Grand Challenges

Breakout sessions were held at the Interagency Workshop to identify and discuss grand challenges. Described below are representative challenges that were identified as requiring an organized research framework and network:

- **Site Characterization Technologies and Mapping:** More cost-effective and powerful site characterization capabilities are required to create an accessible mapping of the ocean environment including wind, waves, currents, extreme events, the marine habitat, and the mechanical properties of the seabed down to the depth of offshore wind turbine foundations. Examples of needed improvements include: autonomous underwater vehicles; scanners that can detect the boulders left behind by glaciation; improved monitoring of marine mammals and their sensitivity to waterborne sound; and a platform for the storage, integration, and analysis of collected data.
- **Extended Design Lives and Condition Assessment Technologies:** To reduce the long-term cost of wind energy, the heavy infrastructure components of offshore wind plants that are valued in the hundreds of billion dollars (e.g. electrical grid network, foundations, towers) need to be planned for design lives that exceed the 25-year lifespan currently in place. Examples of needed advancements include: improved fundamental understanding of fatigue and corrosion of traditional materials, advancements in new materials, soil-structure interaction, constructability, and improved monitoring strategies and inspection technologies.
- **System-Level and Predictable-Accurate Computational Modeling Platform:** The complexity of offshore wind development, technologically, politically, and financially, demands system-level understanding in order to identify opportunities for significant innovations. Existing computational modeling tools can be advanced with improved understanding of material behavior, unsteady aerodynamics, and the interactions between wind turbine components, systems and the environment.
- **Learning, Education, and Training:** Given that offshore wind can hold the key to American energy independence, provide thousands of jobs to coastal towns in the U.S., provide the necessary base load to ensure that clean energy can be a sustainable American resource, and is a relatively new industry with substantial room for advancement, our nation needs a strategy for learning effectively from its first offshore wind farms, new educational opportunities for preparing industry professionals and policy leaders, and extensive training programs for skilled labor. In order to lead the development of its own resource, the U.S. needs to vastly increase the education and training of its personnel in the private, public and academic sectors.

Stakeholders Represented at the Workshop

Academic Institutions:

Massachusetts Research Partners UMass-Amherst, UMass-Dartmouth, UMass-Lowell, Northeastern University, Tufts University, and Woods Hole Oceanographic Institution.

Federal and State Agencies:

Department of Energy; National Science Foundation; Bureau of Ocean Energy Management; National Oceanic and Atmospheric Administration; National Aeronautics and Space Administration; Massachusetts Clean Energy Center.

National and International Industry Representatives:

Offshore Renewable Energy CATAPULT (United Kingdom); Fraunhofer Institute for Wind Energy and Energy System Technology (Germany); Business Network for Offshore Wind (U.S.)

Interagency Workshop: Advancing American Offshore Wind Research

Workshop Motivation

The U.S. is on the cusp of commercial development of its offshore wind energy resource, as evidenced by the recent competitive leases, state commitments, infrastructure preparations, and other signs of gathering momentum. Our nation needs to determine how it will drive U.S. innovation to lower costs and ensure responsible development over the long term.

Tufts University convened a workshop in Washington, D.C. on September 20, 2016 on *Advancing American Offshore Wind Research*. The workshop participants included federal officials from executive branch agencies, policy staffers from Capitol Hill, leaders from international institutes, faculty from the Massachusetts Research Partnership (MRP) in Offshore Wind, and industry representatives.

Contents of this Workshop Summary:

Tufts

Activities of Participating Agencies, Centers, Institutes, and Industry

U.S. Federal Agencies have been preparing for the development of the U.S. offshore wind energy resource for more than a decade; international institutes already have large programs geared for advancing innovation. At this workshop, these agencies and institutes presented their programs, as described below:

The **Bureau of Ocean Energy Management** (BOEM), within the Department of the Interior (DOI), has regulatory authority for the development of offshore wind energy resources. BOEM established and auctioned 11 significant lease areas after public comment and stakeholder input. BOEM provides funding directly and indirectly to conduct environmental assessment studies to support "Science-Informed Decisions through Use-Inspired Research." BOEM's work includes studies on avian biology, marine mammals, the benthic layer, archaelogy, seawater chemistry, and acoustic effects. BOEM also supports the Real-time Opportunity for Development Environmental Observations (RODEO) program, and a limited program to advance geophysical/geotechnical studies, foundations, and cabling.

The **Department of Energy (DOE)** has made major investments in offshore wind and published the results in guideline, vision, and strategy documents including the 2016 National Offshore Wind Strategy that was published jointly with the DOI. DOE programs have supported Technology Development ($104M) including new test facilities, Market Barrier Removal ($16.5M), and Advanced Technology Demonstration projects ($168M). The DOE also developed the Atmosphere to Electrons (A2e) program to reduce the cost of clean energy, as well as activities at national labs, including the **National Renewable Energy Laboratory (NREL)**, to provide computational tools for design, and physical testing resources.

The **National Science Foundation's (NSF)** vision is "A Nation that creates and exploits new concepts in science and engineering and provides global leadership in research and education." Recently, NSF has funded more than $300M of clean energy research for the collection, conversion, storage, and distribution of energy from diverse power sources. This research has supported smart grids, engineering energy materials, energy use, and computing systems, including significant backing for Massachusetts research programs such as the UMass-Amherst IGERT Offshore Wind Energy Program, the UMass-Lowell I/UCRC Windstar program, and the study of hurricane hazard and risk assessment.

The **National Oceanic and Atmospheric Administration (NOAA)** within the U.S. Department of Commerce, examines marine spatial planning, and its relationship to changes in climate, weather, oceans and coasts. NOAA also has a strong computational modeling platform and visualization capabilities.

The **National Aeronautics and Space Administration (NASA)** has identified offshore wind energy as an area where technology transfer from NASA to industry can have substantial benefits to the nation. As a few examples, NASA has identified autonomous vehicles, aerodynamic modeling, advanced sensors (e.g. LIDAR), and satellite imaging as areas that NASA technologies can benefit offshore wind energy development.

The **Massachusetts Clean Energy Center (MassCEC)** was created by the Massachusetts Green Communities Act in 2008 and is funded by the Renewable Energy Trust. Since 2008, MassCEC has constructed the first major offshore wind infrastructure in the United States including the Wind Technology Testing Center (WTTC) in Charlestown, and the New Bedford Marine Commerce Terminal (NBMCT) in New Bedford. MassCEC provided the funding to convene the Massachusetts Research Partnership (MRP) in Offshore Wind, which has worked with national partners to convene the Partnership for Offshore Wind EneRgy in the United States (POWER-US).

The **Ore-CATAPULT (United Kingdom):** institute is centered in Blyth, where approximately £250M was invested to create testing facilities for blades, drivetrains, grid-technologies, foundations, and an offshore wind tower. Ore-CATAPULT also operates a data-analysis center for site-characterization and wind-plant operations using data required by the Crown Estate and archived within a secure access platform. They have also established academic hubs in several scientific areas to advance the engineering and science of offshore wind at a fundamental level.

Fraunhofer-IWES (Germany) links academia to industry with the goal of advancing innovation. They operate testing laboratories for blades, drive-trains, and support structures. They also conduct site assessments, computational-fluid dynamic modeling, and field monitoring. The primary field monitoring is part of the Research at the Alpha-Ventus wind farm which is a € 250 million initiative. Fraunhofer-IWES has 150 employees, and their funding is equally split between the German government, industry, and Euro-funded projects.

Business Network for Offshore Wind (BNOW) is a 501 (c)3 nonprofit that is leading the way toward building an offshore wind industry in the United States. Bringing together top developers, global experts and member businesses, the Network has convened the offshore wind community and has provided networking opportunities and business decision-making support.

Design of a National Research Framework and Network

MassCEC funded the Massachusetts Research Partnership (MRP) in Offshore Wind to develop a report outlining a national research framework and network for advancing offshore wind through learning, modeling, testing, innovation, and industry engagement. The MRP consists of six partnering institutions whose expertise covers the spectrum of technical and policy issues related to offshore wind. The MRP has begun their work by examining worldwide research capabilities and projects, and by hosting quarterly international workshops on short and long-term needs and opportunities for advancing offshore wind. The initial findings of the MRP, as presented at this interagency workshop in D.C., are that the essential elements of a national research framework and network include the following:

- Laboratories to measure the performance of current and future technologies for all components of an offshore wind plant including blades, drive trains, towers, foundations, seabeds, cables, the electrical grid, and their interactions.
- Field Measurements of the performance of all components of an offshore wind plant.
- Data Archives of laboratory and field data that are structured, integrated, and accessible through secured access that protects intellectual property.
- Science-Based Regulations and Standards for site characterization, environmental/habitat impact assessment, and the design and assessment of all physical components of a wind plant.
- A Numerical Simulation Platform that enables system-level modeling, adequately captures all key effects, and is able to identify the needs for and value of innovation.
- Educational Programs to create leaders in industry and policy; qualified engineers and scientists; and skilled-labor for construction and operations.
- Substantial Public Investment to launch major initiatives that will attract industry investment, and then can transition to be primarily supported by industry.
- A Scientific and Technical Community integrated with Policy Makers and Industry
- National and International Partnerships

At the interagency workshop, presentations and discussions focused on the suitability of different types of research frameworks that could handle the complexity and scale of offshore wind energy development. The National Science Foundation was identified as a necessary partner because of its experience in creating networks comprising a range of distinct facilities and disciplines, building robust cyberinfrastructures that include secured digital data archives and a common simulation platform, and making fundamental scientific advancements that drive innovation. A consortium based model, as proposed by DOE, is a necessary step in bringing all stakeholders together. An estimate of the public research expenditure on offshore wind in Europe is $2-3 billion.