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World-Class Wind Testing Facilities Build Global Competitiveness

Federal investment in scientific discovery and technology is vital to maintaining U.S. economic leadership in the world and in growing such key emerging sectors as clean energy

Overview

With more than 60 gigawatts of installed capacity, the American wind industry supports 50,000 full-time jobs, including workers at more than 550 domestic manufacturing facilities.[1] Although only 4.5 percent of U.S. electricity generation comes from wind,[2] Department of Energy research suggests that figure could reach 20 percent by 2030.[3] Additional wind generation capacity means job growth and continued export opportunities for advanced materials and components.

Wind energy is also playing a significant role in the Obama administration's efforts to double clean electricity generation over the next decade and reduce the nation's carbon pollution. Power generation from wind in the United States has tripled since 2008—and now is enough to supply over 15 million homes.[4]

In the early 1970s, the marketplace for wind energy was limited and few federal research and development programs were dedicated to helping advance the technology. Without support for R&D, the nascent wind industry faced stiff market barriers to development and deployment, and wind turbines remained less reliable and more expensive than conventional fossil fuel electricity generation. Then, in 1975, Congress authorized an R&D program for wind energy—the Wind Program, part of the Wind and Water Power Technologies Office—which has contributed to significant technological advances and made it possible to develop reliable utility-scale turbines at competitive prices.[5] Today, the Wind Program continues to provide critical investments not only to make the U.S. electricity grid cleaner and more efficient, but also to ensure American competitiveness in the rapidly growing global wind energy market.

Stages of Innovation

The introduction of advanced ideas, devices, or processes drives the emergence and creation of market sectors and supports the U.S. economy. The three stages of progression for discovery and invention are:

- **Basic science and early stage R&D.** Fundamental exploration to acquire new knowledge of materials and processes leading to novel theories and products.
- **Applied research.** Establishment of state-of-the-art concepts and prototype advancements, and exploration of the feasibility of scaling up these modern commodities.
- **Technology maturation and deployment.** Evaluation of materials, components, and efficiencies to optimize performance, demonstrate concepts, and support market adoption.

DOE Wind Program boosts U.S. competitiveness

To generate more power more efficiently, innovators over the past few decades designed increasingly larger wind turbines, taller towers, and longer blades. As these machines grow, producing more electricity per unit, new methods and facilities are necessary to ensure these advanced systems perform with high reliability.

Because the United States did not have adequate testing facilities, applied R&D of cutting-edge wind turbine designs were being drawn to Europe. To regain groundbreaking research in next-generation wind turbines, the U.S. Department of Energy made significant investments in several state-of-the-art testing facilities to help position the United States as a leader in wind innovation.

Figure 1

Wind Investment and Ranking

U.S. Department of Energy's R&D dollars return billions

Key Statistics	
$1.7 billion	Amount of DOE investment in wind energy technologies, 1976–2008
$10 billion	Economic savings and value of health benefits resulting from DOE investment
$84 million	DOE funding for domestic testing facilities
1st	DOE rank in number of wind power patents worldwide

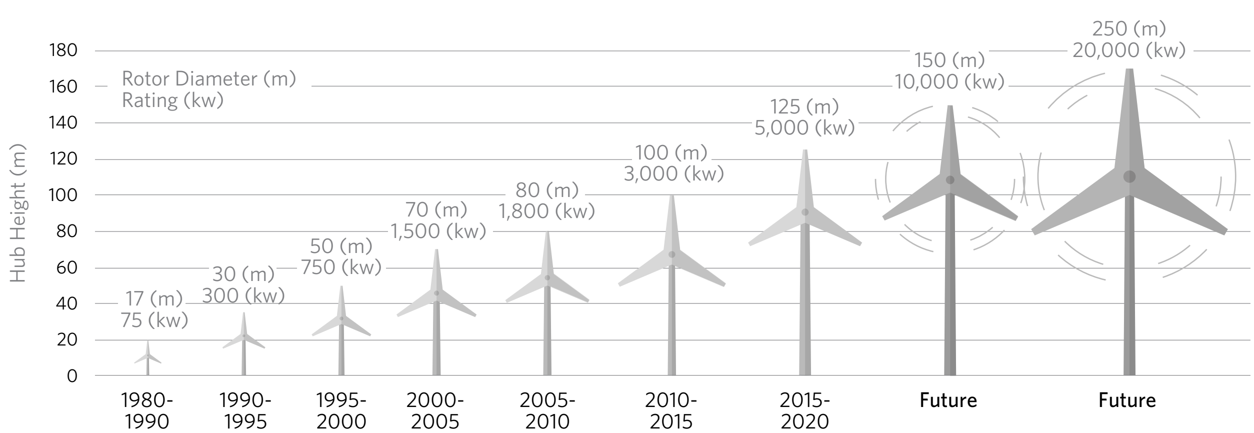
Source: U.S. Department of Energy

Increased turbine capacity through larger rotor diameters—the area covered by the wind blade's rotation—allows project developers to take greater advantage of wind resources, especially offshore. Wind speeds and consistency increase with altitude, so larger turbines are able to harness stronger, less turbulent, and more reliable resources.[6] Further, while onshore turbines are constrained by the capacity of the roads, bridges, and railroads used to transport them, offshore installations do not face these limitations because barges can deliver parts to the sites.

Figure 2

Growing Size of Wind Turbines

Technological advances have enabled longer blades that can generate more energy

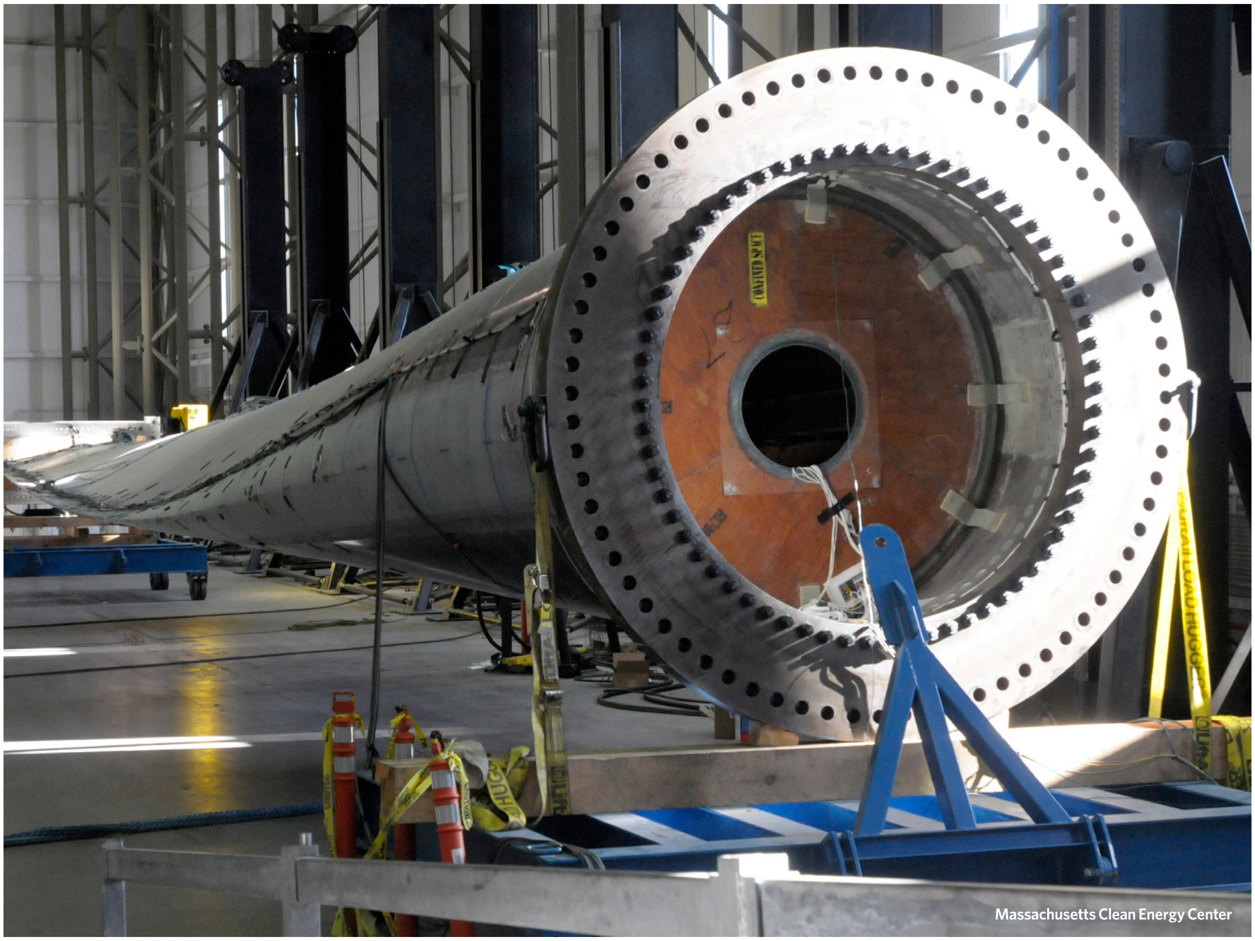


Source: European Wind Energy Association

DOE partnership results in cutting-edge wind testing facilities

According to the National Renewable Energy Laboratory (NREL), wind turbine blades for land-based systems have grown from about 26 feet (8 meters) in the 1980s to more than 130 feet (40 meters) in 2014.[7] This increase has enabled greater electricity generation—up to four times more energy is captured when blade lengths double.

To allow domestic businesses to compete with foreign companies that have access to European research resources and operations, two domestic blade-testing facilities have been established in the U.S. These laboratories provide American manufacturers with a full suite of certification tests necessary for reliable deployment of larger turbines, setting the course for the next generation of wind technology innovation.[8]



A testing blade at the Massachusetts Clean Energy Center's Wind Technology Testing Center in Boston.

In 2011, with more than $25 million in DOE funding and $13.2 million in grants and loans from the Massachusetts Clean Energy Center, the Wind Technology Testing Center opened as the first facility in the world with the ability to test wind blades up to 295 feet (90 meters) in length.[9] "As a U.S. company, the ability to conduct ultimate strength and fatigue durability tests on the world's largest, next-generation-size rotor blades right here in America will accelerate our ability to finalize designs and get our products to market," said Craig Christenson, Clipper Windpower's senior vice president of engineering. At a similar facility in Colorado, engineers are working alongside testing experts from NREL's National Wind Technology Center—a facility with testing capability for 165-foot (50-meter) blades—to ensure they meet international standards.

DOE Supports Commercial Wind Development at South Carolina Facility

With $47 million in Department of Energy investment and an additional $60 million in private funding, Clemson University's Restoration Institute in North Charleston launched the South Carolina Electric & Gas Energy Innovation Center in 2013. The facility verifies the safety and performance of commercial-scale offshore wind systems to ensure reliability.* A 15-megawatt drivetrain testing bay is planned and will feature a grid simulator to mimic real-world conditions. In collaboration with other national testing facilities, the Innovation Center will help private industry and public researchers better study interactions between wind energy technologies and the U.S. power grid.

* U.S. Department of Energy, "Two Facilities, One Goal: Advancing America's Wind Industry," Nov. 27, 2013, http://energy.gov/eere/wind/articles/two-facilities-one-goal-advancing-america-s-wind-industry.

Research partnerships accelerate wind energy technology

Although large-scale turbine development is crucial for utility-scale generation, smaller turbines are playing a key part in local and distributed renewable energy. The Skystream 3.7—which is installed in neighborhoods, at schools, and even next to the U.S. Capitol—is one of the most successful small-scale wind energy turbines deployed around the nation. Engineers at NREL's National Wind Technology Center began working with Southwest Windpower in 2001 to develop the turbine.[10]

In 2006, Southwest Windpower's design won the Best of What's New award from *Popular Science* magazine and was recognized as one of the Best Inventions by *Time* magazine. The commercial success of the Skystream 3.7 led to the company's 2013 acquisition by Xzeres Wind Corp., a designer, manufacturer, and marketer of distributed wind power. Xzeres now has more than 9,000 small residential wind turbines in operation worldwide.[11]

DOE's Wind Program, with support from national labs, pioneers and prepares for next-generation wind technologies that will help power the U.S. economy for years to come. Continued support of all stages of energy innovation is essential to creating thousands of American manufacturing and installation jobs and securing the U.S. position as a leader in the global clean energy economy.

For more information about state-of-the-art wind testing facilities, visit:

- **U.S. Department of Energy's Wind Program.**
- **Massachusetts Clean Energy Center's Wind Technology Testing Center.**
- **Clemson University's SCE&G Energy Innovation Center.**
- **National Renewable Energy Laboratory's National Wind Technology Center.**

Endnotes

1 American Wind Energy Association, "Get the Facts: Wind Energy Facts at a Glance," http://www.awea.org/Resources/Content.aspx?ItemNumber=5059.

2 U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "2013 Wind Technologies Market Report," August 2014, http://energy.gov/sites/prod/files/2014/08/f18/2013%20Wind%20Technologies%20Market%20Report_1.pdf.

3 U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "20% Wind Energy by 2010," July 2008, http://www.nrel.gov/docs/fy08osti/41869.pdf.

4 U.S. Energy Information Administration, "Electricity Data Browser: Net Generation for All Sectors, Monthly," http://www.eia.gov/electricity/data/browser; American Wind Energy Association, "Get the Facts."

5 U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Retrospective Benefit-Cost Analysis of U.S. DOE Wind Energy R&D Program," June 2010, http://www1.eere.energy.gov/analysis/pdfs/wind_bc_report10-14-10.pdf.

6 ClimateWire, "Offshore Wind Turbines Keep Growing in Size," *Scientific American* (Sept. 19, 2011), http://www.scientificamerican.com/article/offshore-wind-turbines-keep.

7 National Renewable Energy Laboratory, "Wind Energy Technology: Current Status and R&D Future," August 2008, http://www.nrel.gov/docs/fy08osti/43374.pdf.

8 National Renewable Energy Laboratory, "Wind Research: Facilities," last modified Oct. 4, 2011, http://www.nrel.gov/wind/facilities.html.

9 Massachusetts Clean Energy Center, "Governor Patrick Celebrates Opening of Nation's First Large-Scale Wind Blade Testing Facility," May 19, 2011, http://www.masscec.com/news/governor-patrick-celebrates-opening-nations-first-large-scale-wind-blade-testing-facility.

10 Xzeres Wind Corp., "The Original Skystream Personal Wind Turbine," http://www.windenergy.com/products/skystream/skystream-3.7.

11 Xzeres Wind Corp., "Xzeres Launches PowerLease Financing Program" (Feb. 26, 2014), http://www.xzeres.com/news/xzeres-launches-powerlease-financing-program.

For further information, please visit:

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Contact: Jason Wynne, senior associate
Email: jwynne@pewtrusts.org
Phone: 202-540-6536