ADDRESSING NOISE CONCERNS FROM ENERGY STORAGE PROJECTS

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The Basics of Acoustics

Sound Pressure Level

Sound creates air pressure variations measured in decibels (dB).

The decibel scale is a logarithmic scale where 0 dB is the threshold of human hearing, while the threshold of pain is 120-140 dB.

Sound pressure levels are added logarithmically (for example 50 dB plus 50dB is equal to 53 dB).

Common sources of sound	Decibel Range (dBA)
Car horn at 3 ft Shouting or barking in the ear	100-110
Gas lawn mower at 3 ft Diesel truck at 150 ft Motorcycle engine running	90-100
Busy highway at 50 ft Washing machine, TV, Radio	70-80
Loud urban area	65-75
Commercial area Normal conversation	55-65
Quiet urban area	45-55
Quiet rural area Library indoors	35-45
Recording studio indoors	10-20
Threshold of human hearing	0-10

Frequency

Frequency is a measure of the cycles per second of a sound wave. To many, this is known as pitch and is measured in Hertz (Hz).

Relative Frequencies of Sound Waves and Examples:

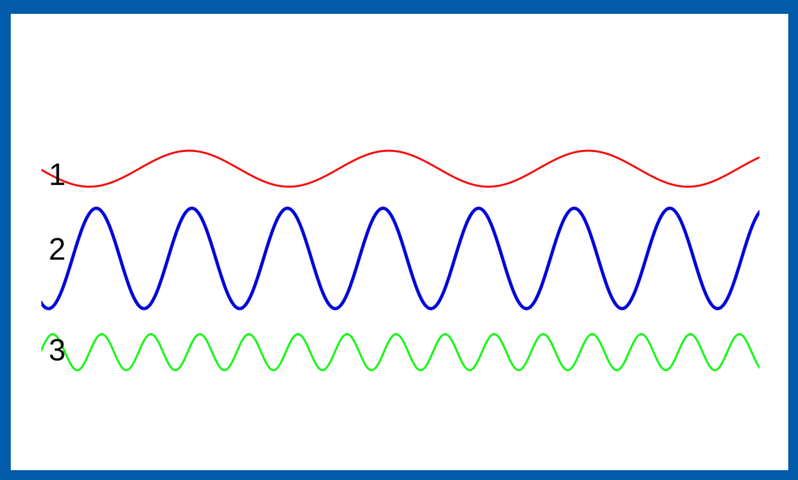
1: Low frequency such as ocean waves or thunder

2: Mid frequency such as a dog bark

3: High frequency such as a truck reverse beeper

The audible range of the healthy human ear spans from 20 to 20,000 Hz. Since the human ear does not perceive every frequency with equal loudness, spectrally varying sounds are often adjusted with a weighting filter.

The A-weighting filter is applied to closely approximate the human ear's response to sound. Most sensitive at mid-high frequencies. This scale is commonly used in environmental and industrial sound assessments. Sound expressed in the A-weighted scale is denoted dBA.



How We Perform Noise Assessments

Using the following methods, an assessment of the sound contribution of an energy storage project prior to construction can be conducted and compared to sound regulations.

Sound Modeling

- Using manufacturer data or measured data as inputs into a model, sound levels of noise generating energy storage equipment for a specific project layout can be determined.
- Sound sources for energy storage equipment include HVAC equipment on the battery enclosures, inverters/transformers in Power Conversion Systems and main power transformers.
- DNV uses commercial sound modeling software to predict sound levels at nearby property lines or homes using ISO9613-2 propagation calculation methods.

Example sound propagation map showing potentially impacted Points of Reception (PORs)

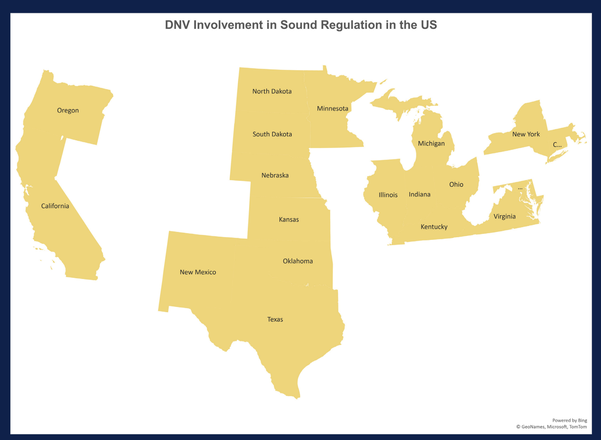
Sound Measurement

- Sound measurement using Class 1 equipment can quantify the existing sound environment and, using results from modeling, can determine the possible impact that an energy storage project might have on nearby residents.
- This can help with community consultation efforts by quantifying the expected increase in sound level relative to the existing sound environment the residents are used to.
- Measurements can also be conducted post-construction to verify the modeling and to more accurately monitor the acoustic impact on the nearby community.

Why Noise Should be Considered for Energy Storage Projects

As energy storage grows, more projects will be sited in urban settings, in proximity to homes and residential neighborhoods where potential noise impacts are possible.

Sound from energy storage equipment including battery enclosures, inverters and transformers have the potential to alter the sound environment that nearby residents have become accustomed to. Sound regulations exist in some areas, with decibel level limits at project property lines or receiving property lines. Acoustic analysis and assessment are required in these situations to determine if the project will meet the regulatory limits.



Dan Coogan

Jan Hornbein, City of Mill Creek, WA

Sound Mitigation Design

- If sound modeling results exceed regulations, mitigation methods can be included within the modeling to achieve compliance.
- Sound mitigation methods can be designed specifically for an energy storage project, such as changing the equipment configuration, designing a sound wall, and installing absorptive acoustic panels, equipment silencers or acoustic louvres.

Best Management Practice - Proactive Acoustic Assessment

With proactive approaches to energy storage acoustics such as preconstruction modeling and mitigation design, projects are significantly more likely to:

- Gain approval during the permitting process by complying with regulations prior to construction.
- Achieve transparency by communicating expected sound levels to regulators and the community before the project is built.
- Provide evidence of good faith effort from developers to prioritize good-neighbor practices.
- Promote the coexistence of energy storage projects and urban environments located in close proximity.

For further information, please contact DNV.