**Aeroacoustics**

The vision of the aeroacoustic thrust area is to bring clarity through new science, technology, education, to help industry answer critical questions, address public concerns about wind turbine noise, provide additional physics-based data that are required for regulators to establish sound policy, and enable development practical noise reduction methods and technology.

**Thrust Area Objectives**

* *Better understanding of the fundamental mechanisms of wind plant noise generation, propagation, and reception through scientific research*
* *Dissemination of research and best practices into public documentation that will benefit industry and communities alike*

**Primary Goals**

**Goal #1: Scientific basis for long-term advances in wind-plant noise prediction and reduction**

The goal is to provide a better physical understanding of the noise generation and propagation mechanisms that dictate wind plant noise, including turbine source noise, wind turbine interactions and far field propagation in a variety of environments. It will also include recommendations for industry on how to design turbines at lower noise levels, relative to the A2e baseline turbine and current SOA in wind plant modeling.

**Goal #2: Standardized metrics and regulatory models for wind plant noise**

This goal encompasses a better understanding of the characteristics of wind plant noise that are annoying to residents. This will enable the definition of metrics suitable for quantifying noise reduction and also guiding local regulations. The goal will include development of best practices for noise measurement and simulations that can be used to standardize the compliance process. By better defining noise metrics and the regulatory tools required to predict that they are met, wind farms and turbine technology will be able to be operated to lower noise level margins .

**Goal #3: Public information warehouse**

The goal is to provide an easily accessible and reliable summary of the latest the latest technical advances in noise modeling, observation, and mitigation and science concerning the impact of wind plant noise on people produced both prior to and by this thrust area for a range of stakeholders.

**Work Packages**

**Work Package #1: Community / human factor/ dose-response studies**

This work package is focused on gaining a better understanding of the human and community impacts of wind plant noise including what makes this noise source unique relative to other industrial noise sources. Once understanding is improved, new noise metrics will be developed that accurately reflect the annoyance of wind plant noise to inform improved regulations. The package also includes development of best practice guidelines for measurement and simulation of wind plant noise.

**Work Package #2: Plant Level Noise and Propagation**

This work package encompasses experimental observations and simulation tool development of noise focused at the plant level. Much of this will involve better understanding of turbine noise interactions with the atmosphere, other turbines, local terrain, vegetation and residential structures. The package will also involve examination of wind plant operational strategies that may reduce noise.

**Work Package #3: Turbine Level Noise and Control**

This work package involves experimental observations and simulation tool development at the turbine level including turbine components. The work package will look at the fundamental understanding of noise generation and also explore possible noise mitigation technologies for the wind turbine design.

**Work Package #4: Public Dissemination**

This work package involves the creation of a public information warehouse that will be used to summarize and distribute previous and ongoing research in the area wind plant noise. The work package will be dependent on output from other packages, though not exclusively and should commence immediately.

**Integration with Other Thrust Areas**

**High Fidelity Modeling**

* High Fidelity models that are validated and open source and provide insight into the interaction of the atmospheric boundary layer with an entire wind farm and/or a complete turbine including unsteady wind-farm/weather/terrain specific inflow and noise mitigation technologies

**Experimental Measurement Campaigns**

* Extended field measurement campaign that comprehensively describes the noise generated by individual turbines at different scales and full wind farms including meteorology, terrain and wake effects.
* Detailed aerodynamic and acoustic definition of the properties of a family of open, representative blade airfoils and potential noise mitigation technologies.
* Design, manufacturing and validation of low noise rotor technologies by instrumented full turbine measurement campaign.

**Integrated Wind Plant Control**

* Definition of low noise operation strategies for both individual turbines and wind farms based instantaneous meteorological, terrain and wake effects.

**Data Archive and Portal**

* Development and dissemination of open databases for model validation
* A continuously updated website with summaries of the latest scientific social and technological studies, both inside and outside of DOE funding
* Links to A2e software development websites and experimental data

**Integrated Wind Plant Design and Analysis**

* Development and validation of open source engineering models for wind plant noise that describes the noise generated by individual turbines and a farm
* Comparison of measurements and model with simple engineering models … elaborate best practices for using simple engineering models to predict future wind farm noise footprints.

**Financial Risk, Uncertainty, and Portfolio Analysis**

* Estimate current delayed or prevented wind plant construction and curtailment due to noise. Estimate noise curtailment effect on LCOE.

**Wind Plant Reliability**

* Minimal interaction with this thrust area, except for possible acoustic technology used for condition monitoring.