U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Wind Program Newsletter

October 2012 Edition

wind.energy.gov

Where Are We Now: The U.S. Department of Energy Makes Strides to Advance Offshore Wind in the United States

In 2011, the U.S. Department of Energy (DOE) Wind Program, in coordination with the Department of the Interior's Bureau of Ocean Energy Management, released the National Offshore Wind Strategy, which lays out a detailed plan to support responsible deployment of offshore wind energy facilities in U.S. coastal waters and helps to shape the federal government's role in this effort. The Strategy identifies three key areas of activity in order to reach offshore wind deployment scenarios of 10 gigawatts (GW) by 2020 and 54 GW by 2030:

- Develop innovative technologies that lower the cost of energy of offshore wind plant systems
- Remove market barriers to facilitate deployment and reduce technical challenges

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AWEA Offshore WINDPOWER

Presentations by DOE Wind Program and Program-Funded Projects

Virginia Beach, Virginia
October 9–11, 2012
offshorewindexpo.org
Agenda subject to change.

WEDNESDAY Oct. 10

State of the Art Resource Characterization—10:30 a.m.–12:00 p.m.

Dr. Bruce Bailey, President and CEO, AWS Truepower LLC
Evolving Standards and Industry-Accepted Application of Measurements and Modeling Results

DOE Studies Part I: Planning for Market-Scale Deployment—10:30 a.m.–12:00 p.m.

Session Chair/Moderator: Fara Courtney, Executive Director, U.S. Offshore Wind Collaborative
Cash Fitzpatrick, Energy R&D Engineer, Department of Energy
Eric Lantz, Energy Analyst, National Renewable Energy Laboratory (NREL)
Nick Baldock, Garrad Hassan
Benjamin Maples, Engineer, NREL

DOE Studies Part II: Deeper Dive: Manufacturing, Ports and Vessels—1:30 p.m.–2:30 p.m.

Session Chair/Moderator: **Jose Zayas**, Program Manager, Wind and Water Power Program, U.S. Department of Energy
Steve Kopits, Managing Director, Douglas-Westwood LLC
Dr. Christopher Elkinton, Ph.D., **Garrad Hassan**
Bruce Hamilton, Director, Navigant Consulting

Protecting Offshore Wildlife—1:30 p.m.–2:30 p.m.

Dr. Andrea Copping, Senior Program Manager, Pacific Northwest National Laboratory
Keeping Right Whales Safe While Establishing a Sustainable Offshore Wind Industry

Kathryn Williams, Wildlife and Renewable Energy Program Director, Biodiversity Research Institute
Environmental Risk Reduction: A New Study to Understand Wildlife Densities and Movements Across Temporal and Spatial Scales on the Mid-Atlantic Continental Shelf

Achieving a Sustainable Industry: Cost Reduction and Design Improvements—2:45 p.m.–4:15 p.m.

Dr. Dale Karr, Associate Professor, University of Michigan
Bottom Fixed Platform Dynamics Models Assessing Surface Ice Interaction for Transitional Depth Structures in the Great Lakes

Walt Musial, Offshore Wind Research Manager, National Renewable Energy Laboratory
Setting the Right Standards for Long-term Production

THURSDAY Oct. 11

Understanding and Engaging Utilities—8:30 a.m.–10:00 a.m.

Mary Doswell, Senior Vice President – Alternative Energy Solutions, Dominion Resources Services, Inc.

Smart Leasing and Efficient Permitting on the Outer Continental Shelf—10:30 a.m.–12:00 p.m.

Michael Ernst, Director, Regulatory Affairs, TetraTech
Evaluation of Best Federal and State Policies to Overcome Major Barriers to Development of U.S. Offshore Wind Industry

YOU DECIDE—Advances in Technology—10:30 a.m.–12:00 p.m.

Bonnie Ram, RAM Power (AWEA Offshore R&D Subcommittee Chair)
Dr. Christopher Hart, OPTIMUM Offshore Wind Energy Systems, LLC.

In this interactive session, attendees will hear short pitches from 10–15 presenters and then will vote on which presentation they want to hear more about. Those with the most votes will present in greater detail about their work and take questions from the audience. Topics could include: the DOE FOAs on drivetrains, next-generation turbines, floating platforms, or projects being funded by DOI.

Where Are We Now
continued from page 1

- Demonstrate advanced technologies that validate innovative designs and verify full system performance and costs under real operating and market conditions.

In less than two years, the Wind Program is well on its way down the path laid out by the National Offshore Wind Strategy. In 2011, DOE announced 41 projects in the areas of offshore wind technology development and market barrier removal, totaling more than $43 million in DOE funding. Each of the projects targets a specific knowledge gap identified in the market and industry analyses that were conducted when preparing the National Strategy. These projects are diverse in scope and represent a broad range of geographic and technical interests: they aim to more accurately characterize wind resources; monitor and protect marine and avian life near wind farms; optimize ports, vessels, and supply chains for offshore wind farm construction and installation; and better integrate wind energy into existing electrical grid infrastructure. In addition, these projects work to build larger turbines that capture more energy, lead to a greater understanding of the interactions between hurricanes and ice with turbines in the Atlantic Ocean and Great Lakes, and create open source design and analysis tools that will better enable industry to develop and deploy integrated offshore wind systems.

Keeping in line with the direction set forth by the National Offshore Wind Strategy, the DOE Wind Program announced its largest investment in offshore wind to date in the spring of 2012 when it opened a funding opportunity announcement for advanced technology demonstration projects for offshore wind. The projects selected will receive up to $180 million dollars in total over the next five to seven years (pending congressional appropriations) to deploy next-generation technology designs. This will include a "fast-track" project, which will aim to reduce permitting, approval, environmental, and other uncertainties often associated with the high capital costs for financing offshore wind projects; as well as five additional projects that will focus on bringing innovative technologies to market, including those offshore wind technologies specific to transitional and/or higher water depths that present a unique technical challenge in U.S. waters.

By making these strategic investments in offshore wind that are in line with the National Offshore Wind Strategy, the DOE Wind Program is ensuring that the United States moves towards the responsible, cost-effective, and innovative development and deployment of offshore wind power.

AWEA and DOE Collaborate on Offshore Wind Recommended Practices

In October 2009, the American Wind Energy Association (AWEA), in collaboration with the U.S. Department of Energy's National Renewable Energy Laboratory, began an effort to develop recommended practices for design, deployment, and operation of offshore wind turbines in the United States. This effort was motivated by concerns that no single set of guidelines and standards could be identified that addressed the complete design, deployment, and operation of offshore wind turbines, and because unique conditions exist in the United States that cannot be directly compared to conditions at European offshore wind facilities.

This effort, known as the Large Turbine Compliance Guidelines Initiative, enlisted more than 50 expert stakeholders in the offshore wind community to develop a consensus document, *AWEA Offshore Compliance Recommended Practices 2012*. Known more briefly as AWEA OCRP 2012, the document recommends good practices in the use of existing standards for planning, designing, constructing, and operating offshore wind facilities in U.S. waters.

The AWEA OCRP 2012 committee draft went out to U.S. offshore wind stakeholders for review and comment this summer. The committee addressed all comments in a meeting at AWEA's WINDPOWER 2012 and submitted a final draft to the AWEA Standards Coordinating Committee that oversees the initiative. AWEA plans to release the document at its 2012 Offshore WINDPOWER Conference in Virginia Beach, Virginia, October 9–11.

DOE Funds Advanced Magnet Lab and NREL to Develop Next-Generation Drivetrains

Investing in next generation drivetrains can help lower the cost and improve the reliability of wind turbines, particularly in larger offshore applications. This includes both improving current drivetrain configurations, as well as creating innovative drivetrain designs. For these reasons, the U.S. Department of Energy (DOE) recently awarded

Advanced Magnet Lab (AML) in Palm Bay, Florida, and the National Renewable Energy Laboratory (NREL) in Golden, Colorado, additional funding to continue work in developing their proposed next-generation drivetrains.

AML – Smaller and Lighter Direct-Drive Generators for Large Wind Turbines

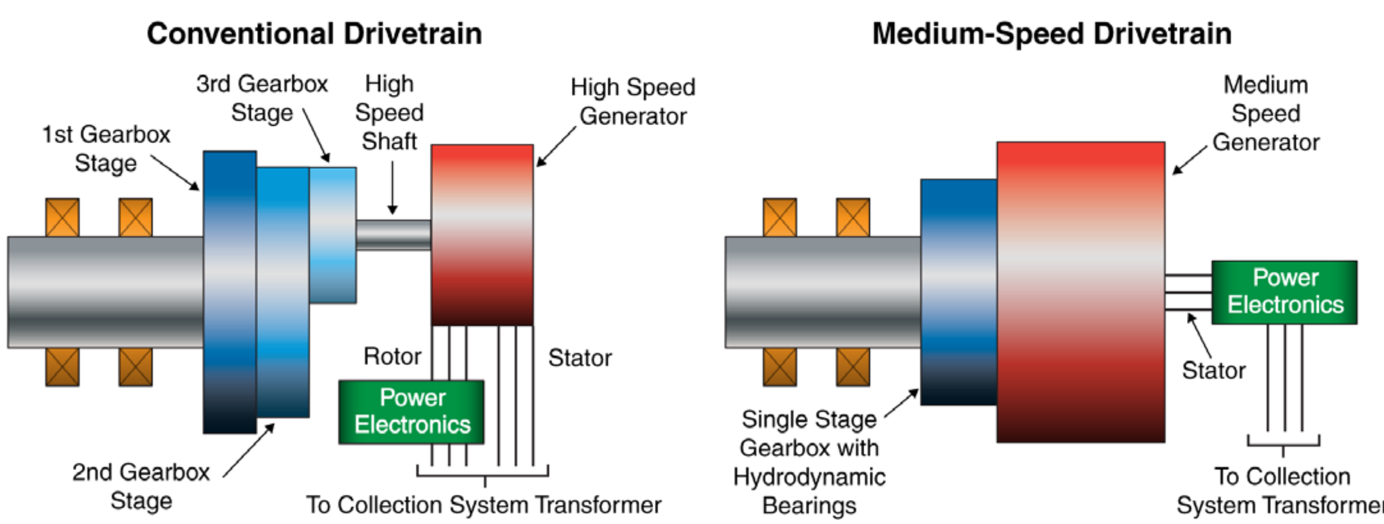
AML and its partners (Emerson Electric Corporation, Creare Inc., DNV USA, and DOE's Argonne National Laboratory) are developing a 10-megawatt (MW) direct-drive fully superconducting generator for use in next-generation wind turbines. As wind turbines continue to increase in size, particularly in the offshore market, AML's drivetrain concept has the potential to out-perform competing concepts, ultimately reducing the cost of wind energy.

Key potential advantages of the AML direct-drive generator include improved scalability, reduced weight, and coils that are free of rare-earth materials. AML's design does not require a gearbox, which may lead to improved reliability and reduced maintenance costs. While this may also be true for contemporary, gearbox-free direct-drive generator designs, the AML generator makes a magnetic field using superconducting windings that are more powerful and compact than copper-based alternatives. They are also constructed of more readily available and lower-cost materials than permanent-magnet-based generators, which are sensitive to cost fluctuations in the volatile rare-earth magnet market. In addition, AML calculates that its generator will weigh up to 50% less than a comparable permanent-magnet rare-earth generator with a 10-MW power rating. A lower generator mass has major system benefits, including a lighter—and thus less expensive—tower, and reduced installation costs through the use of smaller cranes and offshore vessels.

To reduce commercial risk and validate the key technical assumptions made during the design of the generator in Phase I of the project, AML will use the Phase II funding awarded by DOE in July 2012 to build and test the generator's key subcomponents.

NREL – Next-Generation Drivetrain

Building on its role as a world-class DOE research facility, NREL and its industry partners (BEW Engineering, Brad Foote Gear Works, Clipper Windpower, CREE, Danotek Motion Technologies, McCleer Power, DOE's Oak Ridge National Laboratory, QuesTek, Romax Technology, Texas Tech University, and Vestas) have developed an innovative



This illustration compares a medium-speed drivetrain to a conventional drivetrain. NREL's medium-speed drivetrain is designed to increase reliability, improve efficiency, and reduce costs. *Illustration by NREL* drivetrain system designed to increase reliability, decrease mass, improve efficiency, and reduce costs. In addition, NREL's concept for a medium-speed drivetrain will facilitate the scaling of generator design up to ratings as high as 10 MW while maintaining the lowest possible cost.

NREL's concept takes a system approach to improving the conventional wind turbine drivetrain design, focusing on all three of its major components: a single-stage gearbox, a medium-speed permanent-magnet generator, and high-efficiency power electronics. Traditional three-stage high-speed gearbox designs have been plagued with reliability issues caused by the large and unpredictable loads imparted on the gears and bearings from the wind acting on the rotor. The NREL design eliminates the last two stages of the traditional gearbox (the lower-reliability, higher-speed stages); uses a more compliant gear system of flex-pins and journal bearings in the remaining low-speed planetary stage that improves load distribution and increases the overall reliability; and is constructed from premium steels, which increases capacity. This single-stage gearbox connects to a medium-speed generator that uses a fraction of the rare-earth magnets used in a standard gearbox-free direct-drive permanent-magnet generator of similar power.

Additionally, the generator operates at medium voltage, rather than the traditional low-voltage designs, which reduces cooling system requirements and the copper mass and cost of the power cables running down the tower. Efficiency improvements in the power electronics are derived from advanced materials and improved circuit design. These combined innovations result in increased reliability, capacity, and efficiency; and thus, more energy generation and a lower cost of energy.

Download a copy of the 2011 Wind Technologies Market Report at *wind.energy.gov/pdfs/2011_wind_technologies_market_report.pdf*

DOE Releases 2011 Wind Technologies Market Report

According to the *2011 Wind Technologies Market Report* released by the U.S. Department of Energy in August, the United States remained one of the fastest-growing wind power markets in the world in 2011—second only to China. Roughly 6,800 megawatts (MW) of new wind power capacity were connected to the U.S. grid in 2011, up from more than the 5,200 MW built in 2010.

Wind power comprised 32% of all new U.S. electric capacity additions in 2011 and represented $14 billion in new investment. At the end of 2011, wind power contributed more than 10% of total electricity generation in six states (with two of these states above 20%), bringing the nation's total wind-generating capacity to 47,000 MW. Since then, the total U.S. capacity has increased to 50,000 MW. That's enough to power more than 12 million homes annually, as many homes as in the entire state of California, and it represents an 18-fold increase in capacity since 2000.

Other key findings from the DOE report include:

- A growing percentage of the equipment used in U.S. wind power projects is being sourced domestically: 67% in 2011, up from just 35% back in 2005–2006.
- Since 1998–99, the average nameplate capacity of wind turbines installed in the U.S. has increased by 174% (to 1.97 MW in 2011), the average turbine hub height has increased by 45% (to 81 meters), and the average rotor diameter has increased by 86% (to 89 meters).
- Turbine prices have fallen 20% to 30% from their highs back in 2008, but this decline has been slow to show up in installed project cost data, which only began to turn the corner (on average) in 2011. Data from a preliminary sample of wind power projects being built in 2012 suggest further reductions in installed project costs.
- Among a sample of wind power projects with power purchase agreements (PPAs) signed in 2011, the capacity-weighted average levelized price is $35/megawatt-hour (MWh), down from $59/MWh for projects with PPAs signed in 2010,

and $72/MWh for projects with PPAs signed back in 2009.

- With key federal incentives for wind energy (including bonus depreciation and a choice of the production tax credit, investment tax credit, or Section 1603 Treasury cash grant) currently slated to expire at the end of 2012, new capacity additions in 2012 are anticipated to substantially exceed 2011 levels. However, with the possible expiration of these incentives at the end of 2012, in concert with continued low natural gas prices and modest electricity demand growth, researchers expect new capacity additions to slow dramatically in 2013 and beyond, despite recent improvements in the cost and performance of wind power technology.

The annual *Wind Technologies Market Report* is funded by the DOE Wind Program and prepared by the Lawrence Berkeley National Laboratory. To download the *2011 Wind Technologies Market Report,* a summary presentation of the report, and an underlying data spreadsheet, visit the Information Resources page on the Wind Program website at wind.energy.gov/resources.html.

Wind Powering America Hosts 11th Annual All-States Summit

Approximately 100 members of Wind Powering America's (WPA's) network attended the 11th Annual All-States Summit on June 7 at the Georgia Tech Research Institute Conference Center in Atlanta, with an additional 53 attending via webinar. The Summit, which followed the American Wind Energy Association's (AWEA's) annual WINDPOWER Conference and Exhibition, provides state Wind Working Groups, state energy officials, U.S. Energy Department (DOE) and national laboratory representatives, and professional and institutional partners an opportunity to review successes, opportunities, and challenges for wind energy and plan future collaboration.

One of the highlights of the annual WPA All-States Summit is an awards presentation recognizing the accomplishments of peers. For the second year, network stakeholders participated in an online survey to nominate individuals for awards. Team members at the National Renewable Energy Laboratory and the DOE reviewed the nominations and presented the following awards during this year's summit:

- Outstanding Wind Working Group: Georgia Wind Working Group for efforts to promote wind energy in Georgia and the Southeast, including support for the 2012 Summit
- Outstanding Leadership in Education: Gwen Andersen of St. Francis University for her efforts to spearhead the development of wind energy education
- Outstanding Wind Powering America Partner: Southern Alliance for Clean Energy for efforts to support land-based and offshore wind energy development in the Southeast
- Larry Flowers Outstanding Leadership Award: Mackinaw Power and the Gratiot Community Wind Project for leadership in developing wind projects in harmony with the local community
- Outstanding Young Advocate Award: Karin Wadsack of Northern Arizona University for her incredible energy and creativity in developing wind energy education across the state
- Small Wind Leadership Award: Brett Pingree for his tireless efforts in support of the small and community wind industry

Karin Wadsack, Northern Arizona University (left), receives the Outstanding Young Advocate Award at the WPA All-States Summit in Atlanta from Ian Baring-Gould, Wind Powering America National Technical Director (center), and Charles Newcomb, Wind for Schools lead (right). *Photo by Susan Hinnen, NREL/PIX 21971*

From left to right: Taylor Eighmy, VP of Research at TTU; Juan Torres, Senior Manager for Renewable Energy at SNL; Anurag Gupta, Director of Rotor Systems R&D at Vestas; Kent Hance, Chancellor of Texas Tech University System; and Jim Ahlgrimm, Manager of Wind Testing and Certification at the Energy Department. *Photo from Texas Tech University, Office of the Vice President for Research*

- Western Regional Leadership Award: Western Interstate Energy Board for forward-thinking efforts to develop the Western Renewable Energy Zones and multi-state collaboration in transmission planning
- Midwestern Regional Leadership Award: Windustry for supporting community wind development and the Community Wind across America conference series
- Eastern Regional Leadership Award: Massachusetts Clean Energy Center for long-term leadership in offshore and community-scale wind development
- Lifetime Achievement Award: Dwight Bailey, U.S. Department of Energy and National Energy Technology Laboratory, for his tireless efforts in support of wind energy and regional networks.

For those individuals who could not attend the event, the morning's proceedings were available via a live webcast. Attendees were able to view not only the presentations but also participate via Internet.

Read the Wind Powering America 10th Annual All-States Summit Proceedings at windpoweringamerica.gov/wkshp_2012_state_summit.asp.

U.S. Department of Energy Breaks Ground on State-of-the-Art Wind Turbine Test Facility

The U.S. Department of Energy (DOE) joined with Texas Tech University (TTU) and Sandia National Laboratories (SNL) in July 2012 to break ground on a new state-of-the-art wind turbine test facility in Lubbock, Texas. Supported by a $2.6 million investment from the DOE Wind Program, the Scaled Wind Farm Technology (SWIFT) facility will be the nation's first public facility to use multiple wind turbines to measure how wind turbine wakes interact with one another in a wind farm. Scheduled to begin operation later this year, the facility will help wind turbine designers and manufacturers continue to drive down the cost of wind energy by reducing the aerodynamic losses of wind energy plants, enhancing energy capture, and mitigating turbine damage.

Along with the ability to monitor wind plant performance, the SWIFT facility will have additional advanced testing and monitoring capabilities, as well as space for up to 10 wind turbines, allowing researchers to examine how larger wind farms can become more productive and collaborative. The facility, which will host both open-source and proprietary research, is the result of a partnership between SNL, the TTU Wind Science and Engineering Research Center, Group NIRE, and wind turbine manufacturer Vestas. The site will initially be equipped with two research-scale wind turbines provided by DOE and a third installed by Vestas Technology R&D of Houston.

SWAY's one-fifth scale prototype demonstration wind energy system installed off the coast of Bergen, Norway. *Photo by Rob Wallen, NREl/PIX 21966*

U.S. Department of Energy and SWAY Collaborate on Offshore Wind Demonstration Project

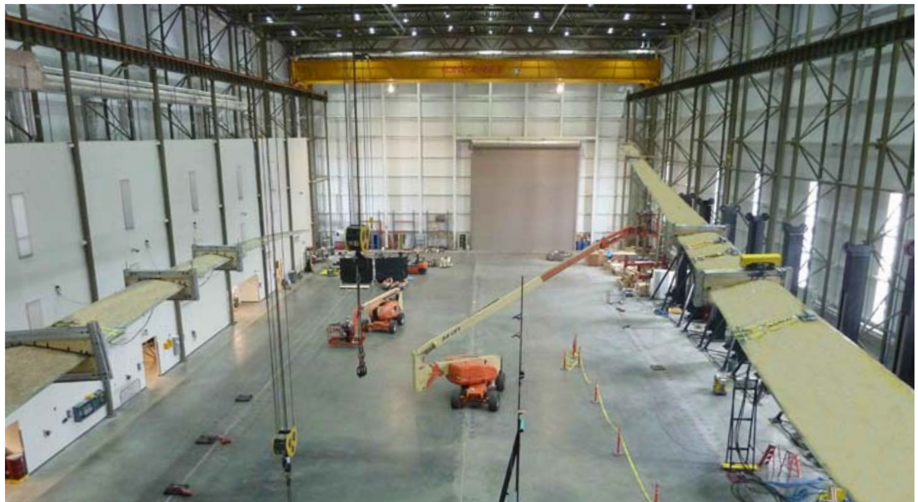
The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) is collaborating with SWAY, a renewable energy company from Norway, on an offshore wind energy demonstration project deployed off the coast of Bergen, Norway. The project provides the Energy Department and NREL with a unique opportunity to study one of the world's first floating wind turbines to be deployed and enhances SWAY's data collection program. SWAY hopes these data will validate its design for a 10-megawatt floating offshore wind turbine.

The SWAY one-fifth scale prototype has a 13-meter (m) downwind rotor on a 29-m tower, with a large portion of the tower beneath the ocean surface. The tower and turbine rotate together on the mooring and are designed to swivel according to wind direction. A downwind rotor allows the tower to have support cables on the upwind side, reducing the structural requirements on the tower and saving weight and costs.

In June, NREL installed scientific equipment on the seabed and on the prototype above the water line to collect data that will help validate a computer model of the SWAY design. The equipment will provide NREL researchers with practical experience on testing floating offshore wind systems, and the data gathered from this project will accelerate the development of offshore wind design tools and models.

The instruments on the seabed will collect information such as wave height and direction, tidal variations, and sea temperatures. Instrumentation installed on the turbine prototype above the water will collect atmospheric data such as wind speed and direction and operational data such as platform motions, loads, and performance.

Since its commissioning on June 23, 2012, the equipment has been collecting data around the clock at a rate of 1.5 gigabytes per day. NREL researchers hope to continue collecting data for 6 months to a year. NREL will then remove the equipment, analyze the data, and publish a report on the findings.



The Wind Technology Test Center in Boston, Massachusetts, is the only test center in the United States capable of testing wind turbine blades up to 90 m in length to IEC standards. Here, the test center is preparing two 49-m blades for testing. The blade on the left is being prepared for a flapwise static test and the blade on the right for an edgewise fatigue test. *Photo from Nathan Post, WTTC*

Wind Technology Testing Center Earns A2LA Accreditation for Blade Testing

The Massachusetts Wind Technology Testing Center (WTTC), a joint effort by the U.S. Department of Energy (DOE), the Massachusetts Clean Energy Center, and National Renewable Energy Laboratory (NREL), was recently accredited by the American Association for Laboratory Accreditation (A2LA) to test wind turbine blades to International Electrotechnical Commission (IEC) standards. The facility is one of the first test centers in the world that can test blades up to 90 meters in length, and is the only test facility in the United States that is accredited to test these longer blades to IEC standards.

Manufacturers that have their blades tested by an accredited center can use the test results to have their blades certified, and certification plays a critical role in successful marketing at home and abroad. Local building authorities, project financiers, and insurance companies ask for certification to reduce their risk before projects move forward. To compete overseas, U.S. manufacturers must have their products certified to standards adopted by other nations.

In certification, an independent party gives written assurance that a product, process, or service conforms to specified requirements. International certification relies on standards that are continually updated and expanded. This standards development process is conducted by international committees of experts, the foremost being the IEC, to develop appropriate international standards and testing procedures. Researchers in the DOE Wind Program work closely with the IEC to ensure reciprocity and acceptance of the U.S.-developed analytic tools used in the process of designing wind turbines and wind turbine components.

In 2009, DOE awarded Massachusetts an additional $25 million in funding (up from the original $2 million) from the American Recovery and Reinvestment Act to accelerate construction of the Wind Technology Testing Center, which was fully commissioned in May 2011.

Researchers from the DOE's NREL and the Massachusetts Clean Energy Center have worked together for the past year to develop and implement the quality management system required to achieve accreditation. By the end of September 2012, the WTTC had completed certification testing on several multimegawatt blades for industry partners.

Glosten Associates Tests Innovative High-Strength Mooring Lines for Deepwater Offshore Wind Installations

Funded by the U.S. Department of Energy's Wind Program, Glosten Associates recently completed testing on innovative high-strength, high-stiffness synthetic-fiber ropes being proposed for use in deepwater offshore wind power installations. Glosten Associates and its partners tested six sub-rope specimens to confirm the ropes' strength, elongation, and stiffness properties. The innovative rope design was developed by Samson Rope Technologies for Glosten's *PelaStar* floating wind turbine tension-leg platform (TLP).

Tension-leg platforms have been deployed for decades by the offshore oil and gas industry and represent one proposed solution for deploying deepwater offshore wind technology. The TLPs use vertical high-tension mooring lines known as tendons to minimize vertical platform motions. Traditional TLPs use tendons comprised of tubular steel with universal-joint connectors at the upper and lower ends. These tubular steel tendons are robust but costly and difficult to deploy. The new synthetic rope tendons comprise several sub-ropes, jacketed together, to form a rope tendon. These rope tendons can be spooled on the deck of a barge and deployed at a lower cost than the traditional systems.

Synthetic-fiber ropes are a well-known technology, both on land and offshore. They have been used in applications such as heavy lifting, military, high-performance racing sailing yachts, and offshore catenary mooring systems. Several factors combine to make synthetic-fiber ropes an attractive option for TLPs. Recent advancements in material science have produced rope fibers that are resistant to creep and fatigue—key concerns for offshore wind turbine TLPs. New termination methods also enable the manufacture of rope tendons to precisely specified lengths. Finally, the cost of rope terminations and connections to the floating platform and seabed anchors are lower than those used in traditional steel tendons.

In the recent testing, sub-rope test specimens were subjected to static and dynamic loading. In the laboratory, loads were applied to the test specimens by a programmable hydraulic tensioning machine while the ropes were continuously sprayed with water to simulate offshore conditions. Static tests verified the strength and quasi-static elongation-stiffness properties of the rope. Dynamic testing verified the effects of aging on the rope's properties and measured the dynamic elongation-stiffness properties of the rope, which change as a function of strain rate or the combination of load frequency and amplitude. The dynamic testing also provided a limited verification of the ropes' resistance to fatigue damage. The test results indicate that the ropes perform as expected and provide the initial data needed to proceed with synthetic-fiber rope tendon design for floating offshore wind TLPs.

Glosten Associates is a naval architecture and marine engineering consultancy based in Seattle, Washington. Technical support, preliminary testing, and sub-rope test specimens were provided by Samson Rope Technologies. Independent rope testing was conducted by Tension Member Technology Laboratories in Huntington Beach, California.

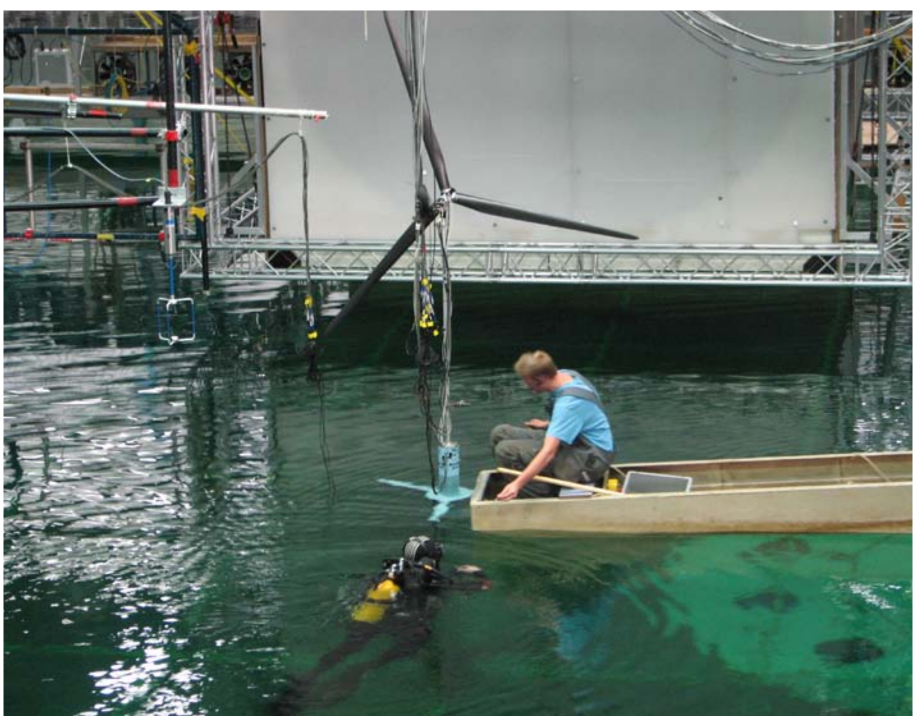
University of Maine Researching Floating Technologies for Deepwater Offshore Wind

In 2010, the University of Maine's (UMaine) Advanced Structures and

Composites Center received funding from the U.S. Department of Energy and the National Science Foundation to launch an offshore wind research program: the DeepCwind Consortium. The DeepCwind Consortium comprises 36 industrial, university, and national laboratory partners with the shared goal of developing floating offshore wind technologies. Since its formation, DeepCwind has made significant strides toward the commercial development of floating offshore wind technology.

The gross U.S. offshore wind potential is more than 4,000 gigawatts (GW)—more than four times the combined generating capacity of all U.S. electric power plants. Although this wind resource is located within 50 nautical miles from shore, most of it is located in deep water that would be cost prohibitive to develop without floating offshore wind technology.

To pursue commercial development of floating wind turbine technology, DeepCwind researchers at the center are working to validate numerical modeling tools that will accurately predict system behavior for use in efficient design and optimization. Currently, there are very few coupled numerical modeling tools for simulating the performance of floating wind turbines. Codes, such as the Fatigue, Aerodynamics, Structures, and Turbulence (FAST) code developed by the DOE's National Renewable Energy Laboratory (NREL), have yet to be fully validated against real data because little published information of this type currently exists.

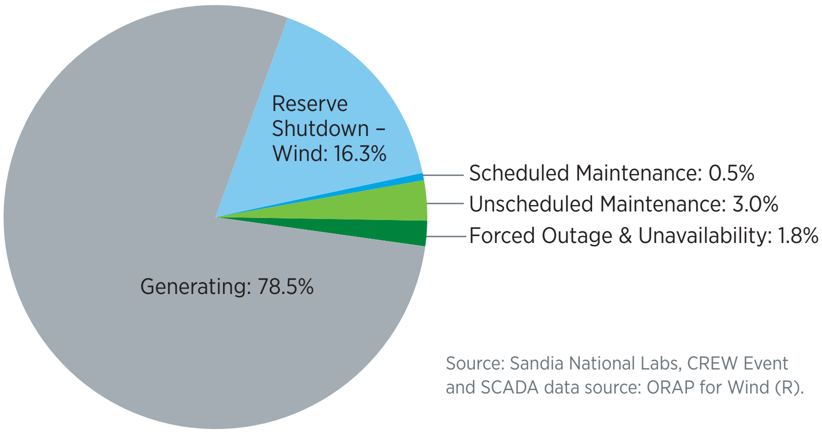


A researcher prepares to test the 1/50th-scale model wind turbine at the Maritime Research Institute Netherlands as part of the DeepCwind Program. *Photo from Deepwater Floating Offshore Wind Turbine, NREL/PIX 19574*

In 2011, the National Science Foundation Partnerships for Innovation and the DOE Wind Program funded the center's DeepCwind researchers to perform 1/50th scale model testing of three floating wind turbine concepts at the Maritime Research Institute Netherlands in Wageningen, the Netherlands. The experiments used a scaled version of NREL's horizontal-axis 5-megawatt reference wind turbine atop three different platforms: a tension-leg, a spar-buoy, and a semisubmersible. These models were tested under 60 different metocean conditions found in the Gulf of Maine. UMaine and NREL are now analyzing the test results and will use the test data to validate NREL's coupled numerical tools for accurate modeling of future offshore designs, including the UMaine semisubmersible pilot-scale turbine that the university plans to deploy in 2013 at its Deepwater Offshore Wind Test Site near Monhegan Island, Maine.

Additional work underway employs the DeepCwind model test data to further advance the knowledge base of the offshore floating wind turbine industry. This work includes:

- Floating wind turbine model scaling method improvements
- Additional data analysis and investigation of coupled physics and validation of FAST for spar-buoy and semisubmersible systems
- Design, deployment, and testing of a pilot-scale floating turbine using composite components in 2013
- Additional work with the composites industry to integrate components, such as tower systems, into full-scale floating offshore wind turbines.



Wind turbine availability time accounting. *Illustration by Stacy Buchanan, NREL*

For more information, visit the DeepCwind website at DeepCwind.org and the University of Maine's website at aewc.umaine.edu.

DOE Lab Releases Wind Turbine Reliability Benchmark Report

The U.S. Department of Energy's Sandia National Laboratories (SNL) recently released its second annual public benchmark report for the Continuous Reliability Enhancement for Wind (CREW) database. CREW is a national reliability database that enables the analysis of wind plant operations and the ability to benchmark the reliability performance of the current U.S. wind fleet. The CREW database gained traction in late 2009 with a partnership between SNL and Strategic Power Systems (SPS). SPS manages the Operational Reliability Analysis Program (ORAP) system, which collects monthly time, event, and capacity-based data from more than 2,000 gas and steam turbines worldwide. Through collaborative efforts between SNL and SPS, ORAP for wind will allow the wind industry to report on wind turbine and plant reliability, availability, and maintainability once it completes the commercialization phase in late 2012. This development would not have been possible without the support of SNL's industry partners: EDF Renewable Energy (formerly enXco Service Corporation), Shell Wind Energy Inc., Xcel Energy, and Wind Capital Group.

While the participating wind plants are land-based, the techniques, knowledge, and partnerships gained during the creation and development of the CREW database can be applied to the conditions and issues of offshore wind plants as well. These efforts can enable analysis of the performance, reliability, and operation and maintenance (O&M) costs of large-scale commercial offshore plants. In CREW's first annual benchmark report, published in October 2011, scheduled and unscheduled maintenance activities occurred approximately once per week in land-based wind plants. The expected O&M costs for offshore wind plants is estimated to be two to five times greater than those of land-based wind plants due to the remote siting, difficulty of access, and increased loading. This means that having a technician physically accessing the turbine weekly is not sustainable. Research is needed to improve O&M processes that can increase availability and lower O&M costs, both leading to a meaningful cost of energy reduction.

To download the **CREW Database Wind Turbine Reliability Benchmark Report** and other SNL wind energy publications, go to SNL's Energy, Climate & Infrastructure Security website at energy.sandia.gov/?page_id=6682.

Cover photo: Principle Power's floating foundation, WindFloat, provides siting of offshore wind turbines in water depths greater than 40 m and without the use of heavy-lift vessels. This turbine has been grid-connected for more than 9 months and has provided almost 3 gigawatt-hours of electricity to the grid. DOE's National Renewable Energy Laboratory will support Principle Power by verifying the performance and dynamic behavior of the WindFloat system. *Photo from Principle Power*

International Energy AgencyWind 2011 Annual Report

Available for Download

The IEA Wind Energy 2011 Annual Report is available for download on the Wind Program website. The report contains information on generation capacity, progress toward national objectives, benefits to national economies, issues affecting growth, costs of projects and turbines, national incentive programs, and research and development results from the 20 International Energy Agency (IEA) member countries and China. The Executive Summary synthesizes the information for 2011 and includes data on capacity and generation since 1995.

Key statistics found in the report include:

- The world added about 40 gigawatts (GW) of wind generation in 2011, a 24% increase from the previous year
- Capacity increased in the IEA Wind member countries as a whole, from less than 5 GW in 1995 to more than 200 GW in 2011
- More than 85% of the world's wind-generating capacity resides in the 20 IEA wind member countries and China
- Among the IEA Wind member countries, offshore wind systems totaled about 3.3 GW at the end of 2011
- Electrical production from wind met 2.8% of the total electrical demand in IEA wind member countries.

Download a copy of the IEA Wind 2011 Annual Report at *wind.energy.gov/pdfs/iea_wind_2011_annual_report.pdf*

Wind Program Events

Wind Powering America Webinar: Social Acceptance of Wind Energy

Date: October 17, 2012, 3 p.m. ET

Join Eric Lantz of the National Renewable Energy Laboratory for an examination of the issues related to social acceptance of wind energy.

Web access: https://www.mymeetings.com/nc/join.php?i=RW9341550&p=5263973&t=c

Tribal Energy Program Review

Date: November 13–16, 2012

Location: Renaissance Denver Hotel, 3801 Quebec St., Denver, CO

The Tribal Energy Program Review will provide an overview of the wide range of renewable energy and energy efficiency projects underway in Indian Country. The annual gathering provides Tribes an opportunity to network, report on their energy efficiency and renewable energy projects, and learn from the experience of other tribes pursuing similar projects. Currently, the program has more than 50 active projects. No registration fee is being charged, but advance registration is required for meeting space and food service planning. Register at apps1.eere.energy.gov/tribalenergy/register_meeting.cfm

Recent Publications

- 2011 IEA Wind Annual Report
  wind.energy.gov/pdfs/iea_wind_2011_annual_report.pdf
- 2011 Wind Technologies Market Report
  wind.energy.gov/pdfs/2011_wind_technologies_market_report.pdf
- Dynamic Analysis of Wind Turbine Planetary Gears Using an Extended Harmonic Balance Approach
  www.nrel.gov/docs/fy12osti/55355.pdf
- Impact of Wind Development on County-level Income and Employment: A Review of Methods and an Empirical Analysis
  www.nrel.gov/docs/fy12osti/54226.pdf
- Impacts of Wind and Solar on Fossil-Fueled Generators
  www.nrel.gov/docs/fy12osti/53504.pdf
- Offshore Energy Knowledge Exchange Workshop
  wind.energy.gov/pdfs/offshore_energy_knowledge_exchange_workshop_report.pdf
- Offshore Wind Projects
  wind.energy.gov/pdfs/offshore_energy_projects.pdf
- Systems Engineering Applications to Wind Energy Research, Design, and Development
  www.nrel.gov/docs/fy12osti/54717.pdf
- Wind Power Plant Prediction by Using Neural Networks
  www.nrel.gov/docs/fy12osti/55871.pdf
- Workforce Development and Wind for Schools
  www.nrel.gov/docs/fy12osti/54445.pdf

Stay current on important wind energy events around the United States by subscribing to receive the Wind Program Newsletter by email. *www.eere.energy.gov/wind/subscribe.html*

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