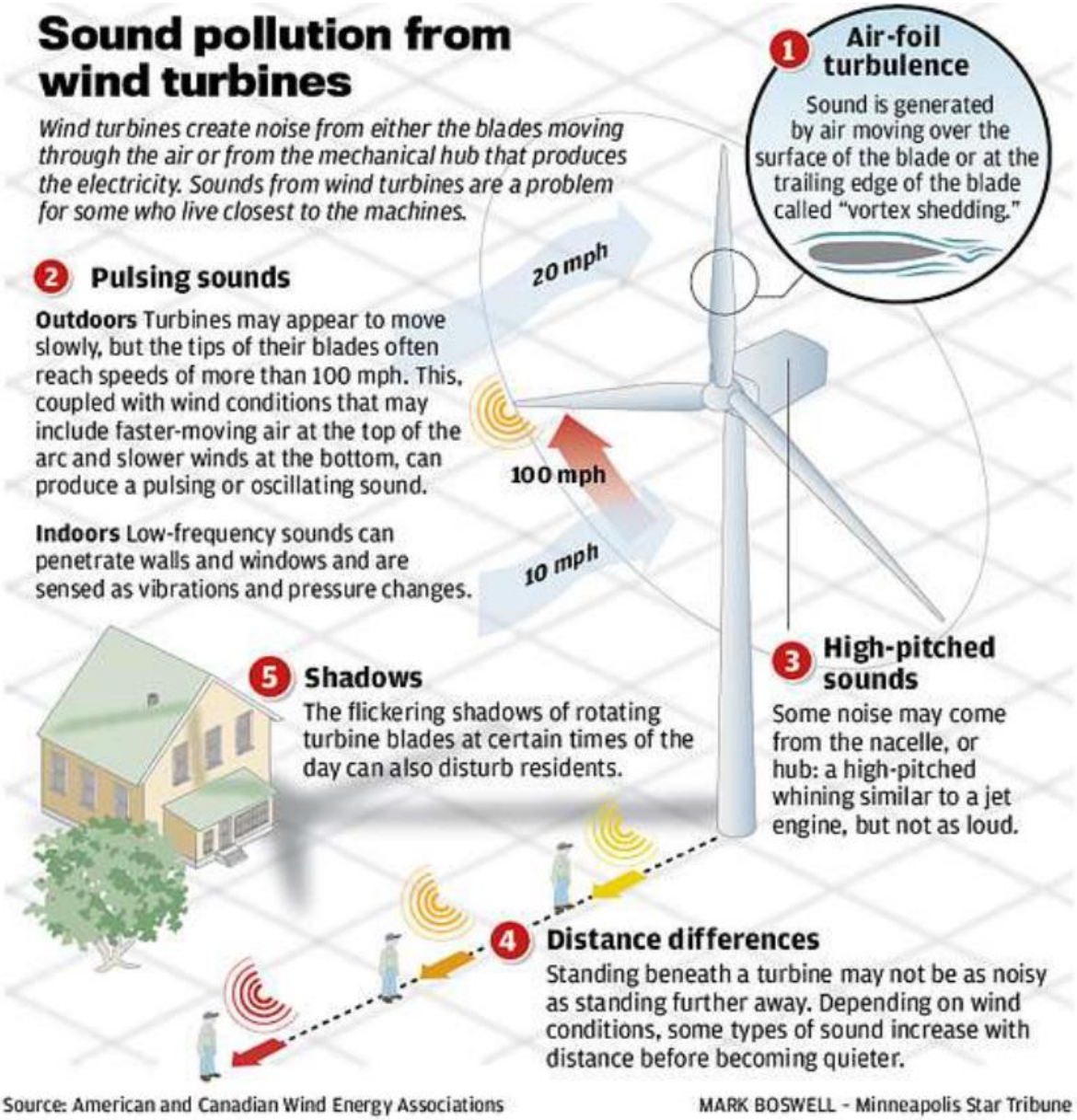
At the time it was written (1990's), the NZS assumed the turbines would be about 60-70 metres in height and many kilometres from houses. It assumed turbine noise would be heard by people as a constant hum, from the distance.

But now turbines are 160 – 280m high and only 1-2 kms away from homes. Turbines are distinctively loud in a rural environment, with annoying and loud special audible characteristics, intermittent noise and debilitating infrasonic pulsations.

Sound pollution

Turbines noise, vibrations and infrasonic pulsations cause turbine sickness and sleep disturbance.

See the figure below illustrating sound pollution from wind turbines



Turbines are alien to a rural environment.

Turbines are distinctively noisy in rural areas, particularly during certain times of the year when the atmospheric conditions increase noise transfer.

The Bald Hills Judge did not consider the wind farm as one of the established uses in the locality.
"The locality is rural, relatively quiet, and remote…. …… The rural activities of stock grazing and farm activities do not cause intrusive noise at night"

The Bald Hills Judgement can be found here

The grinding sounds of the gear boxes adjusting the blade angles, and the screeching of the brakes controlling the blade speed, wake people up at night – And people often can't get back to sleep.

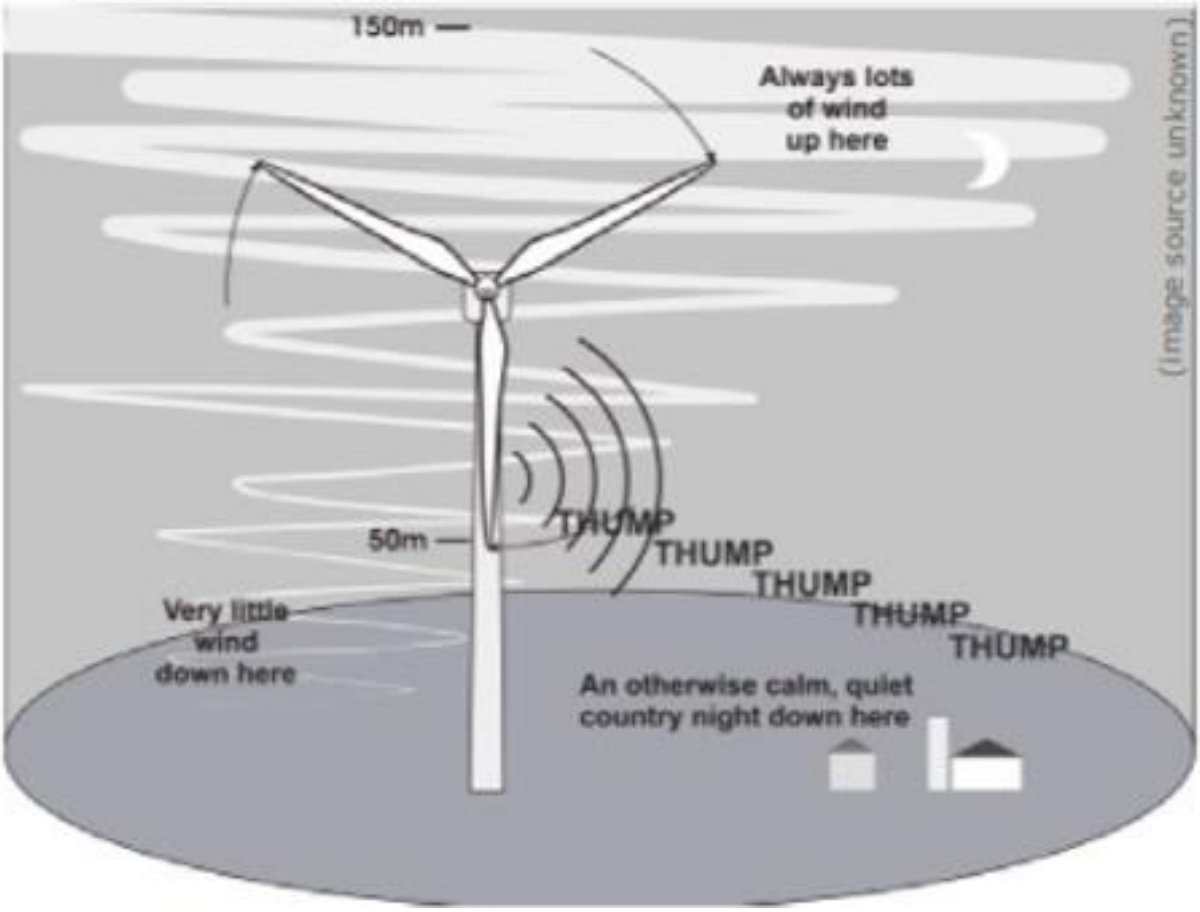
Even when the blades are not moving, the fans in the turbines cooling the hydraulics continue to produce an annoying humming noise.

In some bedrooms the humming resonances is amplified.

Turbines also vibrate in the ground. The long blades leveraged off the towers cause the towers to vibrate and shudder.

These vibrations are transmitted through the ground to the houses, up through the foundations, walls, and floors, into the bedroom and through the pillows.

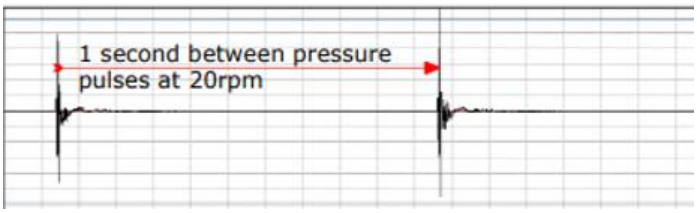
Old houses on stumps are particularly vulnerable to ground vibrations.



Pressure waves – Infrasonic Pulsations

Sounds such as the thump-thump-thump of the blades as they rotate through the downward phase past the tower, cause significant problems.
This is referred to as the *Blade Pass Frequency*.
A short pressure pulse occurs causing a burst of infrasound.

These pressure pulsations appear as tones during analysis.



But people don't hear the tones, instead they feel the *Blade Pass Frequency* pressure changes as pulsations, internal organ vibrations, or as pain. (e.g. body aches, ear ache or migraines).

The Cooper Hypothesis of Sleep Disturbance by Wind Turbines

Cooper explains that during the time delay in which a turbine's technical program works to find the blades most efficient angle to match the changing wind, it produces air turbulence behind and around the blades.

It is this air turbulence from the adjusting blade angles that increases the magnitude of the pulsating waves. These pulsation waves of air occur at a very low rate and activate the brain's sensory receptors, i.e. the signals from the outer hair cells of the inner ear. This is the mechanism of sensing the pulsations rather than hearing the noise.

It has been suggested that the brain becomes confused, the brain thinks it receives noise, but there is no noise – just the pulsations. People are woken in the night – their brain and body tell them there is a noise – but no noise is heard.

A burning turbine demonstrates the air flow/turbulence through the turbine blades.

Noise is directed out behind the turbine like a torch beam.

The blades create a concentrated spiral of air turbulence flow directed downwind of the turbine. This spiralling wave of air occurs along the central axis of the hub (in both a plan view and a cross sectional view), this gives a directional component to the noise.

The video of a burning turbine demonstrates this spiralling pulsating effect.

Source: https://youtu.be/cRVB2i6ZWOU

The torch beam direction is effected by airflow from upwind and downwind of the turbines.

The noise pattern and levels of the pulsations are dramatically effected with changes in wind speed and direction.

The torch beam effect means that specific location downwind of the turbine are impacted by noise.

This explains why people many kilometres downwind of the turbines have problems.

This directional / torch beam effect is why cows are not bothered below the turbines, and why people standing underneath the turbines say they don't hear any sound.

The greatest impact is in the path of the torch beam.

People living between 1.5 – 3 km away from the turbines hear the noise distinctly, because this is where the pulsations create the most noticeable effect.