Renewable Energy Vermont

Lawrence H. Mott

Principle/Founder

New Generation Partners

Development group: Wind/PV/biomass

Chairman of Renewable Energy Vermont (REV) a 501c6
Business trade group: www.revermont.org

Renewable Energy Vermont

Overview for Webinar

- Activities/myths/falsehoods on the ground
- Strategies to inform, respond
- Who needs to know in your region
- How to support them
- Follow –up, professional, scientific

Vermont's response is on multiple levels

REV's Wind Video: available Feb 5: latest topics (health, property, sound, traditional uses,..) 18 minute CD - $20

Presentation Overview

Renewable Energy Vermont

- Wind Power -- Worldwide to Vermont
- Acoustic terminology and sound emanating from turbines
- Discussion of wind turbines and potential health issues
- Review of noise guidelines/limits an d regulatory system
- Conclusions
  - Wind projects have not been demonstrated to cause health effects, other than sleep disturbance under certain conditions.
  - PSB has set noise limits that are protective, and address sleep disturbance issue; informed by standards elsewhere, current research, and current technology
  - PSB process working as designed

Wind Power

Renewable Energy Vermont

- Worldwide
  - There are tens of thousands of wind turbines around the world
    - Many are located near population centers
    - Individual turbines located between tens of meters and miles from residences
    - Turbine designs are mature and improved
- Vermont

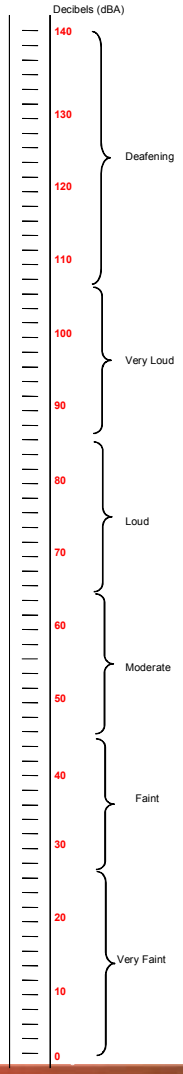
Principles of Sound

- Decibel System
- Frequency Spectrum
- Sound Levels
- Weighting

Sound Pressure Levels

Renewable Energy Vermont

Perception	Occupational Noise Measured at the ear	Everyday Noise	Transportation Noise
			Near a jet engine
Threshold of Pain			
		Hard Rock Band	
	Chainsaw		
	Table saw Circular saw Bandsaw Impact Wrench		Auto horn at 10 feet
	Electric hand drill		
			Snowmobile
		Riding lawn mower, at ear	
			Street Sweeper
		Shop-vac, at ear, outdoors	
			Truck passby, 60 mph at 50 feet
			Inside car, windows open, 65 mph
			Truck passby, 30 mph, at 50 feet
		Vacuum cleaner, at ear	
		Playground recess (avg)	Inside car, windows closed, 65 mph
			Car passby, 30 mph, at 50 feet
Urban Area Conversational Speech		TV in quiet room	
		Microwave oven at 2.5 feet	
			Car passby, 30 mph, at 100 feet
		Field with Insects	Idling car at 50 feet
Suburban area	Office, with computer and HVAC		
		Refrigerator at 3 feet	
		Library	
Quiet rural area, no wind, insects or traffic			
Quiet winter night, wilderness area, no insects, traffic or wind			

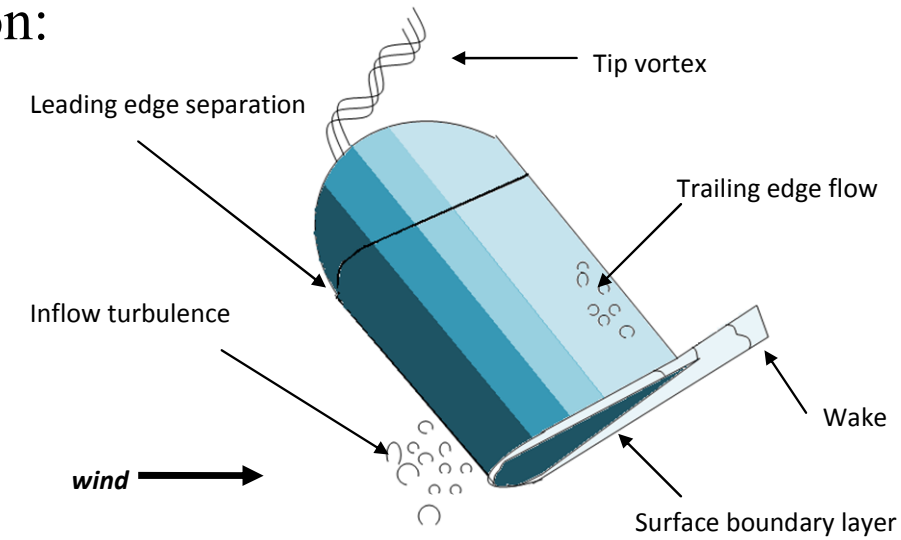


1 Hour Max

Searsburg
Deerfield
Georgia
Sheffield
Wind Farms

Noise generation from wind turbines

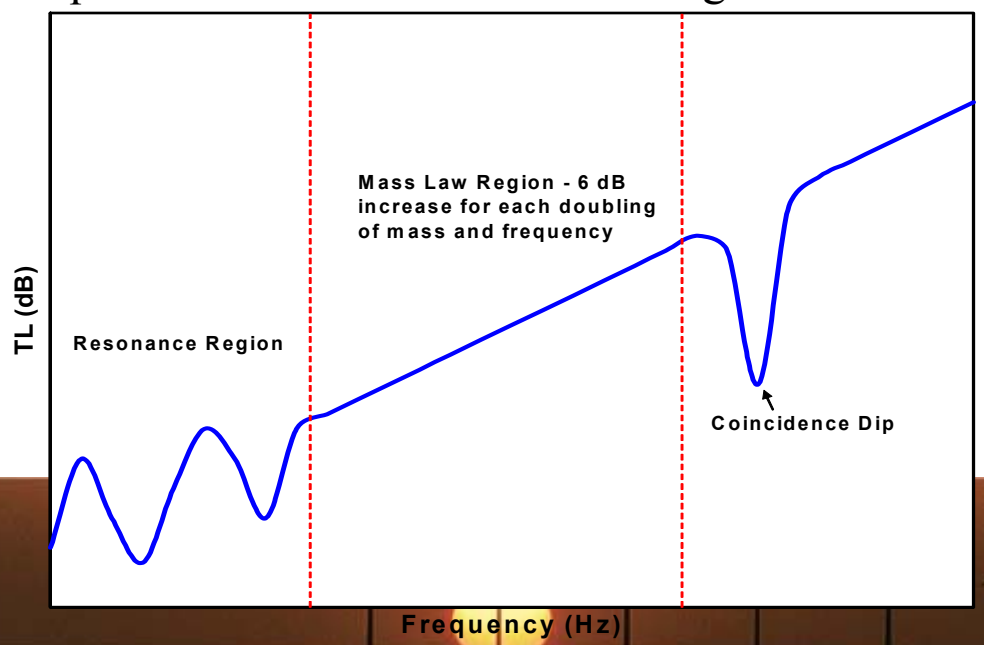
- Modern wind turbines make noise
- Some mechanisms of noise generation:
  - Broadband blade noise
  - Broadband and tonal hub noise
- Manufacturer sound power levels:
  - IEC 61400-11 and -14
  - Include standard deviation above mean
  - Includes broadband and tonality levels



Low frequency noise

- Low frequency noise is generally not a problem with the now standard upwind turbine designs – modulation is not low frequency noise

- Lower frequency sounds from turbines are more noticeable
  - Higher frequencies are absorbed more readily by the atmosphere
  - Lower frequencies tend to bend more towards the ground during inversions
  - Lower frequencies are attenuated less through structures



Typical transmission loss through a wall or partition by frequency

Low frequency turbine noise and potential impacts

Renewable Energy Vermont

- Low frequency noise was a problem with older downwind turbine designs
- Modern turbines (upwind design) have much lower levels of low frequency noise
- Modern turbines do not generate audible levels of infrasound.
- Modern turbines do not generate the level of low frequency noise that create health impacts

References: Leventhall, DTI, DEFRA

Potential Health Effects from Wind Turbines

Renewable Energy Vermont

- Wind turbine noise is no different from other noise sources; in that health effects may be found at high levels.
- Dose/Response studies done with large populations around wind farms have found no attributable health impacts below 45 dBA
- Searsburg -- has been operating 12 years, with turbines as loud and more densely spaced as modern turbines. No reported health impacts.
- Turbines can cause annoyance to a minority of those exposed below 45 dBA. Annoyance is related to, among other things, attitude.

Health Effect Claims

Renewable Energy Vermont

- "Vibro-acoustic" issues
  - Results from very high levels of low frequency sound
  - Not demonstrated to result from a wind farm
- "Wind Turbine Syndrome" – Pierpont's work
  - Based on a case-series study of phone interviews with 10 self-reported households
  - No dose/response relationship determined
  - No cause/effect determined due to nature of study
  - No controlled study yet conducted
  - Impacts to residents are reported similar to those from annoyance
- Infrasound
  - Level of infrasound generated by properly operated modern wind farms is well below demonstrated human health thresholds

Experience close to home

Renewable Energy Vermont

- Searsburg
  - 12+ years in operation
  - Turbines louder than new models and more densely spaced (250 ft between turbines as opposed to 700 to 1000 feet today)
  - Approx. 3,500 feet to nearest home (2/3 of a mile)
  - No reported health complaints
- Lempster, NH
  - One year of operation with modern turbines
  - 1,500 feet to nearest non-participating residence
  - No reported health complaints

World Health Organization Guidelines

Renewable Energy Vermont

- WHO has established noise guidelines to protect human health (1999, 2009)
  - The 2009 guidelines do not override those of 1999, just elaborate and expand on them.
  - Outside the bedroom window 45 dBA averaged over the night and 40 dBA averaged over the year at night. Inside the bedroom 30 dBA averaged over the night.
  - Guidelines relate to sleep disturbance and the subsequent possible effects.
  - WHO assumes a partially open window, and guidelines reflect this.

Regulatory System in VT

Renewable Energy Vermont

- Public Service Board (PSB) required by statute to determine that a project will not have an undue adverse effect on public health and safety, and that a project "promotes the public good."
- PSB has issued limits in two large wind projects, and one case Is ongoing – 45 ext/30 int (1 hr leq)
- PSB has essentially adopted the WHO guidelines, but is <u>more</u> strict – 1 hour Leq rather than 8 hour average (Lnight,outside) or annual average.
- PSB has experience with noise issues in other types of cases, e.g., substations.

Existing Regulations, Cont.

Renewable Energy Vermont

- PSB is in the appropriate position to evaluate noise limits on a going-forward basis in each new case, to the extent that any new valid science establishes the need to be more protective.

- Noise Limits are currently and properly focused at the receivers, not at arbitrary setbacks.
  - Sound levels are affected by topography, vegetation, climatic condition, and equipment used.
  - Turbine technology and operation will evolve, as will health related science. Setback won't take this into account.