Quick Facts

According to a report from the U.S. Department of Energy (DOE), the United States could feasibly build 54 gigawatts of offshore wind power capacity by 2030.

With DOE's support, NREL has developed and maintains a robust, open-source, and modular computer-aided engineering tool, known as FAST.

FAST is the result of more than two decades of work by NREL and its collaborators. It has become an industry standard for wind turbine analysis and development.

The FAST tool has state-of-the-art capabilities for full dynamic system simulation of a range of offshore wind configurations.

FAST was recently expanded to enable the modeling of multi-member, fixed-bottom offshore systems. For example, FAST can model "jackets," which are typically four-legged, open-lattice trusses consisting of welded steel tubing, with piles driven through each leg into the seabed.

FAST is used by thousands of users, including all major U.S.-based (and many international) wind turbine and offshore support structure designers, manufacturers, consultants, and researchers.

As a federal laboratory, NREL develops and supports free, open-source, computer-aided-engineering tools for wind turbines.

NREL Software Aids Offshore Wind Turbine Designs

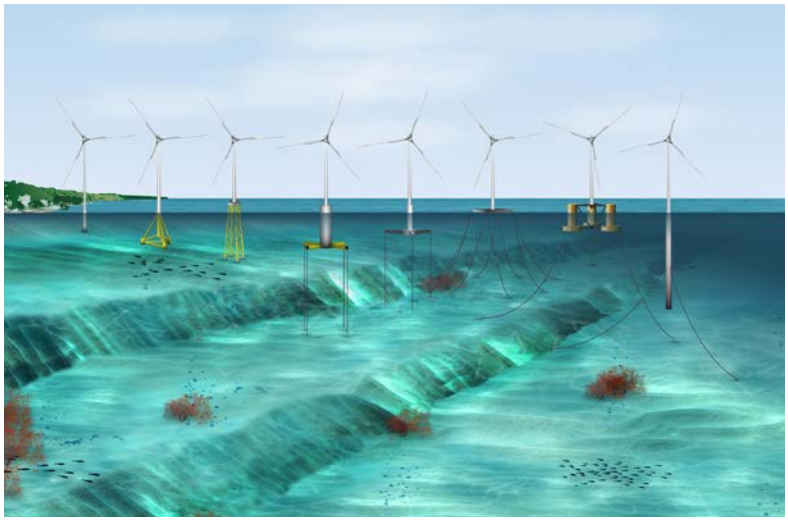
For the United States to tap into its vast offshore wind energy resources, wind turbines must be developed that are cost-effective. Designing such wind turbines requires complex computer models. Researchers at the National Renewable Energy Laboratory (NREL) are supporting offshore development with computer models that allow detailed analyses of both fixed and floating offshore wind turbines.

Offshore wind projects face many new design challenges not faced by land-based wind turbines. Land-based wind turbines are designed and analyzed using computer-aided engineering (CAE) modeling tools, capable of predicting a design's dynamic response to wind conditions and calculating the extreme and fatigue loads the system will encounter. CAE modeling tools incorporate models for wind inflow, aerodynamics, control-system behaviors, and structural-dynamic effects, and the models are then used to simulate the conditions and stresses that a wind turbine experiences over its lifetime.

Offshore turbines require the additional considerations of variations in water depth, soil type, and wind and wave severity, which also necessitate the use of a variety of support-structure types. NREL's core wind CAE tool, FAST, is capable of modeling both land-based and offshore wind systems; FAST's offshore models include the additional effects of incident waves, sea currents, and the foundation dynamics of the structure.

While floating offshore wind functionality was previously added to FAST, recent efforts have expanded the capabilities of FAST to enable the modeling of multi-member, fixed-bottom, offshore systems. These types of offshore wind structures are being built in what is called the "transition" region of water depth—between 30 and 60 meters. With this addition, NREL is able to model the full range of proposed offshore wind systems.

FAST helps quantify and analyze the coupled architecture, providing designers with a tool to analyze the most cost-effective design. The tool is now being applied to many promising offshore wind turbine concepts and designs.



NREL's software for turbine modeling is able to analyze the full range of proposed offshore wind turbine options, as shown here.

Illustration by Josh Bauer, NREL

National Renewable Energy Laboratory
15013 Denver West Parkway, Golden, CO 80401
303-275-3000 • www.nrel.gov

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

NREL/FS-6A42-60377 • October 2013