

Literature Review: Assessment of Wind Energy Impacts

Summary to the Reno County Planning Commission

Nick Baldetti, DBAc, MBA, MS
Director / Health Officer

April 4, 2019



Background

- Extensive review of body of literature with regard to health outcomes
- Peer-reviewed science based literature and world recognized research institutes and regulatory bodies
- Topics Examined
 - Visual Impact, Annoyance, Noise (Infrasound), Air Pollution, Economic Effect (Health)

Visual Impact

- Shadow Flicker (SF) – *Alternating levels of light intensity produced by rotating turbine blades*
 - Insufficient evidence to suggest wind turbine SF cause adverse health impacts
 - Evidence suggest very few individuals report annoyance with SF
- Visual placement of wind turbines (WT) alter natural landscape
 - Evidence suggest physical placement of WT will lead to increased levels of annoyance*

Noise

- Wind Turbine Noise (WTN)
 - Perception of sound noise is a subjective response influenced by factors related to the noise, the person, and the social/environmental setting
 - Results in considerable variability, per person, regarding perception and response to noise
 - Some evidence to suggest WTN may be more noticeable, annoying and disturbing than other industrial noise at same levels
 - W.H.O. (2018) suggest conditional levels not to exceed annual daily average of 45 dB L_{den}
 - European studies show increase annoyance at 35-40 dB

Noise

- Wind Turbine Noise (WTN)
 - No authoritative evidence that sound from wind turbines represent a risk to human health among neighboring residents (Thorne et al., 2019)
 - Noise annoyance is the main effect associated with the exposure to sound from an operational wind turbine (Kamp & Van den Berg, 2018)
 - Vibroacoustic disease and Wind Turbine Syndrome are controversial and scientifically not supported (Kamp & Van den Berg, 2018)

Noise

- Wind Turbine Noise (WTN)
 - Dose-response evidence of a positive correlation between audible WTN and annoyance has been granted sufficient legitimacy in the literature (Taylor & Klenk, 2019)
 - ...there was no association between exposure to WTN and the self-reported of objectively measured health points examined (Michaud et al., 2018)
- Conclusion
 - Annoyance is a certainty as a result of WTN, no scientifically proven human health impacts as a result of WTN

Infrasound (IS)

- There is no evidence of a specific effect of the low-frequency component or infrasound... .. Infrasound and low-frequency sound from wind turbines have been suggested to pose unique health hazards. There is little scientific evidence to support this [statement]. (Kamp & Van den Berg, 2018)
- A direct link between infrasound and adverse physiological effects is found to face several trials - ... - none of which have successfully been overcome (Taylor & Klenk, 2019)

Infrasound (IS)

- Berger et al. 2015 measured IS at 450m and 900m from receptors and found that “Indoor IS component of WTN at distances of 450m and 900m, was well below the levels of human perception, providing support to previous literature... ..there is no scientific evidence to indicate that exposure at the g-weighted levels of IS can directly impact human health.”
- Conclusion
 - No scientific evidence/consensus that inaudible low frequency sound vibrations adversely impact human health outcomes
 - Berger et al paper suggests a 450 m or greater threshold from receptor

Air Pollution

- Wind energy facilities do not generate air emissions (USPA, 2010; USEPA, 2010)
- Any net positive is contingent upon wind energy displacing coal-fired sources of energy
- Conclusion
 - Wind energy facilities could indirectly lead to positive health outcomes, addressing general carbon emissions

Economic Impact

- Wind energy facilities increase personal income for participating property owners and subsequent job creation (Krumenauer et al., 2011) and increased tax revenue local government through property taxes and other fees (NRC, 2007; RNP, 2011)
- Socioeconomic status is known to be a strong predictor of life expectancy and overall health
- Conclusion
 - Wind energy development could indirectly result in positive health impacts
 - Contingent upon impact on income inequality, or uneven distribution of costs/benefits

Annoyance

- Annoyance – key negative health outcome identified
- Annoyance -> Stress -> Sleep disturbance -> Health outcomes
- Only scientifically confirmed outcome as a result of wind energy development

Annoyance

- ...only causal link that can be identified is that wind turbines may pose annoyance to some who live near them (Thorne et al., 2019)
- Sleep disturbance as well as other health effects in the vicinity of wind turbines was found to be related to annoyance, rather than directly to exposure (Kamp & Van Den Berg, 2018)
- Noise annoyance is the main health effect associated with the exposure to sound from an operation wind turbine (Kamp & Van Den Berg, 2018)

Annoyance

- ... study did demonstrate a relationship between increasing levels of WTN and annoyance toward several feature (noise, perceived indoor vibration, visual impacts, shadow flicker, and aeronautical lighting) associated with wind turbines (Michaud et al., 2018)
- WHO (2018) community noise guidelines list annoyance as one of the adverse health effects of community noise exposure.

Annoyance

- ... sound-level drivers (modeled and background) are poor predictors of very annoyed responses; one's prior support or opposition to a local project is the strongest predictor of very annoyed responses in the regression model (Hoen et al., 2018)

Annoyance

- Conclusion

- Evidence suggests that it is highly probably that a percentage of the existing population for which a wind energy project is developed will register annoyance with a smaller percentage registering as very annoyed or chronically annoyed
 - Studies around sound levels have suggested thresholds between 37-45 dB average before annoyance levels significantly increase (Pederson, 2009, 2011; Bakker et al., 2012; WHO, 2018)
 - No specific setback is offered in the literature in response to annoyance only (*)
 - Hoen et al. (2018) show a statistically significant difference in attitude toward local wind energy between the <1/2 mile (n = 609) and 1/2 -1 mile (n=296) national survey

Impacts [Nature of impact/size/likelihood]

- Visual impact – subjective / (small)large / definite
- Noise – subjective / small-medium / probable
 - Infrasound – inconclusive / inconclusive / speculative
- Air pollution – positive / large / speculative
- Economic effect – neutral / positive / speculative