Energizing the Wind Industry

Increased complexities require a system-level approach in designing and evaluating wind turbines.

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Wind energy projects around the globe — from small installations to very large wind farms — have a common goal: to reduce unit energy cost while improving reliability. From a business perspective, technology contributes to viability by influencing efficient wind turbine design, manufacture, deployment and operation. Whether the application is an onshore, offshore or far-shore installation, advancements in science and engineering will contribute to the industry's success, especially through capabilities related to aerodynamic design, material science, structural design, electronic mechanical control, site selection and farm layout.

Wind turbines and wind energy projects are becoming increasingly more complex, so they must operate dependably at levels unimaginable a few years ago. Installations of very large wind turbines in offshore and floating configurations are a major technological achievement. Energy companies hope to design, install, and efficiently and reliably operate superstructures whose wind blade spans are over 50 meters and subject to wave and wind loading at different angles of attack.

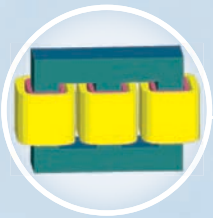
Historically, wind energy companies have used engineering simulation software as a point solution, used only to simulate a specific design aspect or analyze a component. Successful application of ANSYS solutions ranges across the wind energy industry, including:

- **Aerodynamic design**: thrust coefficient, blade structural integrity, ultimate loads and fatigue, noise predication, wind gust fluid–structure interaction, bird strike, icing, boundary layer transition, near-wake and far-field studies
- **Structural design**: tower and rotor structural integrity/safety, power conversion efficiency, installation cost and maintenance, offshore transport and installation
- **Component design**: blades, gearboxes and bearings, generators, nacelles, rotors, drivers, motors, electronics cooling
- **Site selection and farm layout**: maximum project potential, power output (both peak and average), wind loads, fatigue
- **Turbine placement**: variable terrain, roughness, forestry, multiple wake effects, buildings and setbacks
- **Electromechanical system**: electrical machines, variable-speed control systems, transformers, power electronics, power distribution, sensor and actuator design
- **Blade manufacturing**

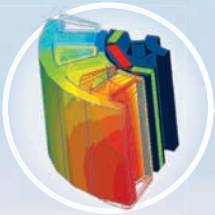
Today's increased complexities require a system-level approach in designing wind turbines and evaluating performance based on real-world conditions. Advances in engineering simulation software increasingly make this possible: For example, the ANSYS Workbench environment is designed with capabilities that enable modeling entire wind turbine systems. Its value is further enhanced through advanced solver functionality including turbulence transition models, advanced contact models, multiphysics capabilities, composites tools, high-performance computing and the flexibility to connect to third-party software for wind turbine blade manufacturing or aero-elasticity calculations.

Engineers can perform electromechanical system-level analysis using Simplorer software, electromagnetic analysis on electric machines and drives with Maxwell, wind power analysis via ANSYS CFD, and stress and modal analysis using ANSYS Mechanical. By leveraging high-level integration and advanced capabilities,

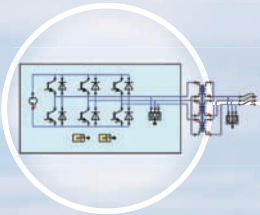
Speed sensor design



Transformer design



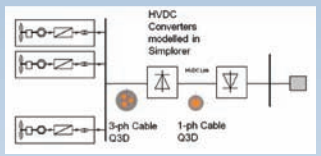
Electric machine analysis



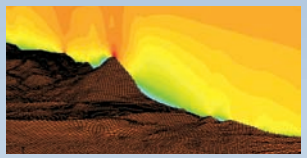
Power electronics design

Generator and shaft design

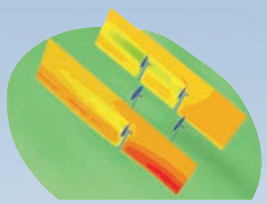
Wind Farm and Power Distribution



Power distribution analysis



Site selection, land and sea



Wind farm configuration for optimal power generation

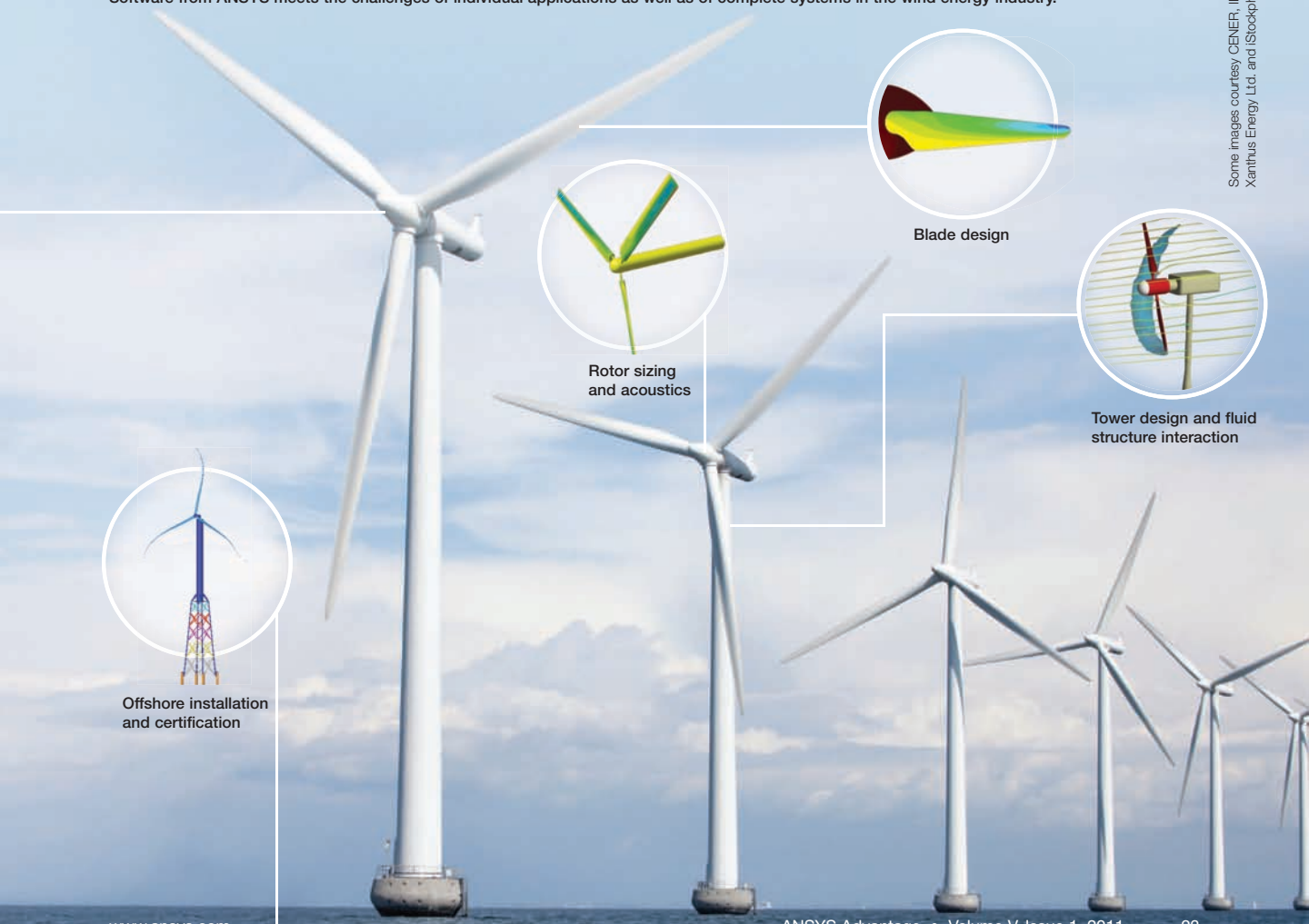
Design of floating offshore wind turbine

engineers over time are extending their once-simplified simulations to include additional details in overall wind turbine design — enabling small efficiency gains, important in an industry in which a minute efficiency/performance gain can translate into much larger electricity production, reduced downtime and greater project profitability. Such details can also improve reliability and enable better wind energy project operation.

Already, there are many exciting examples of the expanding use of engineering simulation throughout the wind energy supply chain. Three separate wind energy applications are presented in this issue of *ANSYS Advantage* — and each highlights the breadth of ANSYS solutions. Without simulation capabilities, the projects presented may not have been as successful.

With increased demand for wind energy, engineers will face additional complexities, such as even-larger turbine blades that will be installed farther offshore and in harsher environments. Wind farm site selection must continue to reduce risk and overcome proximity and environmental concerns. New powertrains, lighter towers, multi-access turbines, floating platforms and quieter machines will be developed. The industry will innovate to meet the challenges of increased safety and reliability, improved remote monitoring, reduced system maintenance and regulatory concerns. ANSYS is keeping pace by providing high-fidelity integrated, advanced capabilities that meet single-physics needs as well as system-level and multi-disciplinary requirements of the wind energy industry.

Software from ANSYS meets the challenges of individual applications as well as of complete systems in the wind energy industry.



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