Wind Energy Programs

Applying research and advanced technologies to improve wind turbine performance and lower the cost of wind energy.

For more than 40 years, Sandia National Laboratories has applied its research to develop innovative carbon-offsetting technologies, solve wind industry challenges, and reduce the cost of wind energy. Sandia also partners with the U.S. Department of Energy (DOE) and other government agencies, industry, academia, and other national laboratories to increase the viability of wind energy technology. Sandia’s science and engineering capabilities support U.S. progress toward a cleaner, safer, and more secure energy economy.

Rotor Innovation

Advanced rotor concepts—from aerodynamics to instrumentation—offer great potential for further improving wind plant performance and reducing energy costs. Sandia leads research and development on next-generation rotors. Wind engineers are developing open-source design codes, evaluating new materials and manufacturing methods, testing load and aerodynamic measurement and control concepts, and creating new rotor designs.

SWiFT

Sandia’s Scaled Wind Farm Technology (SWiFT) Facility at Texas Tech University in Lubbock, Texas, is the principal research site for investigating wind turbine wakes as part of the DOE A2e initiative. SWiFT enables Sandia and its academic and industry partners to study turbine-to-turbine interaction and test new technologies. The facility features three variable-speed, variable-pitch modified wind turbines; two heavily instrumented inflow anemometer towers; and site-wide, time-synchronized data collection.

Wind Plant Performance

In large wind farms, turbines “shadow” one another, creating wakes that reduce turbine output and increase fatigue issues that impact longevity and reliability. To address this problem, Sandia plays a key role in the DOE Atmosphere to Electrons (A2e) initiative, which strives to ensure that wind farms are sited, built, and operated to produce the most cost-effective and usable electric power. As part of the A2e initiative, Sandia uses advanced simulation and wake imaging techniques to develop a deeper understanding of wind plant wakes and reduce turbine-to-turbine interaction.
Predicting Wind Plant Performance to Reduce Uncertainty
Sandia develops tools to help wind plant operators and planners more accurately predict the plant’s power production and understand potentially damaging blade loading scenarios. Sandia applies high fidelity modeling capabilities and uncertainty quantification techniques, originally developed for weapons research, to reduce uncertainties in wind plant operations. In particular, the Nalu computational fluid dynamics code is emerging as a basis for a next-generation wind plant flow modeling capability that will be exercised on the nation’s largest supercomputers. Under development in collaboration with other national laboratories and validated by experiments at SWIFT and other facilities, this capability will enable operators and developers to predict blade health, power production, and plant costs more accurately, thereby reducing the overall cost of wind energy.

Open-Source Codes
Sandia develops and maintains open-source tools that simplify the rotor design process.
- **NuMAD** (Numerical Manufacturing and Design), an open-source blade design tool
- **CACTUS** (Code for Axial and Cross-flow Turbine Simulation), an open-source design and simulation tool for cross-flow and axial-flow wind turbines.

Wind Plant Reliability
Unplanned maintenance and component failures are a concern to both wind plant owners and wind turbine manufacturers. Sandia leads efforts in wind turbine reliability research, specifically focusing on:
- Wind plant reliability & analysis
- Nondestructive inspection
- Effects of blade defects
- Composite materials research
- Structural health monitoring

Work with Us
Because the future of U.S. renewable energy relies on industry success, Sandia National Laboratories supports the wind industry through applied research and innovation. To learn more about partnering with Sandia’s wind energy programs, please contact the Wind Energy Technologies Department.

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