**US Department of Energy and US Department of the Interior**
**Workshop to Inform 2016 National Offshore Wind Strategy**

**Summary of Proceedings**
**Prepared January 2016**
**By the Consensus Building Institute**

Consensus Building Institute

## Executive Summary

The US Department of Energy (DOE) and the US Department of the Interior (DOI) convened a daylong stakeholder workshop on December 10, 2015 in Washington DC as part of their process to create the *2016 National Offshore Wind Strategy*. This document will update A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States, published in 2011. DOE and DOI anticipate releasing the *2016 Strategy* in mid-2016.

The goals for the stakeholder workshop were two-fold:

1. Identify the industry's and other stakeholders' top priorities to better enable DOI and DOE to facilitate the development of the offshore wind industry in the US.
2. Articulate each agency's respective role in the offshore wind energy development process.

Opening remarks were given by Dan Utech, White House Domestic Policy Council; Jose Zayas, DOE; and Abigail Hopper, DOI. These three speakers highlighted the importance of offshore wind both globally and for the US energy portfolio, emphasized the eagerness of both DOE and DOI to hear input from workshop participants in order to help shape the *2016 Strategy*, and described how the *2016 Strategy* will guide investment and set a vision for the future. Following the opening remarks, representatives from DOE, DOI, and the National Renewable Energy Laboratories (NREL) made presentations providing background information about their offshore wind programs and highlighting recent developments.

Workshop participants participated in a selection of seven discussion sessions with DOE and DOI personnel. Each session consisted of a short presentation establishing the framework for the discussion followed by facilitated discussion. Discussion session topics, along with suggestions made by workshop participants to DOE and DOI, are as follows:

*Informing and Streamlining the Siting and Permitting Processes*

- Implement a mandatory timeline for permitting or adjust the sequence of permitting to ease developers' ability to secure offtake.
- Adjust the permitting process to make it more tailored to risks presented by specific elements of the development process.
- Improve the availability of data and information for both developers and regulators.
- Enhance coordination across jurisdictions and agencies to streamline permitting.

*Shoring up the Supply Chain*

- Leverage collaboration between agencies and international partnerships to build capacity and reduce risk.
- Explore options under and around the Jones Act.
- Conduct analysis and modeling to understand the steps, mechanisms, or conditions needed to build out a viable supply chain for offshore wind.
- Enhanced communication with stakeholders about the benefits of offshore wind and available opportunities for growing the industry.

*Decreasing Project Risk through Physical Site Assessment*

- Make it easier for developers to conduct site assessments by providing clear guidelines and through a pre-funding system.
- Use diverse technologies and partnerships to collect additional data.
- Enhance data sharing among agencies and jurisdictions and make data easily accessible.
- Prioritize putting steel in the water over broad assessment for future development.

*Reducing Cost and Ensuring Safety through Technology Development*

- Enhance coordination around data across jurisdictions and agencies and make relevant data easily accessible.
- Push forward with research, testing, data collection, modeling, and the development of standards to continue developing technology to serve the offshore wind industry.
- Learn from the expertise of other industries, including offshore oil and gas, European offshore wind, and others.
- Explore improvements in and validate welding and coating technologies.

*Environmental Solutions from Development through Operation*

- Conduct research in areas including right whales, passive acoustic warning systems, socio-economic impacts, air quality impacts, impacts on animal behavior, electromagnetic fields, and operational noise.
- Conduct environmental studies in ways that support the offshore wind industry by providing useful, accessible, actionable information.
- Consider providing greater clarity and consistency around post-construction environmental monitoring requirements to developers.

*Quantifying Electric System Impacts*

- Conduct studies in areas such as: potential cost trajectories of offshore wind energy; the baseload characteristics of offshore wind energy; and potential impacts on: market price and ratepayer bills, transmission costs, grid quality, carbon emissions, and public health.
- Work with other stakeholders, including by providing technical assistance and using communications strategies, to build support and make the business case for the offshore wind industry.

*Communicating the Benefits and Creating Power Purchase Mechanisms*

- Conduct studies in areas including potential cost trajectories of offshore wind energy and offshore wind and cyber-security.
- Provide technical assistance and grants to states for research and modeling.
- Pursue diverse communications strategies, targeted to specific audiences, to build public, political, and policy support for the offshore wind industry.
- Explore creative strategies, such as incentivizing universities and large corporations to purchase electricity generated by offshore wind and using contractual mechanisms to guarantee ratepayers future cost savings.

## Background

The US Department of Energy (DOE) and the US Department of the Interior (DOI) convened a daylong stakeholder workshop as part of their process to create the *2016 National Offshore Wind Strategy*. This document will update A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States, published in 2011.

The goals for the stakeholder workshop were two-fold:

3. Identify the industry's and other stakeholders' top priorities to better enable DOI and DOE to facilitate the development of the offshore wind industry in the US.
4. Articulate each agency's respective role in the offshore wind energy development process.

This summary document is primarily intended to capture the range of comments and discussion from the workshop.

## Welcome and Workshop Opening

**Tushar Kansal**, lead workshop facilitator from the Consensus Building Institute (CBI), opened the meeting by introducing himself and his accompanying team from CBI and Kearns & West. He thanked participants for their attendance and participation, outlined the workshop objectives and agenda, reviewed Information Quality Act compliance requirements, and took a census of workshop attendance by stakeholder group (the list of workshop registrants is available in Appendix A). Mr. Kansal also introduced each of the three opening speakers:

- *Dan Utech*, White House Domestic Policy Council, Director of Energy and Climate
- *Jose Zayas*, DOE, Program Director of the Wind and Water Power Technologies Office
- *Abigail Hopper*, DOI, Director of the Bureau of Ocean Energy Management

**Dan Utech**, White House Domestic Policy Council, framed the workshop as ideally timed to coincide with the 2015 Paris Climate Conference and to push forward the Obama Administration's commitment to advancing renewable energy. He reviewed recent progress that has been made in addressing technological and market barriers to wider adoption of renewable energy technologies, increasing collaboration between and among the federal government and the states, and driving down development costs. Mr. Utech expressed confidence that 2016 will be an important year for building momentum for offshore wind in the United States. Mr. Utech closed by thanking Mr. Zayas and Ms. Hopper for their leadership around offshore wind development.

**Jose Zayas,** DOE, opened his comments by highlighting the importance of offshore wind both globally and for the US energy portfolio. He explained DOE's role in supporting the offshore wind industry, particularly in terms of funding technology research and focusing the industry's long-term vision, and described how the *2016 National Offshore Wind Strategy* will contribute both to guiding investment and setting a vision for the future. Mr. Zayas noted that the *2016 Strategy* will be the product of a close partnership between DOE and DOI. He closed by emphasizing the eagerness of both DOE and DOI to hear input from workshop participants in order to help shape the *2016 Strategy*.

**Abigail Hopper**, DOI, Director of the Bureau of Ocean Energy Management (BOEM), began by articulating the importance of offshore wind development, including on the Outer Continental Shelf over which BOEM has primary regulatory authority, for contributing to the fight against climate change. She requested that workshop participants be open and forthright in providing input to DOI and DOE, ranging from high-level thoughts on strategic goals for their renewable energy program to detailed and specific comments on the Bureau of Ocean Energy Management's processes and procedures. Ms. Hopper also invited workshop participants to provide input to DOI through BOEM's Request for Feedback process and invited participants to contact her personally.[1]

## Program Overviews and Recent Developments – DOE, DOI, and NREL

Representatives from DOE, DOI, and the National Renewable Energy Laboratories (NREL) made presentations providing background information about their offshore wind programs and highlighting recent developments. The following individuals made presentations:

- *Greg Matzat*, DOE, Senior Advisor, Offshore Wind Technologies
- *James Bennett*, DOI, Chief of the Office of Renewable Energy Programs
- *Walt Musial,* National Renewable Energy Laboratory, Principal Engineer
- *Aaron Smith*, National Renewable Energy Laboratory, Analyst

### DOE – Targeted Investments to Lower the Cost of Energy and Reduce Deployment Timelines

**Greg Matzat**, DOE, Senior Advisor for Offshore Wind Technologies, opened his presentation by reviewing the case for offshore wind energy in the United States and DOE's role in catalyzing offshore wind energy development. He summarized the initiatives that were developed and funded following the publication of the *2011 National Offshore Wind Strategy* in the three areas of technology development, market barrier removal, and advanced technology demonstration. Mr. Matzat explained that, as an early step in developing the *2016 National Offshore Wind Strategy*, DOE opened a Request for Information (RFI) to solicit stakeholder feedback about the implementation of the *2011 Strategy* over the past five years and summarized the input received. In addition, Mr. Matzat previewed the organization and key topics of the *2016 Strategy* and explained how it would build on the DOE's recently released Wind Vision report. Mr. Matzat's presentation slides are available in Appendix B.

In response to Mr. Matzat's presentation, a workshop participant inquired whether DOE had conducted an internal debrief and review of its investments in offshore wind energy development since 2011 and whether that information was available to the public. *Mr. Matzat responded that a DOE publication, "Offshore Wind Projects, Fiscal Years 2006-2015" lists all of the investments made since 2011 without analysis.*

### DOI – Beyond Smart from the Start: Facilitating Development through Informed Siting and Permitting

**James Bennett**, DOI, reviewed DOI's role in domestic energy production and, specifically, in conventional and renewable energy production on the Outer Continental Shelf. He proceeded

[1] *Editor's note:* BOEM's Request for Feedback 90-day comment period closed on December 29, 2015.

to explain BOEM's four-stage renewable energy authorization process as well as the renewable energy activities that are currently underway off the US Atlantic and Pacific coasts. Mr. Bennett noted that BOEM has an Environmental Studies Program that collects information to determine and evaluate the effects of renewable energy activities on the Outer Continental Shelf on natural, historical, and human resources and to determine the appropriate monitoring and mitigation measures for those effects. This research includes both information for planning offshore renewable energy development and the effects of that development activity. In addition, Mr. Bennett summarized key information about BOEM's activities collected by DOE through its Request for Information process. Finally, he closed by explaining how BOEM employs ocean-planning principles for offshore energy leasing in federal waters, including through Intergovernmental State Task Forces. Mr. Bennett's presentation slides are available in Appendix C.

In response to Mr. Bennett's presentation, workshop participants asked the following questions; *responses given by Mr. Bennett are indicated in italics.*

- Would it be possible for BOEM to focus its efforts on characterizing wind resources and allowing development accordingly? If given the chance, industry may be able to resolve any specific environmental concerns, such as minimizing impact on certain species. *BOEM is legally mandated to carry out certain environmental analyses and relies on NREL to characterize wind resource potential. It is BOEM's responsibility to ensure that renewable energy development takes place in a safe and environmentally-responsible manner.*
- Is BOEM receiving sufficient interest from the industry on the areas that is making available for leasing? For example, there were two blocks offshore Massachusetts that did not receive lease bids and the same could happen with the South Carolina blocks, given their location. *The process offshore South Carolina is at a very preliminary stage, and the current Call Areas will be adjusted according to various factors, including wind resources, environmental constraints, market conditions, and public perception. Through the Call and Area Identification process, BOEM tries to carve out blocks that will attract commercial interest. Incidentally, the cited blocks offshore Massachusetts did receive lease bids.*
- Is BOEM's mandate to promote development of offshore wind energy or is it to regulate that development? *Both of those aspects are part of BOEM's mandate. BOEM has a mandate to expeditiously develop the Outer Continental Shelf, promoting development in those areas where it is advantageous and in the public interest. However, it is also BOEM's responsibility to ensure that renewable energy development takes place in a safe and environmentally-responsible manner.*

### NREL – Analysis to Build a Business Case for Offshore Wind

**Walt Musial** and **Aaron Smith**, NREL, presented the initial results from NREL's analyses to support the 2016 National Offshore Wind Strategy, including:

- The elements needed to make a compelling business case for offshore wind development to policy makers;

- Characterizing offshore wind resources and terminology to enable comparisons to the oil and gas industry;
- Initial results from an updated US offshore wind resource assessment that includes consideration of technology boundaries;
- The market for new electric energy generation, both nationally and regionally;
- Overview of major cost reduction opportunities in the U.S. offshore wind market; and
- Identification of non-levelized cost of energy (non-LCOE) market benefits of offshore wind energy development.

Mr. Musial's and Mr. Smith's presentation slides are available in Appendix D.

In response to Mr. Musial's and Mr. Smith's presentation, workshop participants asked the following questions and made the following comments; *responses given by Mr. Musial and Mr. Smith are indicated in italics, unless otherwise indicated.*

- What elements were not included in NREL's analyses? For example, what about stranded resources in Alaska and sites closer to shore that could become more viable for development if the public becomes more concerned about climate change? *While the potential for development in Alaska is likely significant, NREL has not yet been able to dedicate the resources needed to perform that resource assessment. Greg Matzat added that the potential for offshore development is very significant even with areas closer to shore being excluded in response to conflicting uses and public concerns about visual impacts.*
- NREL may want to test their distance filters against the Department of Defense's and the US Coast Guard's map of red, yellow, and green zones. For example, the 90 percent area exclusion offshore Virginia seems high. *NREL is trying to avoid performing actual marine spatial planning, which falls into the purview of other agencies, but additional data is always useful.*
- Why did NREL exclude the social cost of carbon from its business case analysis? *At present, the social cost of carbon is not currently valued by the market. If policies change to incorporate it, the levelized avoided cost of energy would shift upwards and yield a higher equilibrium point for offshore wind energy to enter the energy market.*
- It would be preferable if NREL would allow developers to work out conflicts and exclusion areas with other ocean users and stakeholders directly instead of broadly excluding areas in its analysis.
- With onshore wind energy, lowering operational costs has a more significant impact on lowering LCOE than does lowering capital costs. Has NREL considered that in its offshore analysis? *NREL's modeling has found that the two biggest sources of cost reduction for offshore wind are shifting to larger turbines and building out the supply chain for offshore wind.*
- How significant is the impact of the projected lifespan of wind energy installations? Would it help lower the cost of energy to consider turbine lifespan longer than 20 years? *Most major turbine suppliers are designing for 25-year lifespans. Over the long run, the lifespan of the turbines does not seem to have a significant impact on the cost of energy.*

- What did NREL assume in terms of a distribution between floating and fixed turbine platforms in its modeling? *NREL accounted for both types of platforms in its modeling, with sites in deeper water assumed to be built on floating platforms.*
- Coastal states face a tremendous threat from sea level rise resulting from climate change. Did NREL look at the potential avoided adaptation costs from greater offshore wind energy development? *NREL has not directly considered the impact of climate change on coastal states as part of the levelized avoided cost of energy. This will be very important to do, but it will need to be done at a localized scale.*
- ISO New England recently released a paper indicating that additional production from renewable energy sources is expected to decrease wholesale electric energy prices and could result in increased capacity market prices to ensure resource adequacy. It could be helpful for NREL to investigate this further.

## Discussion Sessions

Workshop participants participated in a selection of seven discussion sessions with DOE and DOI personnel. Each session consisted of a short presentation establishing the framework for the discussion followed by facilitated discussion around the following general framing questions:

- What are the industry's and other stakeholders' key priorities over the next five years to expedite development of offshore wind in the US?
- What can DOE and DOI do to achieve these priorities, including in cooperation with industry and stakeholder groups?

In addition to the participant discussions that are summarized below, some workshop participants also provided written input on comments cards. That written input is summarized in Appendix E.

### 1A. Informing and Streamlining the Siting and Permitting Processes

This session addressed siting and permitting challenges, how the agencies can work within their respective authorities to decrease permitting timelines where possible, and how to strike the right balance between regulatory certainty and flexibility.

DOI and DOE personnel opened the session by reviewing BOEM's siting and permitting processes, steps that the agencies have already taken towards streamlining these processes, and stakeholder input about siting and permitting received through DOE's Request for Information. Presentation slides for this discussion session are available in Appendix F.

Workshop participants offered the below suggestions for how the agencies can streamline the siting and permitting processes.

#### *Timelines and Sequencing*

- Add timeframe requirements for BOEM in the permitting process. Currently developers have strict timelines that must be followed, but regulators do not. This could be implemented via an MOU or MOA between a developer and BOEM that would require

their agreement on a timeline for development as well as mechanisms to keep the permitting process moving forward in the event of any delays. A workshop participant also inquired about the possibility of holding BOEM responsible for any costs incurred as the result of permitting delays.

- Revise the permitting process to allow developers to pursue some of the higher cost steps, such as performing a geotechnical survey, after a power purchase agreement is secured.
- Site control could be granted after the developer completes the Environmental Assessment (EA, under the NEPA process) in order to facilitate securing a power purchase agreement.

### *Tailored and Expedited Permitting*

- Offer two separate leasing or siting processes, one for areas closer to shore that have more user conflicts or environmental impacts, and a separate process for areas that are further offshore.
- Implement an ARARs-type (Applicable or Relevant and Appropriate Requirements) or other two-track permitting process to expedite permitting for developers that choose to follow objective standards.
- Employ a nationwide permit for scientific devices, such as meteorological towers and buoys.
- Speed up the permitting process for meteorological towers, buoys, and other site assessment equipment that are temporarily installed.
- Allow for submission of a generic Construction and Operations Plan (COP). Generic COPs could be tailored for different sub-geographies, such as regions, states, or Wind Energy Areas, in order to account for and address more local environmental conditions and impacts. Alternatively, if the entire COP cannot be generic, discrete elements of the COP could be generic in order to lower the cost of development.

### *Data and Information*

- Develop a unified data portal with all existing state and federal data that would be updated regularly to incorporate data from new studies. This data portal could be developed at the federal level and could help developers locate potential sites more efficiently and at lower cost. Identifying state-level points of contact early would be helpful.
- Backfilling data gaps and preloading the permitting system with needed data would both speed up the review process and instill greater confidence in decision-making.

### *Coordination*

- Implement a single, umbrella permit, as the United Kingdom uses for offshore wind development.
- Create a virtual one-stop shop for permitting offshore wind development that has all standards, requirements, data, and studies across diverse agencies and jurisdictions in one place.

- Coordinate permitting steps and timelines across jurisdictions and agencies as is done, for example, in the Deepwater Port Act.
- Earlier coordination with, and more structured guidelines for, the Certified Verification Agent (CVA) would enhance predictability and smooth the process.
- Explore how leasing and siting could be administered on a regional, rather than state, level.
- Enhance coordination among federal agencies for Section 7 consultations under the Endangered Species Act.

### 1B. Shoring up the Supply Chain

This session addressed the strategic first steps to building an offshore wind supply chain by addressing topics such as fabrication, offshore construction, operations and maintenance, vessels, and support infrastructure. The discussion was framed by acknowledging the lack of a mature market and a pipeline of projects, which limits interest in building a robust supply chain.

DOI and DOE personnel opened the session by reviewing steps that the agencies have already taken towards encouraging supply chain development, reports and tools about this topic, and stakeholder input about supply chain development received through DOE's Request for Information process. Presentation slides for this discussion session are available in Appendix G.

Workshop participants offered the following suggestions for how the agencies can contribute to developing an offshore wind supply chain.

#### *Interagency Collaboration and International Partnerships*

- Create an interagency taskforce focused on skills, training, and certifications because there has not been a strong focus on the people required to do the work in the supply chain.
- Create an interagency taskforce focused on identifying and then reducing risk in the US supply chain. For example, the taskforce could investigate ways to mitigate the risk of manufacturing tertiary components in the US.
- Support international partnerships for vessel use and supply chain development to help US firms learn from their international counterparts.
- Where possible, have US standards mirror European standards so that US companies that enter into the US supply chain could also compete for opportunities in other offshore wind markets.

#### *Explore Options Under and Around the Jones Act*

- Clarify exactly what activities are permissible and impermissible under the Jones Act. It is possible that there are transport activities for the offshore wind supply chain that could be undertaken today even under current restrictions.
- Given that there may be options available under the Jones Act, analyze the financial implications for wind energy developers of using diverse vessel scenarios that may be available.

- Given that some types of floating wind turbines do not require the use of heavy-lift vessels, DOE could accelerate research into this technology, which could be particularly well-suited for deployment in the Northeast and off the West Coast.
- Explore how feeder vessels that can already be built in the US can be better utilized.

### *Supply Chain Analysis and Modeling*

- Analyze the supply chain to determine if there is an industry or supplier that would be a catalyst for the formation of a full supply chain. Then, determine what steps, mechanisms, or conditions would be needed in order to bring this catalytic element of the supply chain into being. For example, this catalyst could be vessels, or it could be another portion of the supply chain. If the catalyst is vessels, then the pre-condition for formation could be something like a five-year contract to support offshore wind operations.
- Modeling different supply chain scenarios and contingencies could help to clarify risks and their attendant financial implications for developers and potential supply chain participants.
- Supply chain modeling and analysis of infrastructure for vessels and fabrication should be conducted at the regional and/or national level versus the state level. In the past every state wanted a factory. States need to recognize that attracting a turbine manufacturer to one state could result in components coming from multiple states.

### *Communications with Decision Makers and Stakeholders*

- Enhanced communication with state and local policymakers about the benefits of offshore wind and its associated supply chain could help them understand the potential economic benefits for their districts. For example, an "educational roadshow" could spread the word about the potential benefits of offshore wind development as well as educate policymakers on the type of jobs and skills that will required in the industry.
- Make studies about offshore wind and its supply chain more easily understandable to stakeholders so that, for example, companies can easily understand what savings and efficiencies may be available to them.
- Once there are successful offshore wind developments in the US, promote these stories to policymakers and other stakeholders.

## 1C. Decreasing Project Risk through Physical Site Assessment

This session addressed how physical site assessment can reduce risk in offshore wind projects and how physical site assessment and wind resource characterization can increase confidence in project planning and design.

DOI and DOE personnel opened the session by reviewing work that the agencies have already done around physical site assessment and wind resource characterization and stakeholder input about these topics received through DOE's Request for Information process. Presentation slides for this discussion session are available in Appendix H.

Suggestions from workshop participants for how the agencies can decrease project risk through physical site assessment and wind resource characterization, as well as additional points of discussion, are summarized below.

### *Make it Easier for Developers to Conduct Site Assessment*

- Pre-fund site assessment to reduce risk for developers who otherwise spend millions of dollars without offtake agreements in place. For example, federal and/or state governments can perform early reconnaissance-level site assessment during the pre-lease phase and then recoup these costs (which are not substantial) from developers during the leasing phase. This reduces risk for developers, facilitates better-informed and more viable lease bids, and is ultimately cost-neutral for the government.
- Provide guidelines or standards for what types of data developers need to have at different stages of the design and permitting process. Different types of data are needed for different purposes, such as different phases of development, different metocean conditions, etc.

### *Collect Additional Data*

- Different data collection methods yield different types of data. For example, traditional buoys provide basic metocean data, while lidar towers provide data about wind speeds at greater elevations from the water surface. Fixed offshore platforms can also help to validate lidar data (which should be validated for both vertical and for horizontal accuracy). Invest in data collection by deploying one or more of the following technologies, depending on the need for accuracy versus quantity or geographic spread of data:
    - Meteorological towers offshore in order to characterize the wind resource and validate readings from other data sources such as buoys and floating lidar;
    - Distributed floating lidar that would provide lower quality data than a met tower but across a broader area;
    - Fixed tower with validated lidar as a middle-ground between the above two approaches;
    - Tall towers at the coast in order to get high altitude data.
- Europe's experience with data collection and site assessment could be helpful. Consider partnering with Germany on FINO research platforms that are designed to collect extensive wind, ocean floor, wave and current, and shipping data. They also collect information on birds, marine life and benthos populations.

### *Enhance Data Sharing and Availability*

- Provide basic offshore geological and metocean data to prospective developers on a state-by-state basis.
- Tap data from other federal agencies, such as the US Army Corps of Engineers on wave data, and from other relevant data sources, such as the American Society of Civil Engineers on hurricane modeling.
- Provide links to all relevant government studies and data on a single website that includes short descriptions of the studies and how they can be useful to developers.

### *Prioritize Putting Steel in the Water*

- Focus DOE and DOI resources and support on getting projects that are currently in the pipeline successfully through development as opposed to performing a global assessment of the Outer Continental Shelf in order to identify sites for future development. The early success stories will foster additional development.

## 2A. Reducing Cost and Ensuring Safety through Technology Development

This session addressed how technology development can ensure safe design and reduce costs. Participants discussed innovative technologies designed to address relevant US challenges, including wind plant power performance, foundations, reliability, safety, and testing facilities.

DOI and DOE personnel opened the session by reviewing work that the agencies have already done around technology development and stakeholder input about this topic received through DOE's Request for Information. Presentation slides for this discussion session are available in Appendix I.

Suggestions from workshop participants for how the agencies can reduce cost and ensure safety through technology development are summarized below.

### *Interagency Coordination*

- Continue to advance coordination and collaboration between DOE, DOI, the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), universities, and others.
- Build connections between DOE's research and lending programs to facilitate low-cost financial opportunities for deploying new technologies.
- Create a repository where relevant government-supported data is publicly available.

### *Research, Testing, Standards, and Validation*

- Research extending the design life of offshore wind installations.
- Investigate installation techniques and perform cost-benefit analysis of floating turbines.
- Support a US Offshore Wind Testing Center that could allow developers to test technologies and from where data and information would be publicly available.
- Provide support for testing scale-model prototypes.
- Further develop software and tools for data collection and modeling that can be accepted and used both by industry and regulators. Specific areas that participants identified for further development include:
    - FAST modeling of tension-leg platforms,
    - Validation of FAST against field data,
    - Coupling FAST with design tools,
    - Optimal depths for cable burial.
- Offshore wind turbine design standards are still under development and are more complex than onshore turbine design standards due to the variability of sites and support structures. The offshore design standards require validation in order to ensure

accuracy and consistency of interpretation. Designs need to be tested for both operational and extreme conditions. It may be possible to take lessons from land-based wind classification systems and related turbine designs.
- Validate lidar measurements for metocean data.

### *Learning from Related Industries & International Offshore Wind*

- Both the European offshore wind industry and the oil and gas industry in the Gulf of Mexico have significant experience with offshore installation and operations. This expertise could be tapped in various ways:
    - Conduct a competition to construct a benchmark project,
    - Tour their facilities.
- Study and learn from technology incubation programs for other industries and apply these lessons to create an incubation program for offshore wind energy.

### *Fabrication*

- Explore improvements for welding and coating technologies. Improvements in these technologies could reduce costs for developers, including labor costs.
- Validate newer welding and coating technologies to de-risk them for offshore wind developers and to make them more acceptable to regulators.
- Federal agencies could conduct cost-benefit analysis to determine whether and how these new technologies could be profitably used for offshore wind development.

## 2B. Environmental Solutions from Development through Operation

This session focused on how environmental studies can address data gaps, innovate processes, and develop practical solutions.

DOI and DOE personnel opened the session by reviewing the environmental studies that the agencies have already done and stakeholder input about this topic received through DOE's Request for Information. Presentation slides for this discussion session are available in Appendix J.

Suggestions from workshop participants for how the agencies can support environmental studies to support the development of the offshore wind industry are summarized below.

### *Suggested Research and Studies*

- Studies about the following areas could be useful:
    - Right whales,
    - Passive acoustic warning systems,
    - Socio-economic impacts of development including, for example, on tourism, property values, and fishermen livelihoods,
    - Changes in animal behavior, including the extent of attraction or deterrence to wind energy installations
    - Air quality impacts from service vessels.
- Build an online data mapping service to map the seafloor in which collaborators can contribute data.

- Research into two areas could conceivably "retire" risk to the extent that risks are well-understood and documented such that new studies will not be required for each new project:
    - Electromagnetic fields,
    - Operational noise.

### *Suggested Approaches*

- Collaboratively coordinate data collection efforts across agencies.
- Collect data at a scale that is meaningful to answer relevant questions. For example, data must be at a sufficiently localized scale to be useful for site selection.
- Provide greater support for telemetry, for example installing data collection towers so that more comprehensive environmental data is available.
- Revisit data periodically to identify shifts in animal behaviors.
- Identify what types of information or characteristics about species are required before beginning monitoring efforts (for example, spawning, migration, feeding, etc.).
- Build predictive modeling based on East Coast bird data in order to better understand where to site wind turbines.

### *Guidance to Developers Around Environmental Monitoring*

- Developers would like greater clarity and consistency regarding what is required from them with regards to post-construction environmental monitoring. Examples include:
    - Greater consistency about what types of data must be collected at each site.
    - Agreement among agencies for a process to assess the significance of impacts would be helpful. This could be in the form of a scale or matrix.
    - Marine mammal monitoring requirements.
- Despite the desire for greater clarity and consistency in data collection and monitoring, however, some participants raised the following cautions and concerns:
    - The issues facing each project and site will be different, thereby necessitating a tailored approach to data collection and monitoring.
    - Agencies will need to collaborate in order to synchronize and streamline requirements. Monitoring plans would need to be discussed during the consultation process.
    - An adaptive management approach should be implemented, in which monitoring data is evaluated to assess its adequacy for potential adjustments in approach.

## 2C. Quantifying Electric System Impacts

This session addressed how the direct benefits and externalities of offshore wind on the grid can be captured, particularly those electric system impacts not currently reflected in electricity markets.

DOI and DOE personnel opened the session by reviewing work that the agencies have already done around quantifying electric system impacts and stakeholder input about this topic

received through DOE's Request for Information. Presentation slides for this discussion session are available in Appendix K.

Suggestions from workshop participants for how the agencies can better capture and communicate electric system impacts, as well as additional points of discussion, are summarized below.

### *Suggested Research and Studies*

- Conduct studies on:
    - The potential cost trajectories of offshore wind energy.
    - Disaggregating efficiency improvements and higher wind speeds in projections for increased energy production.
    - The baseload characteristics of offshore wind energy.
    - The potential impacts of offshore wind development on the following:
        - Market price and ratepayer bill suppression impacts,
        - Avoided transmission costs,
        - Grid quality, particularly reliability and voltage control,
        - Carbon emissions and public health.

### *Working With Other Stakeholders*

- Many of the relevant decisions around offtake of energy from offshore wind will be made by policymakers at the state level. DOE and DOI can play some role in working with state governments and other stakeholders, but additional work will need to be done by offshore wind advocates and others to work with decision-makers at the state level.
- NREL could offer to provide technical assistance to states and independent system operators (ISOs) that are undertaking their own studies about electric system impacts, cost savings, or other topics.
- When communicating studies and data, the agencies need to make them both relevant and easily accessible to diverse target audiences, including legislators, public utilities commissioners (e.g. at NARUC meetings), ISOs, renewable energy advocates, and ordinary citizens and ratepayers. For some of these stakeholders, a more technical presentation of the information is appropriate. For others, the issues can be framed clearly and simply by creating communications tools such as fact-sheets, infographics, and videos. In addition, the message should not seem biased and should communicate both the costs and benefits of offshore wind development.

## 3. Communicating the Benefits and Creating Power Purchase Mechanisms

This session focused on how best to communicate the value of offshore wind with the goal of creating power purchase mechanisms.

DOI and DOE personnel opened the session by framing the discussion topic, noting that respondents to DOE's Request for Information identified securing power offtake as the most challenging aspect for the U.S. offshore wind industry. They proceeded to summarize the

challenges and suggestions provided in response to the Request for Information. Presentation slides for this discussion session are available in Appendix L.

Suggestions from workshop participants for how the agencies can better communicate the value of offshore wind, as well as additional points of discussion, are summarized below.

### *Suggested Research and Studies*

- Studies by DOE and NREL projecting how the cost of energy from offshore wind will come down over time would help to build support at the state level for offtake agreements. Studies should cover both energy market and capacity market impacts. It would be especially helpful if these studies were done for individual states.
- DOE and NREL could provide technical assistance and grants to states to conduct modeling on price and reliability from increased integration of offshore wind.
- Explore conducting research on the connection between offshore wind and cyber-security, as this is a key concern for utilities.

### *Communications Strategies*

- Messaging about the benefits of offshore wind energy that are targeted to the general public and other non-technical stakeholders should be easily accessible. DOE should create communications tools such as fact-sheets, infographics, and videos to communicate the benefits of offshore wind energy.
- Studies and messages targeted at utilities and state regulatory commissioners should focus on two aspects: cost and reliability. For utilities and commissioners in certain states and regions, capacity value and resilience are two other key concerns.
- Promote offshore wind as a domestic clean energy source.
- The offshore wind story has several audiences, including utilities, ratepayers, and politicians. Advocates need to understand their audiences and tailor their messaging accordingly. While some of these audiences care solely about the levelized cost of energy, others may care that the industry is making a contribution toward mitigating climate change.
- Although the offshore wind industry does not yet have data available demonstrating decreasing costs over time, the onshore wind industry does. Drawing parallels between the industries could help to tell the offshore wind story.
- Target messaging to the younger generations, who are generally more open to new technologies and more concerned about climate change.

### *Other Comments and Suggestions*

- Explore contractual mechanisms to provide to ratepayers upfront compensation for the promised future savings from offshore wind development.
- DOE could create an incentive program for large corporations to commit to using renewable energy, including offshore wind.
- Universities could be persuaded to purchase power from offshore wind developments.
- Contracts for difference have helped to accelerate the market for offshore wind energy in the United Kingdom.

## Workshop Closing

Workshop facilitators summarized key themes raised by participants throughout the day, with a focus on the afternoon discussions sessions. Tushar Kansal, Greg Matzat, and James Bennett provided closing comments, thanking participants for their contributions and input. The speakers identified a number of follow-up items from the workshop:

- The Consensus Building Institute (CBI) will create a written summary of the workshop.
- DOE will distribute CBI's summary and the presentation slides used throughout the day.
- DOE will send out an email address to which workshop participants can provide additional comment.[2]
- Workshop participants were invited to submit input to DOI through BOEM's Request for Feedback process.[3]
- The agencies anticipate that the *2016 National Offshore Wind Strategy* will be published in mid-2016.

[2] *Editor's note:* DOE distributed an email on December 17, 2015 that provided the following email address for additional comment: offshorewind@ee.doe.gov.

[3] *Editor's note:* BOEM's Request for Feedback 90-day comment period closed on December 29, 2015.

## Appendix A – Workshop Registrants

| ***General Registrants*** | |
|---|---|
| Rashid Abdul | CG Power Systems |
| John Anderson | American Wind Energy Association |
| Cristina L. Archer | University of Delaware |
| Sanjay Arwade | University of Massachusetts, Amherst |
| Tiothy Axelsson | Fishermen's Energy LLC |
| Justin Bailey | Alpine Ocean Seismic Survey, Inc. |
| Kevin Banister | Principle Power |
| Jen Banks | Southeast Wind Coalition |
| Simon Baughman | Bureau of Safety and Environmental Enforcement |
| Jay A. Borkland | ODE/Apex Team |
| Joan Bondareff | The SPECTRUM Group |
| Catherine Bowes | National Wildlife Federation |
| Jennifer Brack | DONG Energy |
| Jai Bucknell | iSIMS LLC d/b/a IntelliSIMS |
| Liz Burdock | The Business Network for Offshore Wind |
| Rain Byars | ABS Group |
| Catherine Creese | US Navy |
| Clayton Cook | Cook Maritime Finance |
| Vicki Cornish | Marine Mammal Commission |
| Catherine Creese | The United States Navy |
| Fara Courtney | Consulting in Clean Energy & Climate Strategies |
| M. Elizabeth Cox | Bureau of Safety and Environmental Enforcement |
| John Cushing | Bureau of Safety & Environmental Enforcement |
| Habib Joseph Dagher | University of Maine |
| Jennifer Daniels | Tetra Tech, Inc. |
| Shawn Danoff | US Maritime Administration, Dept. of Transportation |
| Ruben Delgado | University of Maryland, Baltimore County |
| George Detweiler | The United States Coast Guard (Stop 7418) |
| John Dick | The Office of Management and Budget - Energy Branch |
| Michael Drunsic | DNV GL |
| Dennis Duffy | Cape Wind/Energy Management Inc. |
| Frederick Engle | Department of Defense, Office of the Secretary of Defense |
| Bryan Faehner | National Park Service |
| Anthony Fiore | NYC Mayor's Office of Sustainability |
| Albert Fisas | GE Renewable Energy |
| Jason Folsom | Siemens Energy Inc. |
| Kelly Fortin | Environmental Protection Agency |
| Grover Fugate | Rhode Island Coastal Resources Management Council |
| Josh Gange | National Oceanic and Atmospheric Administration |

| | |
|---|---|
| Stephen Geiger | Green Sail Energy |
| Andy Geissbuehler | GE Renewable Energy |
| Travis Giese | Cape Hatteras Wind |
| D. Todd Griffith | Sandia National Laboratories |
| George Hagerman | Virginia Tech Advanced Research Institute |
| Rudy Hall | Keystone Engineering Inc. |
| Gina Hall | Carbon Trust |
| Sven Hodges | White House Council on Environmental Quality |
| Mary Hallisey Hunt | Georgia Institute of Technology, Strategic Energy Institute |
| Doreen Harris | NYSERDA |
| William Hurley | Glosten |
| Ninna Ipsen | DONG Energy |
| Sean Jessup | Moffatt & Nichol |
| Peter Johnson | Amerigo Offshore LLC |
| Ken Jurman | Virginia Department of Mines, Minerals and Energy |
| Mark Kalpin | Wilmer Cutler Pickering Hale and Dorr |
| Jenny Kelvington | North Carolina Department of Environmental Quality |
| Katherine Kennedy | Natural Resources Defense Council |
| Dan Kuchma | Tufts University |
| John Larson | Dominion Resources Services, Inc. |
| Warren Leon | Clean Energy States Alliance |
| Suzanne MacDonald | Island Institute |
| James F Manwell | University of Massachusetts, Amherst |
| Noah Matson | The United States Fish and Wildlife Service |
| Catherine McCall | Maryland Department of Natural Resources |
| Robert Mecarini | Alpine Ocean Seismic Survey, Inc. |
| Jen Mehaffey | Bureau of Safety and Environmental Enforcement |
| Markian Melnyk | Atlantic Grid Development LLC |
| Shelton Metcalf | Seacalf Holdings |
| Anne Merwin | Ocean Conservancy |
| Michael Miller | Ogos Energy LLC |
| Gerald Morrissey | Winston & Strawn LLP |
| Laura Morton | National Oceanic and Atmospheric Administration |
| Matt Mullin | U.S. Wind |
| Walt Musial | National Renewable Energy Laboratory |
| Andrew Myers | Northeastern University |
| Ralph Nichols | Savannah River National Laboratory |
| Charles Nordstrom | BVG Associates |
| Kris Ohleth | Ecology & Environment, Inc |
| Mike Olsen | Statoil |
| Lucille Olszewski | Ensemble Wind |
| Michael O'Neill | K&L Gates LLP |

| | |
|---|---|
| Rebecca O'Neil | Pacific Northwest National Laboratory |
| Steve Pelletier | Stantec Consulting Services |
| Trevor Peterson | Stantec Consulting Services |
| Doug Pfeister | The Renewables Consulting Group |
| Dennis Phelan | Pacific Seafood Processors Association |
| Stephen Porter | Northwest Pennsylvania Green Economy Task Force |
| Paul Rich | U.S. Wind, Inc |
| David Sackett | Fulgro Consultants |
| Robin Shanen | New York Power Authority |
| Will Shaw | Pacific Northwest National Laboratory |
| Aaron Smith | National Renewable Energy Laboratory |
| Kevin Smith | Fulgro Consultants |
| Michael Snyder | New York State Department of State |
| Nancy Sopko | American Wind Energy Association |
| Erich Stephens | Offshore MW, LLC |
| Alexandra St.Pé | University of Maryland, Baltimore County |
| Morten Svendstorp | Danish Embassy |
| Terry Tarle | AXYS Technologies Inc |
| Michael Thompson | Northland Power |
| Joshua Toepfer | Bureau of Safety and Environmental Enforcement |
| William Toman | Cal Poly Institute for Advanced Technology and Public Policy, CalWave |
| Raya Treiser | Wilmer Cutler Pickering Hale and Dorr |
| Ross Tyler | The Business Network for Offshore Wind |
| Charlene Dwin Vaughn | Advisory Council on Historic Preservation |
| Larry Viterna | Nautica Windpower, LLC |
| Lorry Wagner | Lake Erie Energy Development Corporation |
| Stanley M White | Fishermen's Energy, LLC |
| Bruce Williams | Williams Offshore Wind |
| A. Leigh Williams | Maryland Energy Administration |
| Chris Wissemann | Fishermen's Energy |
| Daniel Woodman | ODE (Offshore Design Engineering) |
| Andy Zalay | EWindfarm |
| | |
| ***Department of the Interior*** | |
| Joan Barminski | BOEM |
| James Bennett | BOEM |
| David Bigger | BOEM |
| Mary Boatman | BOEM |
| Doug Boren | BOEM |
| Ann Bull | BOEM |
| Darryl Francois | BOEM |

| | |
|---|---|
| Jennifer Golladay | BOEM |
| Abigail Hopper | BOEM |
| Isis Johnson | BOEM |
| Brian Krevor | BOEM |
| Jennifer Miller | BOEM |
| Annette Moore | BOEM |
| Michelle Morin | BOEM |
| Dan O'Connell | BOEM |
| Amy Stillings | BOEM |
| Jessica Stromberg | BOEM |
| | |
| ***Department of Energy*** | |
| Gilbert Bindewald | Department of Energy |
| Jocelyn Brown-Sacarino | Department of Energy |
| Kerry Cheung | Department of Energy |
| Charleton Clark | Department of Energy |
| Jordan Dale | Department of Energy |
| Alana Duerr | Department of Energy |
| Luke Feinberg | Department of Energy |
| Patrick Gilman | Department of Energy |
| Todd Griffith | Department of Energy |
| Greg Matzat | Department of Energy |
| Ben Maurer | Department of Energy |
| Maggie Yancey | Department of Energy |
| Jose Zayas | Department of Energy |

# Appendix B

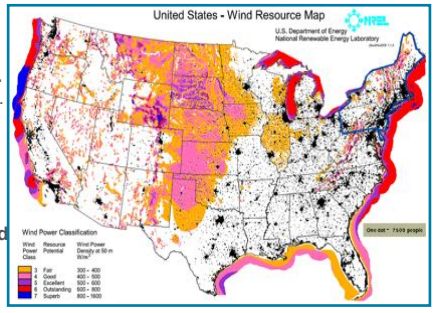
**Targeted Investments to Lower the Cost of Energy and Deployment Timelines: DOE's Past, Present and Future**

Greg Matzat, P.E.
Senior Advisor, Offshore Wind
Wind and Water Power Technologies Office

## Why Offshore Wind?

**Offshore wind complements onshore wind with its ability to provide clean renewable wind energy to coastal states, especially those with fewer sites available for onshore wind.**

1. **The U.S. has over 4,000 GW of gross offshore wind** energy resources (four times the Nation's installed electricity capacity) within 50 miles of its coasts.
2. **The 28 coastal states account for nearly 80% of U.S. electric demand** and tend to have high electricity rates.
3. **Offshore wind does not require long-distance overland transmission**, may be located near load centers and may help distribute renewables across the grid providing increased grid stability and security.
4. **Offshore wind's generation profile similar to the load profile**.
5. **Environmental benefits**
6. **Economic benefits** in the form of direct and indirect jobs.



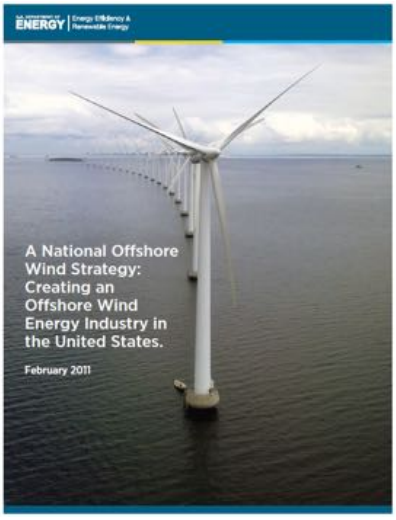
# DOE 101

**Role of DOE**

Catalyze the timely, material, and efficient transformation of the nation's energy system, and secure U.S. leadership in clean energy technologies

**Department initiated substantial funding of offshore wind in 2009**


# 2011 Offshore Wind Strategy Retrospective




## 2011

### Two critical objectives

- Reduce the cost of energy through technology development to ensure competitiveness with other electrical generation sources
- Reduce deployment timelines and uncertainties limiting U.S. offshore wind project development

## 2011 Strategy Implementation

### Three Major Focus Areas

**Technology Development**

**World-Class Test Facilities**

Clemson 15 MW Dynamometer

Massachusetts Large Blade Test Facility (to 90m)

**$70M**

**Next Generation Drivetrain R&D**

Aggressively Targets Key Cost Components

**$7.5M**

**Developing Innovative Technology**

Computational Tools

Turbine Design

Marine Systems Engineering

**$26.5M**

**Market Barrier Removal**

**Removing Market Barriers**

Siting and Permitting

Infrastructure Studies

Resource Planning

**$16.5M**

**Advanced Technology Demonstration**

**Demo Projects**

Advanced Technology Deployed on Demonstration Scale

Partnerships with 50% Cost Share

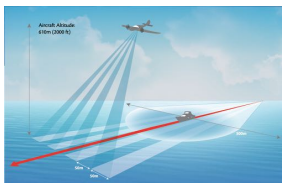
**$168M**

## Implementation: Technology Development

| Test Facilities and Next-Generation Drivetrain | Developing Innovative Technology |
|---|---|
| • Deployment agnostic<br>• Facilitate technology for offshore and land based wind<br>• Clemson Drivetrain Facility, MassCEC Blade Test Facility, two drivetrain awards | • Offshore Specific R&D<br>  • Advanced Turbine Design<br>  • Marine Systems Engineering<br>  • Computational Tools and Modeling |

# Implementation: Market Barrier Removal

| Siting and Permitting | Infrastructure Studies | Resource Planning |
|---|---|---|
| • Siting<br>  • Tools and desktop studies<br>  • I, O&M strategies, market report<br>• Permitting<br>  • Data collection to support offshore wind permitting activities<br>  • Mid-Atlantic baseline study; bat and avian monitoring | • Supply Chain/Ports Assessment<br>  • Desktop studies/ analysis<br>  • Tools<br>• Grid Focus<br>  • Interconnection studies (national and regional) | • Wind Resource Assessment<br>• Operating Conditions Assessment<br>  • Wind, waves, ice<br>  • Hub-height level wind extrapolation methods<br>• Field evaluation and measurements |



**Outcomes**

BRI Mid-Atlantic Baseline Study

- Compared innovative technology which facilitated baseline data collection
- U.S. industry is using innovative approaches and technology that have not been utilized in the mature European market, and could potentially be adopted
- Provides information agencies need to complete environmental analysis as well as speed the permitting process

# Implementation: Advanced Technology Demonstration Projects

**Advanced Technology Demonstration Projects**

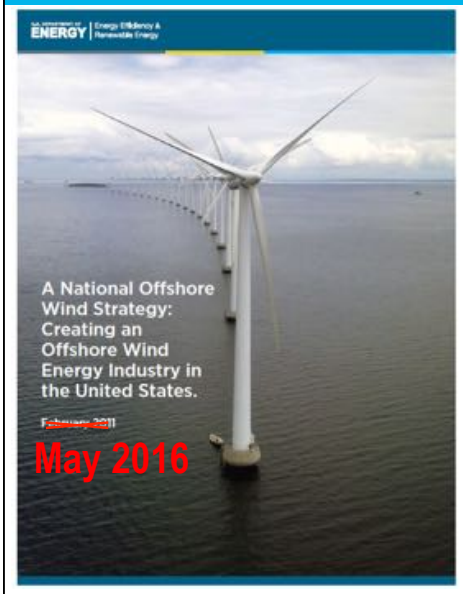
**Goals:**

- Reduce the cost of energy and timeline for deployment
- Collect data to help provide a U.S. baseline for industry to build upon – performance, cost, environmental data, etc.
- Create an offshore wind laboratory at sea to study wake effects, new control technologies, innovative monitoring technologies, etc.

**Lessons Learned**

- Permitting has its challenges, but can be overcome
  - Process needs to be exercised and evaluated according to the experience
  - BOEM has done an outstanding job on the two projects in Federal waters
- Lack of U.S. supply chain is a huge cost driver, with installation vessels and cable supply/installation being major aspects
- Demonstration projects are expensive; even with large amounts of government funding, significant non-Federal investment and cost share is required for project success

## A New Strategy




**Reflecting in order to create a 2016 Strategy**

- Is what DOE funded in the past useful to the industry?
- Should DOE continue to follow the same path and make the same kinds of investments?
- Are there studies that DOE has funded that can be utilized as a springboard for additional R&D?
- Does the current state of the market in the U.S. demand a new outlook for DOE?

## Soliciting Industry Input

- Request for Information regarding the 2011 *Strategy* and Implementation was released in May 2015 with responses due to DOE in July
- Respondents identified these top challenges for spurring industry development

| Challenge Ranking | Topic Area |
|---|---|
| 1 | Market Value Assessment and Power Purchase Mechanisms |
| 2 | Siting and Permitting |
| 3 | Resource Assessment and Site Characterization |
| 4 | Plant Technology Advancement |
| 5 | Demonstration Projects |
| 6 | Supply Chain, Manufacturing, and Logistics |
| 7 | Power Performance, Reliability and Safety |
| 8 | Test Facilities |
| 9 | Electricity, Delivery, and Integration |

## RFI Results

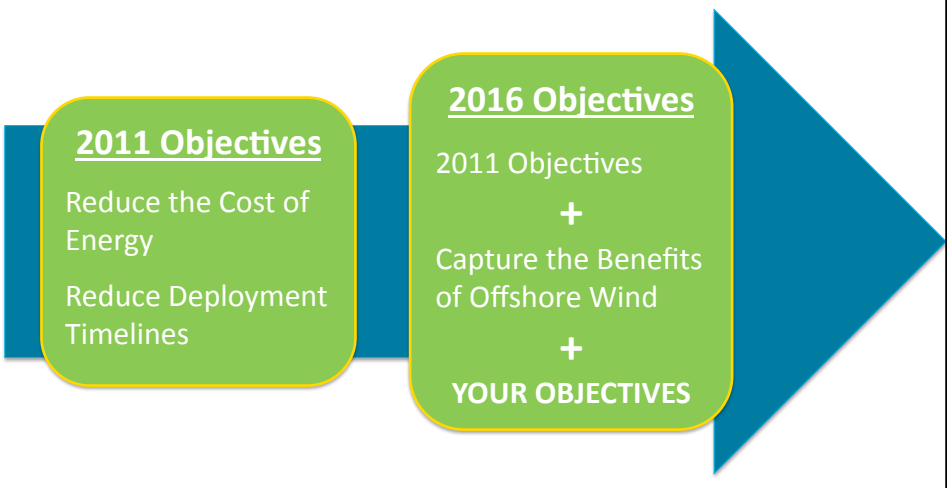
**High-level Feedback**

- The most important challenge currently facing industry is securing power offtake
- Current mechanisms do not properly account for the value offshore wind, e.g. emissions, economic growth, national security, merit order effect, etc.
- Siting and permitting process is still a concern – Smart from the Start has been helpful, and improvements/streamlining can still be found
- Resource characterization and baseline environmental data is highly valuable in early stages of project development
- Based on industry feedback, it was clear that initiatives undertaken by both BOEM and DOE require broader and more robust dissemination and communication strategies

**Additional Feedback Outside of the RFI**

- Vessels
- Funding mechanisms that will benefit the offshore wind community
  - Broad v. specific research initiatives
  - Few large funding initiatives v. many small funding initiatives
  - Near-term incremental efforts v. long-term paradigm shifting research

## Strategy Objectives



## *A National Offshore Wind Strategy 2016*

- **Anticipated publication in mid-2016**
- ***Chapter 1: Background***
- ***Chapter 2: Building a Business Case for Offshore Wind***
  - NREL Studies to create a business case for offshore wind
  - Updated Offshore Wind Resource Assessment
  - Opportunity Spaces for Offshore Wind
  - Potential Pathways to lower the cost of Offshore Wind
  - Other Economic/Business Benefits of Offshore Wind
- ***Chapter 3: National Offshore Wind Strategy***
  - Identify Key Challenges Facing the Industry
  - Establish National Objectives to Address Challenges
- ***Chapter 4: Federal Implementation of National Offshore Wind Strategy***
  - Identify how the Federal government can implement a strategy to meet the objectives
  - Identify a 5-year and 5+year plan
  - Establish a potential collaboration plan between DOE/DOI

## *Wind Vision*

Offshore Wind Benefits: Environmental

| ***Wind Vision* Offshore Wind Deployment Scenarios** | | | |
|---|---|---|---|
| **Year** | 2020 | 2030 | 2050 |
| **Scenario** | 3 GW | 22 GW | 86 GW |

DOE's *Wind Vision* identified the environmental and economic benefits of wind deployment scenarios, and the specific offshore wind benefits are:

| GHG (Cumulative) | Air Pollution (2050) | Water (2050) |
|---|---|---|
| **1.8% reduction** in cumulative GHG emissions (1,600 million tonnes $CO_2$-equivalents), saving **$50 billion** in avoided global damages | **$2 Billion** in avoided mortality, morbidity, and economic damages from cumulatie reductions in emissions of $SO_2$, $NO_x$ and fine PM | **5% less** water consumption and **3% less** water withdrawals for the electric power sector |

## *Wind Vision*
### Offshore Wind Benefits: Economic

| Energy Diversity | Jobs | Local Revenues |
|---|---|---|
| Increased **offshore wind power** adds fuel diversity in key regions of the country, including populous coastal metropolitan areas, ultimately reducing sensitivity to changes in fossil fuel costs.<br><br>Similarly, by reducing demand for fossil fuels offshore wind can support fuel cost savings for consumers based on lower prices outside of the electric sector. | Offshore wind investments could support approximately **160,000 gross jobs** in coastal regions and around the nation | By 2050, **$440 million** annual lease payments and approximately **$680 million** in annual property tax payments |

## Summary/Recap

- Past: Implemented the *2011 Strategy*
- Present: Getting Your Feedback
- Future: Carry out a new Offshore Wind Strategy to serve the entire industry

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

# Thank you.

Greg Matzat, P.E.
greg.Matzat@ee.doe.gov

Appendix C

# Department of the Interior

## Bureau of Ocean Energy Management

James Bennett, Chief
Office of Renewable Energy Programs



National Offshore Wind Strategy Workshop

December 10, 2015

1

BOEM
Bureau of Ocean Energy Management

# OCS Renewable Energy Program

"(T)he outer Continental Shelf is a **vital national resource reserve held by the Federal Government for the public**, which should be made available for **expeditious and orderly development**, subject to **environmental safeguards**, in a manner which is consistent with the maintenance of competition and other national needs"

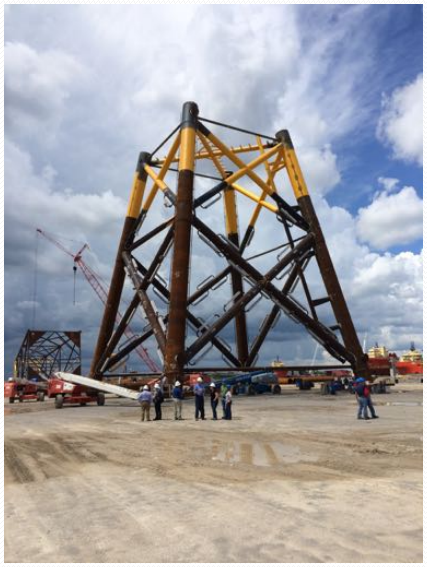
**Outer Continental Shelf Lands Act (OCSLA)**

**Sec 3(3)**

- Energy Policy Act 2005 – Secretarial authority for offshore renewable energy
  - Regulate the production, transportation, or transmission of energy from sources other than oil and gas
  - Coordinate with federal, state, and local agencies, tribal governments & stakeholders

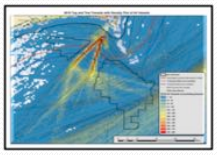
2

## Block Island Wind Farm: Fabrication & Installation



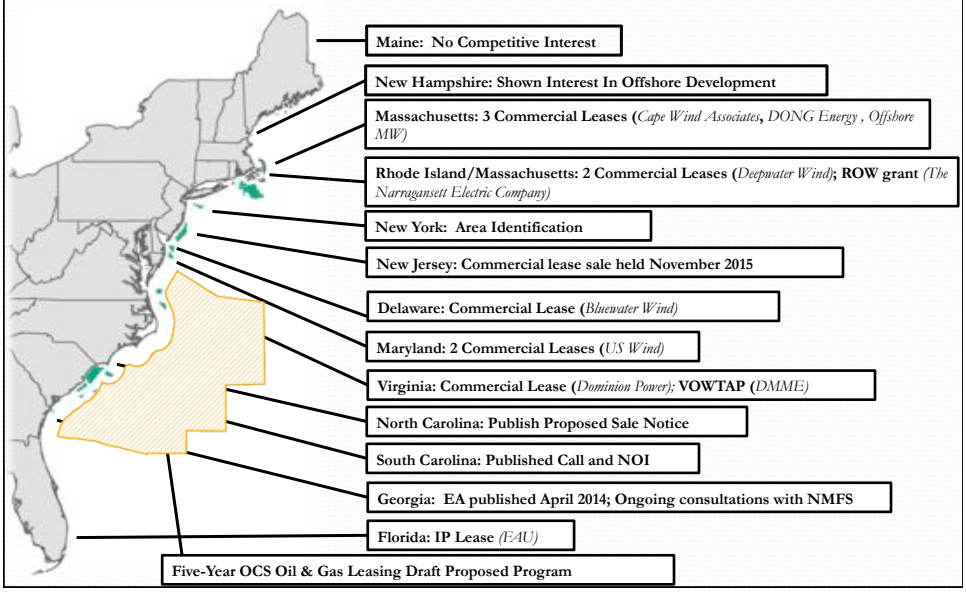

3

## 4- Stage Renewable Energy Authorization Process

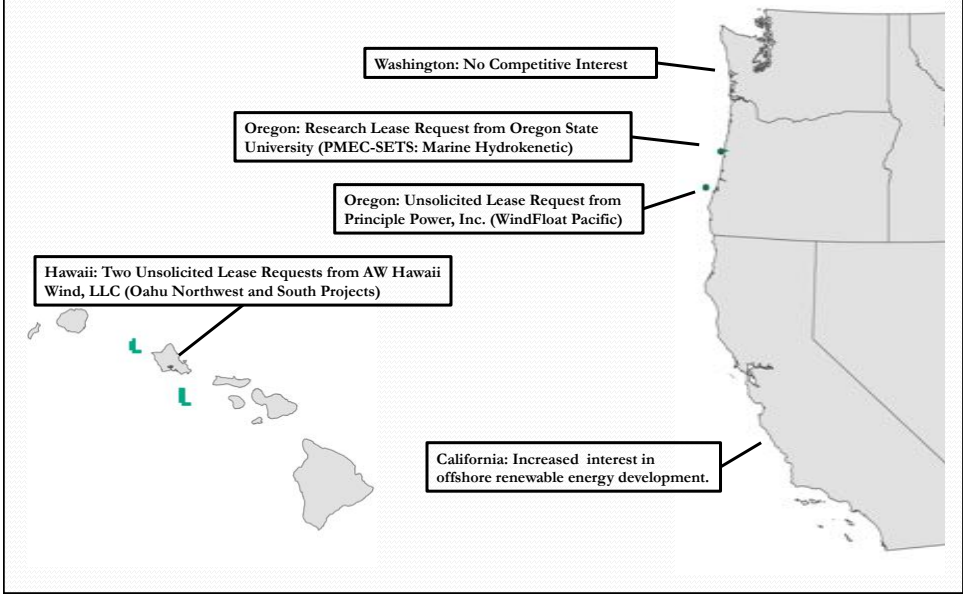
| Planning and Analysis | Leasing | Site Assessment | Construction and Operations |
|---|---|---|---|
|  |  |  |  |
| • Intergovernmental Task Force<br>• Request for Information (RFI)/ Call for Information & Nominations (Call)<br>• Area Identification<br>• Environmental reviews | • Publish leasing notices<br>• Issue Lease(s) | • Site Characterization<br>• Site Assessment Plan (SAP) | • Construction and Operations Plan (COP)<br>• Facility design and facility installation reports (FDR/FIR)<br>• Decommissioning |

4

## BOEM's Atlantic Outer Continental Shelf (OCS) Activities

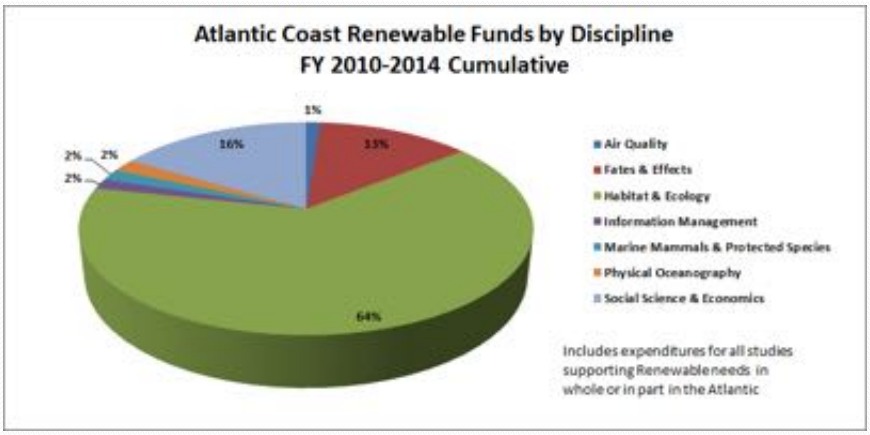



## BOEM's Pacific Outer Continental Shelf (OCS) Activities



# Environmental Studies Program (ESP)

~ $26M spent for studies supporting renewable energy needs with the following distribution:

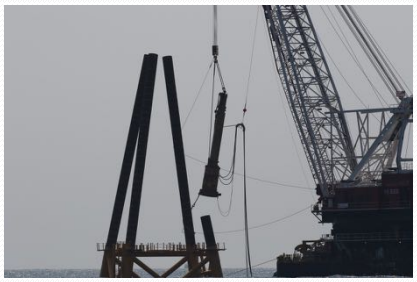



# Information for Planning

- Surveying for marine mammals, turtles, birds
- Tagging species for movement patterns
- Passive acoustic monitoring
- Surveying seafloor habitats

## Environmental Effects

- Electromagnetic Fields (EMF)
- Real-time Opportunity for Development Environmental Observations (RODEO)
- Sound Source Verification



## DOE RFI Comments: BOEM Siting and Permitting

- Need more publicly available information sharing from projects that have gone forward so far
- Put COP requirements more inline with developers' preferred sequencing
- Need for coordination between BOEM, NOAA, and others to develop comprehensive, collaborative monitoring and data management

## DOE RFI Comments: BOEM Resource Assessment and Site Characterization

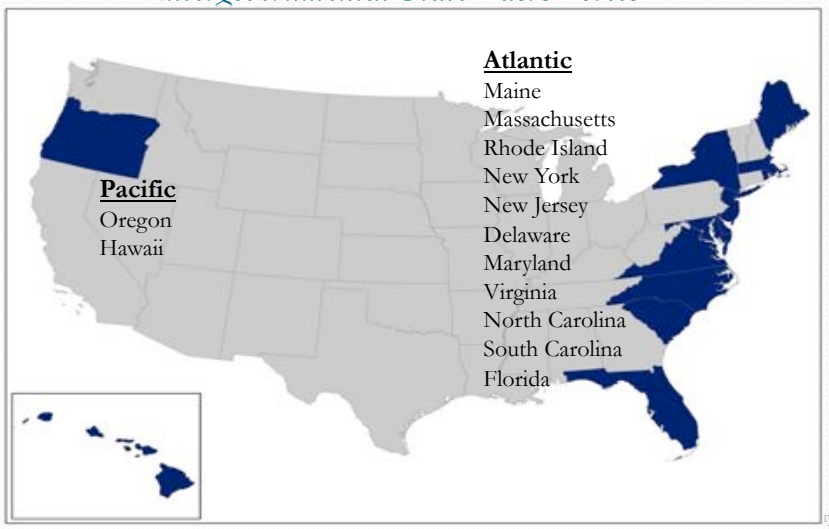
- Need improved and cheaper site characterization to reduce deployment timelines
- Limited meteorological, geotechnical, and ecological data exist for BOEM leasing areas
- Quality of data needs to be improved

## Ocean Planning

- Identify potential conflicts through early coordination
- Evaluate potential wind energy areas
- Participation in Regional Planning Bodies

# Ocean Planning

*Intergovernmental State Task Forces*

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# Questions?

*Bureau of Ocean Energy Management*

**www.boem.gov**

*Renewable Energy Program*

**www.boem.gov/Renewable-Energy**

*State Activities*

**www.boem.gov/Renewable-Energy-State-Activities**

*Regulatory Information*

**www.boem.gov/Regulatory-Development-Policy-and-Guidelines**

14

# Appendix D

## Building a Business Case for Offshore Wind

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

**Walt Musial and Aaron Smith**
**National Renewable Energy Laboratory**

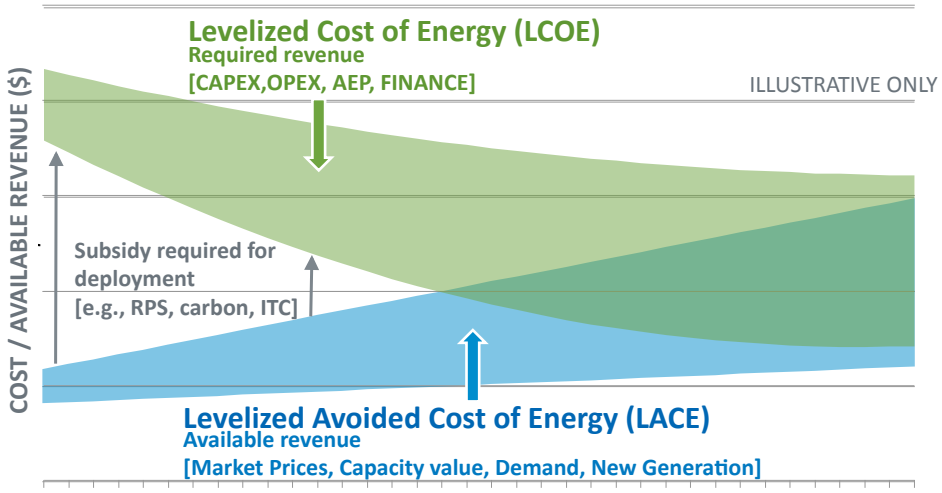
**US DOE and US DOI**
**2016 National Offshore Wind Strategy Workshop**
**Hotel Palomar**
**Washington, DC 20037**
December 10, 2015

## Building the Business Case

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

- The *Business Case* for a competitive offshore wind industry depends on demonstrating a comprehensive "value proposition" to national, state and regional policy makers:
  - Abundant resource in regional markets
  - Accepted siting and regulatory process
  - Market opportunity for transition to offshore wind
  - Technology pathways leading to competitive LCOE
  - Quantification of other non-LCOE market benefits
- Market acceptance from decision makers may lead to favorable market support

## Offshore Wind Strategy Focuses on a Path to Grid Parity




2016 Strategy will consider both **offshore wind supply** and **market demand** to determine the cost level at which deployment becomes feasible



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# Offshore Wind
# Resource Classification and Assessment

## New Resource Assessment Terminology

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Reference: Philipp Beiter, Walt Musial, and Aaron Smith, *"Terminology Guideline for Offshore Wind Resources"*, National Renewable Energy Laboratory, Publication Pending, January 2016


- Gross Recoverable Resource Potential
- Total Non-recoverable Resource Potential
  - Upper Air Wind
  - High Seas Wind (>200 nm from shore)
  - OSW Alaska (Stranded OSW resource)

- Areas within the U.S. Exclusive Economic Zone (<200 nm from shore)
- Turbine density 3 MW/km$^2$ based on typical spacing
- No exclusions

- Technical Limits
  - Water depths less than 1,000 m
  - Wind speeds greater than 7 m/s
  - Ice regions less than 60m depth
- Net capacity factors based on defined power curves
- Exclusions (% of total) based on likely conflicts

- LACE – LCOE
- Market Prices
- Capacity value
- Present and future cost
- Local incentives
- Competition among technologies
- Local market barriers
- Scenario driven (and sensitive)

- Installed Capacity (GW)
- Generated Energy (GWH)



## 2015 Resource Assessment Wind Speeds

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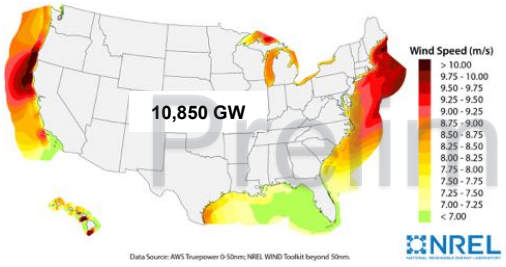


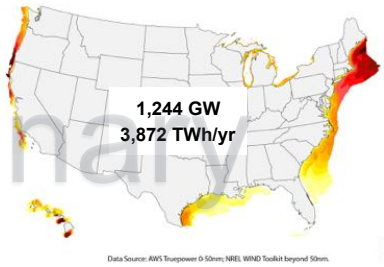




**Gross Recoverable Resource Potential**

- All water area between 0 and 200 nautical miles to EEZ
- 3 MW/km$^2$ power density
- Limited to atmospheric boundary layer at 100-m layer and grid accessible sites

**Technical Resource Potential**

- Exclusions based on distance to shore
- Technology filters at 1000-m, 7.0 m/s
- No deep water above 60-m in Great Lakes due to surface ice

**Technical resource potential provides a more realistic estimate of what can be developed with current technology**

## Technical Resource Potential by Depth and Distance from Shore

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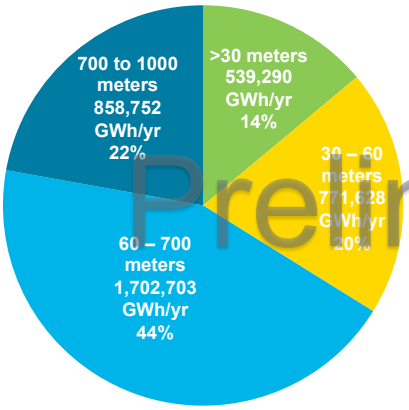
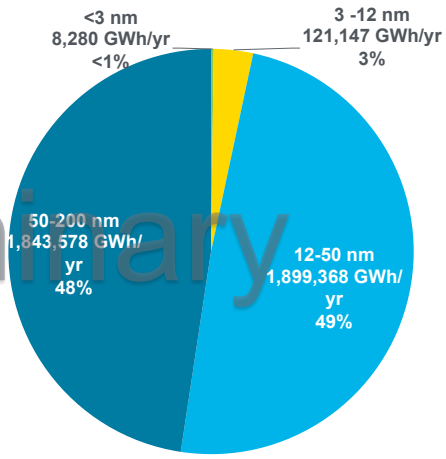
**Total Technical Potential is 3,872 TWh/yr**

**Technical Potential by Depth**




**Technical Potential by Distance**








## Key Offshore Wind Resource Results

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- All wind resources can be classified in new framework
- Definitions are clarified for consistency
- Gross potential is subject to minimal technology assumptions*
- Technical Potential is the Gross Potential with technology and land use exclusion filters included
- All States are counted – except Alaska
- New criteria are more relevant, but resource is distributed differently than the 2010 assessment
  - some regions gain and some lose

* Note that array density (3 MW/km$^2$) assumption and 100-m hub height assumption may change with technology

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# Offshore Wind - Opportunity space for electric energy growth

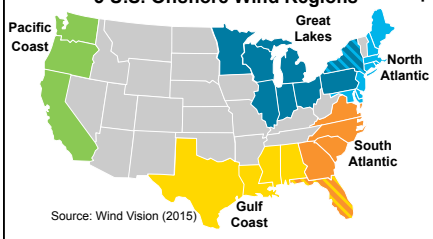
Cara Marcy and Philipp Beiter
National Renewable Energy Laboratory

## Offshore Wind - Opportunity Space for Electric Energy Growth

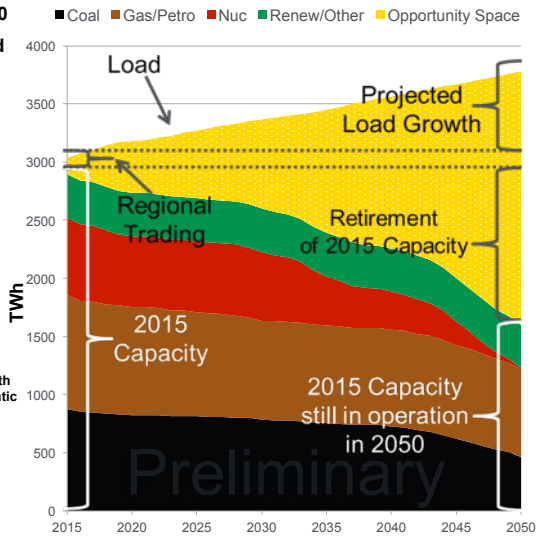
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- **Nearly 2,200 TWh/yr of opportunity space in the offshore wind regions available by 2050**
- **Data based on EIA estimates of announced plant retirements and load growth**
- **Average load growth of 0.66% per year (CAGR) (2015-2050)**
- **Retirements until 2050 from existing**
  - **nuclear (-99%),**
  - **coal (-47%)**
  - **gas/petro (-23%)**
  - **renewables (-2%)**

**5 U.S. Offshore Wind Regions**




Source: Wind Vision (2015)



## Regional Offshore Wind - Opportunity Space for Electric Energy Growth

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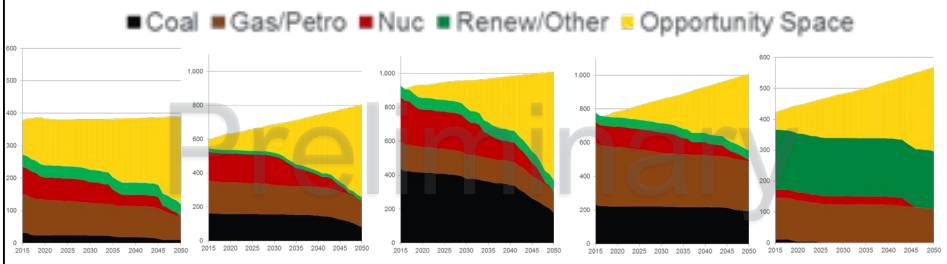


North Atlantic | South Atlantic | Great Lakes | Gulf Coast | Pacific

| U.S Region | Compound Annual Growth Rate (%) | Cumulative retirements 2050 / 2015 capacity (%) | Opportunity in 2050 (TWh/yr) |
|---|---|---|---|
| North Atlantic | 0.08 | 56 | 270 |
| South Atlantic | 0.84 | 53 | 540 |
| Great Lakes | 0.35 | 60 | 640 |
| Gulf Coast | 0.91 | 29 | 450 |
| Pacific | 0.86 | 19 | 270 |



## Comparison of Opportunity for Electric Energy Growth to Regional OSW Resource

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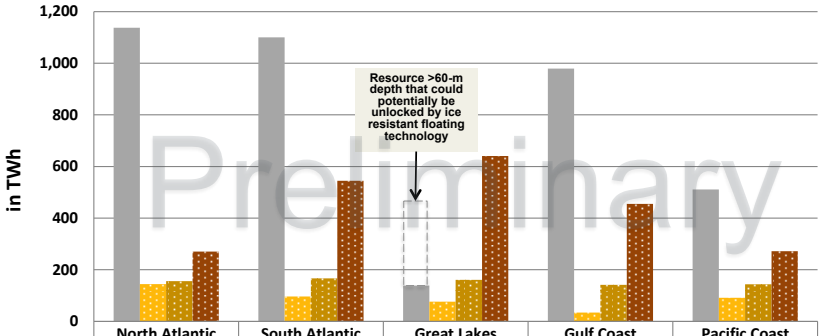
**Offshore Wind Technical Potential and Opportunity Space**




| | North Atlantic | South Atlantic | Great Lakes | Gulf Coast | Pacific Coast |
|---|---|---|---|---|---|
| Technical Potential | 1,138 | 1,100 | 139 | 979 | 511 |
| Opportunity Space 2020 | 144 | 96 | 76 | 33 | 91 |
| Opportunity Space 2030 | 155 | 166 | 160 | 141 | 143 |
| Opportunity Space 2050 | 270 | 544 | 640 | 455 | 271 |

**In most Regions, Technical Resource Potential exceeds the total opportunity for Electric Energy Growth**

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# Offshore Wind LCOE Reduction Pathways

## LCOE Analysis to Support the 2016 Offshore Wind Strategy

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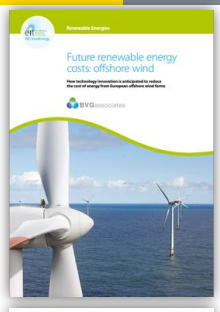
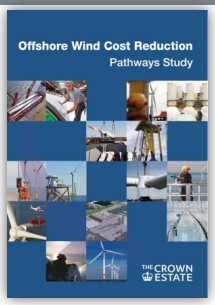
**Objectives:**

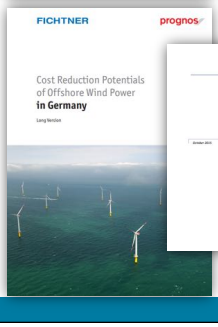
- Update U.S. LCOE targets
- Show a credible pathway towards grid parity:
  - Demonstrate potential to stakeholders
  - Consistent with European LCOE reduction studies
  - Considers U.S. factors related to industry maturity
- Identify high value R&D opportunities

**Approach:**

1) Estimate current LCOE using NREL LCOE model suite and market data
2) Project cost reduction potential through 2030 (Financial Close 2020 and 2025)
   - Tech. Advancement (KIC InnoEnergy, Crown Estate)
   - Floating Tech. Advancement (NREL)
   - Supply Chain/Contracting (E.C. Harris)
3) Vet results against literature, and with industry (direct outreach and NREL Expert Elicitation)




## Analysis Indicates LCOE Reduction Potential is High for Fixed and Floating

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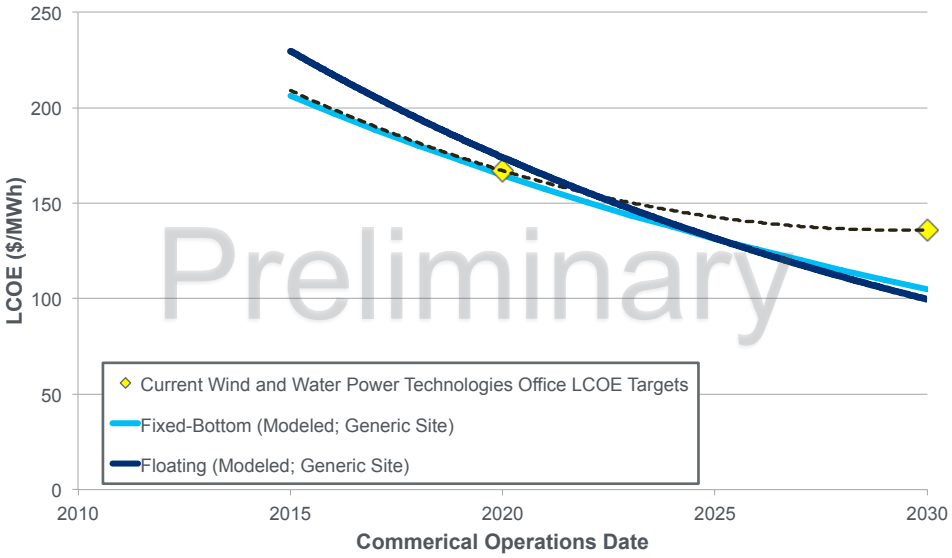





## Other Non- LCOE Market Benefits for Offshore Wind

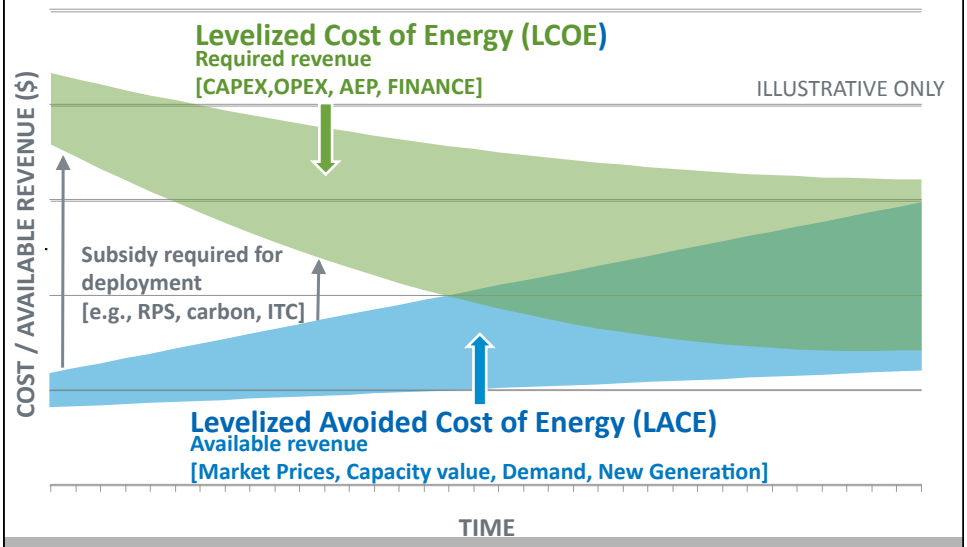
**State/Regional Drivers**

- **Scarcity of Other Renewable Resources in Coastal States**– Indigenous offshore wind is often the only renewable resource in highly populated coastal regions abundant enough to meet high RE penetration scenarios.
- **Economic Development** – Locally generated offshore wind is attractive to many coastal state governments as a way to promote jobs and economic growth.
- **Energy Security** – Coastal states have the highest electricity prices in the nation. Indigenous sources are coveted due to uncertainty of conventional supplies.

**Electric System Impacts**

- **Market Price Suppression** - Offshore wind suppresses wholesale energy prices because marginal generating cost is effectively zero.
- **Transmission Congestion** – Offshore Wind can ease grid congestion and reduce locational marginal prices.
- **High Capacity Value** – Offshore wind resource characteristics trend toward coincidence with load peaks.
- **Fuel Diversity** – The value of generation diversity provided by offshore wind may be greater than least cost energy sources.

## Challenge: Mapping the Path to Grid Parity




A credible path to grid parity in the United States could be a useful tool for the offshore wind industry to communicate value/potential to decision makers



## Summary of Offshore Value Proposition

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- Refined offshore wind resource assessment data show technical resource potential to be sufficient to support a viable offshore wind industry
- Market studies show electric grid opportunity space to be sufficient to support a viable US offshore wind industry
- Preliminary analysis suggests that offshore wind could potentially reach ~$100/MWh by 2030
- Numerous non-LCOE factors could be monetized, which would improve the business case for offshore wind

## 2016 *Strategy* and Beyond

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

### In the *Strategy*

- Resource Assessment
  - Updated based on today's technology
  - What do you think of our filters?
- Electric Sector Opportunity space
  - Identify the opportunity space for offshore wind
- Cost Reduction Analysis
  - Provide credible cost reduction pathway for the U.S. industry
- The *Strategy will* provide a roadmap that outlines industry needs and potential future studies

### Beyond the *Strategy*

- **We want your input!**
- **Resource Assessment**
  - How could the industry improve resource assessment accuracy and resolution?
- **Electric Sector Impacts**
  - What studies or tools are needed to help the industry quantify electric grid impacts such as capacity value, congestion, marginal price suppression, diversity of supply, etc. ?
- **Cost Reduction Analysis**
  - What needs to be done to provide a credible cost reduction path for the U.S. industry?
  - How can we leverage what has been done in Europe while considering U.S. specific factors?
- **Stakeholder Outreach**
  - What are the most effective ways to communicate the value proposition to decision makers?
  - What regionally specific data, and at what fidelity, are needed to develop state-level value propositions?



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## Back-up Slides

## Comparison of Resource Potential Assumptions from 2010 to 2015

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| | Gross Potential | | Technical Potential | |
|---|---|---|---|---|
| **Year** | **2010** | **2015** | **2010** | **2015** |
| Hub Height (meters) | 90 | 100 | NA | 100 |
| Low Wind Speed Cut-Off (meters/second) | 7.0 | None | NA | 7.0 |
| Power Density (MW/km$^2$) | 5.0 | 3.0 | NA | 3.0 |
| Cut-Off Distance from Shore (nautical miles) | 50 | 200 | NA | >1,000 m excluded |
| Water Depth Boundary | None | None | NA | >1,000 m excluded |
| Surface Ice Depth Cut-Off (meters) | None | None | NA | >60 |
| Competing Use Exclusions | None | None | NA | 0-3 nm – 99%<br>3-12 nm – 90%<br>12-200 nm – 40% |
| Total US Resource Potential (GW TWh/yr) | 4,150 GW | 10,850 GW | NA | 1,244 GW<br>3,872 TWh/yr |



## Opportunity Space Chart Definitions

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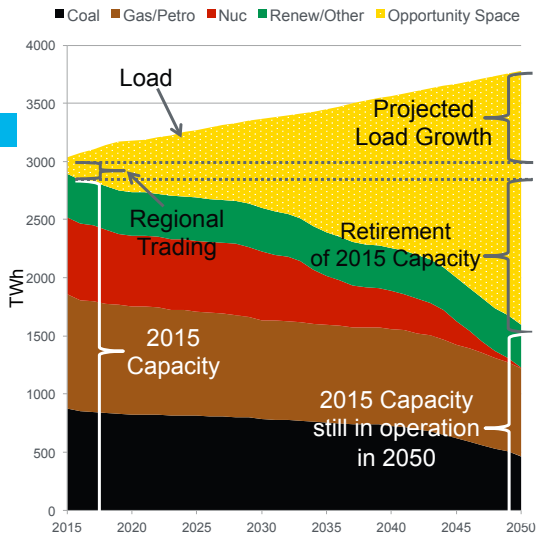
**Offshore wind opportunity space in coastal regions**




**Calculation Method**

**Opportunity Space by year = $L_x$ – O + $R_x$**

- $L_x$ = Load in year X [*MWh*]
- O = Operating capacity in 2015 [*MW*] * Capacity Factor [*%*] * 8760 [*h*]
- $R_x$ = Cumulative Retirements by year X [*MW*]

* Capacity Factor [*%*] * 8760 [*h*]

# Creating a Global Offshore R&D Database

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- Gathering data to provide insight into global offshore wind R&D and opportunities for international partnerships.
- Data collected for offshore wind R&D activities include:

- **Active and recently completed R&D projects**
- **Publically funded projects**
- **Joint industry projects**
- **Private R&D Projects**

- **Country**
- **Funding organizations**
- **Funding levels**
- **Performing organizations**
- **Technology**
- **Project timeframe**
- **Project status**
- **Project goals and summary**
- **Key contacts**

**Key markets in**
**Europe**
**Asia**
**North America**

**Main Categories of Technology**

**Wind plant:** turbine and plant system, nacelle, tower, rotor
**BOS:** Substructure and foundation, Electrical Infrastructure, Assembly & Installation, Substructure & Foundation
**Operations and Maintenance**
**Development:** Environmental impact assessment resource Assessment
**Market and Cost Reduction**

## Appendix E – Comment Cards

**Comment #1**

Public and government outreach and education is very important for general acceptance of offshore wind. That could happe now to lay the groundwork for future acceptance. Provide some funding for grassroots efforts at a number of levels: webinars, commercials, regional workshops/educational seminars.

Summary statement was recorded incorrectly. We DO NOT NEED guidelines to tell us where and when we should be using what data. We need high quality data.

We do not need guidelines for this:

Exam. Data set 1 for siting
Data set 2 for machine loads
Data set 3 for met ocean studies

We need:

1) Free stream met tower to validate lidar that bounces on the waves (floating lidar) OR
2) Multiple stationary lidar to compare floating lidar
3) Multiple sites to verify and feed wind maps

_____

**Comment #2**

Re: Decreasing project risk through physical site assessment

Several comments were made on the need for geophysical, geotechnical and metocean data, gathering more of this data prior to lease sales to attract and help support developers. This type of data does already exist along the east coast, but it is not necessarily easy to access. Compiling all available data to an easily public accessible portal would be beneficial. This way developers can easily get available data to promote project planning, and DOE/DOI can have a better idea where more data/G&G surveys are needed, rather than just blindly spending money to acquire more of this type of data.

_____

**Comment #3**

We need to improve education to the public! Don't think DOE is the body to do this but could help in promoting a program. For example, I've been in this industry 16 years and still the issue of birds is thrown out as a major obstacle. No point in preaching to the industry it's the public that needs to know the truth.

_____

**Comment #4**

Comment relevant to breakout session #2: Reducing cost and ensuring safety through technology development

Area of research that would be of value is with respect to FAA lighting requirements. For example, radar activated lighting, lenses that focus light vertically rather than horizontally.

_____

**Comment #5**

Please coordinate data gathered for risk reduction with project finance companies i.e. what value/(aka cost savings) will they recognize.

_____

**Comment #6**

Suggestion: work w/ Department of Commerce to identify offshore wind technology and components where US companies have a competitive advantage. Help those companies to establish facilities in the US to supply US projects AND European OSW projects to lower the risk of establishing US facilities. US offshore wind manufacturing demonstrates the benefits of an OSW industry tangibly and leads to broad political support for offshore wind. As an example, the US leads in high-temp superconductors which can be used in more efficient, lighter direct drive generators for OSW turbines. DOE could support R&D in this area and building a US manufacturing facility to sell into the US and European markets.

_____

**Comment #7**

More effort is needed in adapting the offshore wind turbine standards and recommended practices (IEC 61400-3-1 fixed bottom) and IEC 61400-3-2 (floating) to US conditions. Validation by comparison to experimental test data is also needed. Continuing update of offshore wind turbines design standards is needed as well.

_____

**Comment #8**

We need to compare offshore wind costs with new-build traditional energy sources.

_____

**Comment #9**

1) Create a compulsory diligence meeting with all agencies, stakeholders with project prior to public notification
2) Eliminate geotech requirement for floating foundations with gravity anchors

# Appendix F

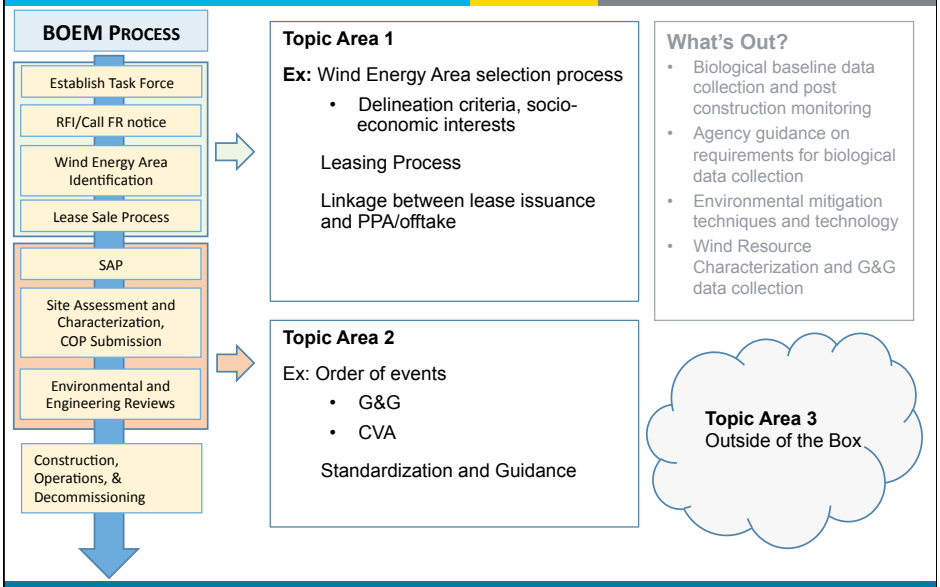
**Informing and Streamlining the Siting and Permitting Processes**
2016 DOE/DOI Offshore Wind Strategy Workshop
December 10, 2015

**DOI: Jim Bennett, Joan Barminski**
**DOE: Luke Feinberg, Greg Matzat**

## Guiding Questions

1. ***What are the key industry and other stakeholder's priorities with respect to siting and permitting to be addressed within the next five years?***
   - For immediate action?
   - For long term planning?
2. ***What can DOE and DOI do to achieve these priorities, including in cooperation with industry and stakeholder groups?***

## Defining the Topic – What's In? What's Out?




## What's been done?

### DOI: Facilitating Site Access and Development

1. Focus on informing decision-making
   a. Governmental and non-governmental coordination
   b. Studies efforts
2. Progress in getting site access granted through leasing process

### DOE: Reducing Market Barriers and Educating Stakeholders

1. Demonstration Projects – exercising the permitting process
2. Public Acceptance – creating an informed stakeholder base
3. Interagency Radar Work

## DOE Request for Information Response Summary

**Overall Takeaways**

- Disconnect between lease issuance and power takeoff mechanisms
- Permitting process is too long and unpredictable, although it has improved

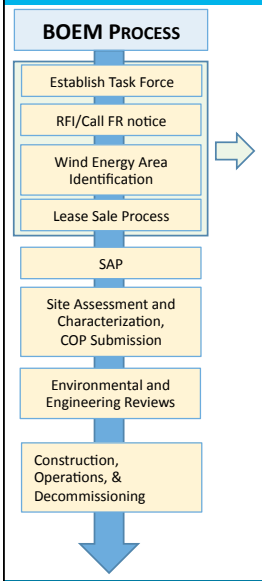
**Challenges**

- Development costs not taken into consideration in Wind Energy Area identification process
- Multiple ocean use issues, such as interactions with fisheries, shipping, and Department of Defense.
- Little data publicly availible as a result of the DOE demonstration projects
- Aspects of the BOEM process do not line up with development timeline

**Suggested Solutions**

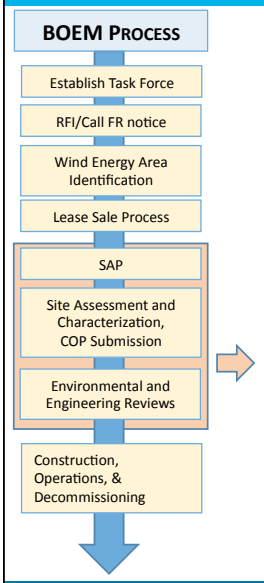
- Predictable and enforceable timelines
- One stop shop

## Topic Area 1: Discussion Questions




How can this part of the process be better informed and streamlined?

## Topic Area 2: Discussion Questions




How can this part of the process be better informed and streamlined?

## Topic Area 3: Discussion Questions

# Outside the Box

*Suggestions for process change outside of the existing regulatory framework*

## Discussion Questions

1. How can the WEA identification process be improved?
   - Should, and if so, how can, the value propostion for OSW be accounted for in the WEA identification process?
   - Are there existing datasets that BOEM can better utilize in its planning processes?
2. How can BOEM process be better aligned with the OSW development process?
   - Linkages to offtake agreements?
   - What is the proper order for development events?
3. How can pre- and post-leasing timelines be reduced and certainty increased, while ensuring necessary flexibility?
4. How do the discussed aspects of siting and permitting add to the value proposition for Offshore Wind Energy?

# Appendix G


**Shoring up the Supply Chain**
2016 DOE/DOI Offshore Wind Strategy Workshop
December 10, 2015

**DOE: Alana Duerr, Aaron Smith (NREL)**
**DOI: Annette Moore, Amy Stillings**

## What have DOE/DOI done in this area?

- Projects
  - U.S. Market Report
  - U.S. Vessel and Ports Assessments
  - Offshore Wind Manufacturing and Supply Chain Analysis and Development
  - U.S. Wind Industry Supply Chain Map
  - Offshore Wind Jobs and Economic Development (JEDI) Model
  - Evaluating the Impacts of Port Modifications and Improvements
- DOE funds expended since 2011 (~$1.3M)
- Studies and tools create a foundational body of knowledge that defines the current state of industries/infrastructure that could support deployment and operation of offshore wind projects in the U.S.
- Provides a robust inventory of gaps and opportunities within the supply chain

- http://energy.gov/eere/offshore-wind-market-acceleration-projects

## Supply Chain Reports and Tools

### Vessels Evaluation
Douglas-Westwood (2013)

- Investigated anticipated demand for various vessel types under three different growth scenarios for 2020 and 2030
- Identified critical shortage of installation vessels (turbine installation and cable-lay) and opportunities for U.S. and international companies to play a role within the U.S. supply chain

### Ports Evaluation
GLGH (2014)

- Evaluated the current capacity of U.S. ports to support offshore wind project development and what improvements were needed
- Established best practices for U.S. ports to modify existing facilities to meet offshore wind
- Released Port Evaluation tool which allows users to identify ports that are suited to specific project needs, i.e. staging, O&M, etc.

## Supply Chain Reports and Tools

### Manufacturing and Supply Chain Development

- Navigant Consulting (2013)
  - Identified gaps in supply chain and opportunities for manufacturers and technical services companies
- Douglas-Westwood and Clean States Energy Alliance (2012)
  - Analyzed supply chain development opportunities in 24 coastal states
- GLWN (2014)
  - Competitiveness Analysis of U.S. Wind Energy Manufacturing
  - Assessed key factors that determine wind energy component manufacturing costs on a global basis

### Other Reports/Tools

- U.S. Market Report (Navigant 2012-2014, NREL 2015)
- Port Assessment Tool (GLGH, 2014)
- Offshore Wind Jobs and Economic Development (JEDI) Model (NREL)

## DOE Request for Information Response Summary

- Overall Takeaways
  - Industry does not know about the Federal investment that has been made
  - Reports and tools are underutilized
- Challenges
  - Chicken-and-egg problem with the growth of the U.S. offshore wind supply chain and investment in U.S. market
- Proposed Solutions
  - Research investigating the required supply chain, manufacturing and logistics assets needed to achieve the offshore wind deployment scenario from DOE's *Wind Vision* (3 GW by 2020, 22 GW by 2030, 86 GW by 2050)
  - Investment in vessels, installation, and O&M infrastructure
  - Regional investment in infrastructure instead of each state reinventing the wheel

## Thoughts for Discussion

**What's in?**

- How DOE/DOI can play a role in supply chain development given limitations
- Infrastructure/supply chain development priorities for the industry
- Business case for infrastructure and supply chain development, including studies that would be useful to the industry

**What's out?**

- Creation of offtake agreements for offshore wind projects (state or Federal level)
- Advocacy to change provision of Jones Act or to support Jones Act waivers

## Guiding Discussion Questions

1. ***What are the industry's key priorities with respect to supply chain development over the next five years to expedite development?***
   a) *For immediate impact?*
   b) *For long term impact?*

2. ***What can DOE and DOI do to achieve these priorities, including in cooperation with industry and stakeholder groups?***

## Discussion Topics

### Supply Chain Development

- How can DOE/DOI help in the supply chain chicken-egg situation for the industry?
  - Vessels, Ports, Manufacturing, Safety, etc.
  - Near term impacts v. long term impacts
- What other Federal/ Government agencies should be involved in supply chain development?

### Potential Studies

- Are the types of studies that DOE/DOI have done useful to the industry? How could they be more useful?
- What are the studies that DOE/DOI could do?
- Beyond reports and studies, how can DOE/DOI help educate the public/ stakeholders/decision makers?
  - Workshops
  - Organizing visits to industry

# References

- Vessels
  - Douglas-Westwood Vessels Report ( http://energy.gov/eere/wind/downloads/assessment-vessel-requirements-us-offshore-wind-sector)
- Ports
  - GLGH Port Assessment ( http://energy.gov/eere/wind/downloads/wind-offshore-port-readiness)
  - GLGH Port Assessment Tool (http://www.offshorewindportreadiness.com/Home)
- Manufacturing and Supply Chain Development
  - GLWN Wind Energy Component Manufacturing Competitiveness ( http://energy.gov/eere/downloads/us-wind-energy-manufacturing-supply-chain-competitiveness-analysis)
  - Navigant Offshore Wind Manufacturing and Supply Chain Capabilities Report ( http://energy.gov/sites/prod/files/2013/12/f5/us_offshore_wind_supply_chain_and_manufacturing_development.pdf)
  - Douglas-Westwood and CESA Supply Chain Development ( http://www.cesa.org/projects/accelerating-offshore-wind-owap/state-specific-offshore-wind-supply-chain-opportunities/)
  - Offshore Wind Technologies Market Report ( http://energy.gov/eere/wind/downloads/2012-2014-offshore-wind-market-and-economic-analysis-reports, http://energy.gov/eere/wind/downloads/2014-2015-offshore-wind-technologies-market-report)

# Appendix H


**Decreasing Project Risk through Physical Site Assessment**

2016 DOE/DOI Offshore Wind Strategy Workshop

December 10, 2015

**DOI: Darryl Francois, Jennifer Miller**

**DOE: Ben Maurer, Jordan Dale, Walt Musial (NREL)**

## What have DOE/DOI done in this area?

- Projects
  - National Offshore Wind Resource Maps
  - Floating LiDAR Field Validation in Lake Michigan
  - Floating LiDAR buoy deployment at VA and NJ sites
  - Offshore Wind Energy Standards and Guidelines: Metocean-sensitive Aspects of Design and Operations in the US workshop
  - New Wind Took Kit
  - Offshore Wind Sediment Stability Study and Tool
  - Construction and Operations Plan Guidance
  - Updated Guidelines for Geophysical & Geotechnical site characterization data
  - Geophysical & Geotechnical methodologies study (ongoing)
  - Unexploded Ordinances Methodology Study (ongoing)
- DOE funds expended since 2011 (~$16.2M)
- DOI active leases (1.5M acres over eleven active commercial leases)
- Guidelines, studies and tools to create and leverage bankable data describing metocean and geophysical and geotechnical conditions for offshore wind projects in the U.S.

## Wind Resource Characterization & Physical Site Assessment

### Wind Resource Characterization

- National Offshore Wind Resource Maps
- Floating LiDAR Field Validation in Lake Michigan
- Floating LiDAR Buoy Deployment at VA and NJ Sites
- New Wind Tool Kit
- US Met-Ocean Data Center for Offshore Renewable Energy

### Physical Site Assessment

- Updated Guidelines for Geophysical & Geotechnical Site Characterization Data
- Geophysical & Geotechnical Methodologies Study (ongoing)
- Unexploded Ordinances Methodology Study (ongoing)
- Offshore Wind Sediment Stability Study and Tool

## Decreasing Project Risk

### Project Planning & Design

- Offshore Wind Energy Standards and Guidelines: Metocean-sensitive Aspects of Design and Operations in the US workshop
- Construction and Operations Plan Guidance

## DOE Request for Information Response Summary

- Overall Takeaways
  - Emphasis on Verification and Validation of LiDAR buoy technology
  - More studies of BOEM lease areas for both metocean and G&G data
- Challenges
  - Baseline physical environmental data is highly valuable, particularly in the early stages of project development
  - Detailed site-specific met-ocean, geophysical, and geotechnical data is needed, particularly in BOEM leasing areas
  - Lack of met-ocean towers
  - Industry and finance acceptance of remote sensing met-ocean data
  - Quality of physical assessment data needs to be improved
- Proposed Solutions
  - Coordination between federal agencies (e.g. DOI, DOE, DOC, DOD), state, and regional entities with regard to favorable project development conditions
  - Additional studies in resource assessment site characterization, (e.g. wind resource and geophysical/technical)
  - Deploy alternative to CLT
  - Verification and validation studies of LiDAR buoys

## Bounds of Discussion

**What's in?**

- Physical Site Assessment
  - Geophysical and Geotechnical Investigations
  - Timing, Source, Methods, and Detail of Data
  - Design Level vs Reconnaissance Level Data
- Wind Resource Characterization
  - Timing of Data Collection
  - Methods and Equipment
  - Met-Ocean Conditions (Extreme vs Operational)
- Project Planning
  - Energy Analysis Tools and Monitoring
  - Radar and Navigation interferences
  - Project Milestone/Plan Requirement Timing
- Project Design
  - Standards/Certification
  - Array Placement
  - Cables

**What's out?**

- Biological Concerns
- Regulatory Processes
- Chesapeake Light Tower
- Policy Reform

## Guiding Discussion Questions

1. ***What are the industry's key priorities with respect to physical site assessment over the next five years to expedite development?***
   a) *For immediate impact?*
   b) *For long term impact?*

2. ***What can DOE and DOI do to achieve these priorities, including in cooperation with industry and stakeholder groups?***

## Discussion Topics

- Are the types of studies that DOE/DOI have done useful to the industry? How could they be more useful?
- What are the studies that DOE/DOI could do?
- How can DOE/DOI help decrease project physical risks for the industry?
  - Physical Site and Wind Resource Characterization
  - Project Planning and Design
  - Near term impacts v. long term impacts
- Beyond reports and studies, how can DOE/DOI help educate the public/stakeholders/decision makers?
  - Workshops
  - Other

# BACK UP CHEAT SHEET

- What is the best way to get data/increase value of lease areas and what types of data are needed? (e.g. LiDAR V&V, G&G, breaking waves, synthetic hurricane data, etc.)
- Please comment on the minimum requirements of Resource and G&G data.
- How to best leverage data already available (e.g. USACE, USGS, NWS)? Collective data archive and portal?
- How to plan for hurricane tolerance/survivability? (e.g. stochastic, synthetic, etc.)
- How to best leverage private or state investment?
- How do BOEM physical site assessment requirements and timelines affect projects?

# Appendix I


**Technology Development to Ensure Safe Design and Reduce Cost**

2016 DOE/DOI Offshore Wind Strategy Workshop

December 10, 2015

**DOE: Greg Matzat and Alana Duerr**

**DOI: Darryl Francois and Dan O'Connell**

## What have DOE/DOI done in this area?

### DOE

- Investing in R&D to reduce LCOE
  - Computational Tools
  - Innovative Turbines
  - Test Facilities
  - System Engineering for Offshore Wind Platforms and Turbines
  - Demonstration Projects
- Funds expended since 2009
  - Non-Demonstration Funding $130M (~$70M test facilities)
  - Demonstration Funding ($168 planned)
- Major Successes
  - University of Maine 1:8-Scale VolturnUS Deployment
  - Development of FAST and modules
  - Field testing of Advanced Turbine Controls
  - Completion of major test facilities

### DOI

- Technology Assessment Program (TAP)
  - Fatigue design for floating offshore turbines and mooring lines
  - Monopile lateral load design
  - Cable spacing
  - Offshore substation design standards
  - Development of Hazard Curves for Atlantic WEAs
  - Axial pile capacity
- Funds expended on TAP
  - $2.15M from 2010-2014
- Lessons Learned:
  - Field data needs to be collected in a standardized way that is appropriate for data validation
  - Prescriptive cable spacing criteria is not recommended, and each project should be assessed on a case by case basis
  - Gaps in CFR and API standards need to be filled with respect to substations

## DOE Request for Information Response Summary

- Overall Takeaways
  - Largest barriers to offshore wind development in the U.S. are not technological; existing technologies are ready for deployment
- Challenges
  - High LCOE is the biggest challenge
  - Finding technology solutions for U.S. operating environment (hurricanes, deep-water)
- Proposed Solutions
  - Additional research in substructures (floating and fixed), installation technology and methodologies, and O&M
  - Leverage current demonstration projects for follow-on research and standards development, and fund additional demonstration projects
  - Establish partnerships/knowledge transfer programs with European public and private institutions to leverage knowledge

## Guiding Discussion Questions

1. ***What are the industry's key priorities with respect to technology development over the next five years to expedite development?***
   *a) For immediate impact?*
   *b) For long term impact?*

2. ***What can DOE and DOI do to achieve these priorities, including in cooperation with industry and stakeholder groups?***

## Thoughts for Discussion

**What's in?**

- Technology Advancements to Reduce Costs
- Research, development, and demonstration of technologies from foundations to blades
- Vessel Technology
- Installation methodologies/ technology
- Design tools
- Test facilities
- Standards

**What's out?**

- Vessel Construction (*Shoring up the Supply Chain*)
- Site Assessment, i.e. metocean, geophysical, geotechnical site assessment studies, data, surveys (*Decreasing Design Risk through Physical Site Assessment*)

## Discussion Topics

- **Investments in the next five years for near-term immediate impact v. long-term, game changing solutions**
  - Near-term – manufacturing/fabrication improvements, improved installation methods, hurricane design standards
  - Long-term – floating technologies, 10MW+ turbines, system resiliency, exporting power (HVDC, eliminating substations, 'socket-at-sea', etc.)
- **Major technology cost drivers and how to reduce the costs**
  - Installation technology
  - Installation methods
- **Best ways to ensure technology development success**
  - Broad v. specific funding opportunities
  - Large awards v small incremental funding
  - Consortia? Incubators?

# Appendix J

**Environmental Solutions from Development through Operations**
2016 DOE/DOI Offshore Wind Strategy Workshop
December 10, 2015

DOI: Michelle Morin,
Mary Boatman
DOE: Jocelyn Brown-Saracino,
Luke Feinberg

## Guiding Questions

1. ***What are the key industry and other stakeholder's priorities with respect to biological environmental issues over the next five years to expedite development?***
   - For immediate action?
   - For long term planning?
2. ***What can DOE and DOI do to achieve these priorities, including in cooperation with industry and stakeholder groups?***

## Defining the Topic

### What's In?

1. **Biological and socio-economic baseline data collection and post-construction monitoring**
2. **Agency guidance on requirements for biological data collection**
3. **Environmental monitoring and mitigation techniques and technology**
4. **Monitoring of impact-producing factors that might affect biota (e.g., construction noise)**

### What's Out?

1. Regulatory and permitting process
2. Marine spatial planning
3. Geotechnical and geophysical analysis
4. Physical resource assessments (e.g., wind energy potential)

## What's been done?

### DOI: Informing the Process

Collection of baseline data for marine mammals, turtles, birds

1. Telemetry work for species of interest - terns, seaducks, fish, bats
2. Specific issues - EMF, chemical spills, acoustics
3. Guidelines for surveys

~$30M invested since 2010


### DOE: Fostering Sustainable Development

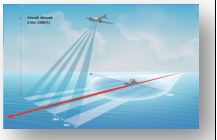
1. Data Collection and Experimentation
2. Monitoring and Mitigation Technologies and Techniques
3. Data Aggregation and Dissemination

~$8M invested since 2011

Notable accomplishments:

- Baseline Assessment of Mid-Atlantic
- Tethys Database
- WREN

TETHYS



## DOE Request for Information Response Summary

Challenges

- Lack of data available to support environmental review
- Complying with endangered species regulations and restrictions
- Biological data requirements should be proportional to project risks

Solutions

- Continued funding of baseline assessments
- Specific studies addressing impacts to endangered species; North Atlantic Right Whale; adoption of voluntary agreements for mitigating impacts

## Question for Discussion

- What are the largest environmental data and monitoring needs that the industry/ regulators face?
- Are these broad enough in scope that government-sponsored efforts would help fill these gaps?

## Question for Discussion

- What is needed to retire risk for specific environmental questions?
- Is there a need for post-construction data collection guidance?
- Are there critical gaps in current tools to collect data or minimize impact?

## Questions for Discussion

1. What are the largest environmental data and monitoring needs that the industry/regulators face? Are these broad enough in scope that government-sponsored efforts would help fill these gaps?
2. What is needed to retire risk for specific environmental questions?
   - Standardization of data collection? Additional data?
   - Are the recommended protocols for data collection developed since the last strategy effective or is more guidance needed here? Is there a need for post-construction data collection guidance?
   - Are there critical gaps in current tools to collect data or minimize impact that impede ability to gather data or address impacts in a cost-effective manner? If so, for what issues?
3. How do we right-size post construction monitoring/mitigation requirements?
4. How do the discussed environmental solutions add to the value proposition for Offshore Wind Energy?

# Appendix K


**Quantifying Electric System Impacts**
2016 DOE/DOI Offshore Wind Strategy Workshop
December 10, 2015

**DOE: Ben Maurer, Charlton Clark, Aaron Smith (NREL)**
**DOI: Douglas Boren**

## What have DOE/DOI done in this area?

- Projects
  - EWITS – Eastern Wind Integration and Transmission Study
  - NOWEGIS – National Offshore Wind Energy Grid Interconnection Study
  - Great Lakes Offshore Wind: Utility and Regional Integration Study
  - Great Lakes Best Practices Report
  - COWICS – Carolina Offshore Wind Integration Case Study
  - MAOWIT – Mid-Atlantic Offshore Wind Interconnection and Transmission
  - Renewable Electric Futures Study
  - CPUC Renewable Portfolio Standards Calculator Input Study (DRAFT)
  - DOE Office of Electricity HVDC Workshop
- Studies and tools create a foundational body of knowledge that identify, capture, and or quantify the electric system benefits of offshore wind projects in the U.S.

## Specific Prior Work

### National/Regional Capacity Expansion Modeling

**Examples:**

- Wind Vision
- Renewable Electric Futures
- CPUC Renewable Portfolio Standards Calculator Input Study (DRAFT)

- Reports consider scenarios with high offshore wind penetration

- Provides quantitative insight into impacts: electricity prices, carbon emissions, water savings, avoided health, jobs/econ. development

- Important tool for communicating feasibility and benefits of large-scale deployment to stakeholders

### National/Regional/State Interconnection Studies

**Examples:**

- National (NOWEGIS)
- Eastern Interconnection (EWITS)
- Mid-Atlantic (MAOWIT)
- Carolina (COWICS)
- Great Lakes (GLOW: URIS)

- Focus on electric -sector impacts of integrating offshore wind power:
  - Focus on specific scenarios; considers local conditions
  - Infrastructure requirements and cost
  - Operability impacts (e.g., capacity value, reserve requirements, marginal price impact)

- Case studies provide template for how to conduct integration studies in any region.
- Effective to support communications with regulators and utilities

## DOE Request for Information Response Summary

- Overall Takeaways
  - Broad industry interest in better understanding the benefits and positive externalities of offshore wind
  - Interest in planning and/or designing offshore transmission networks
- Challenges
  - Economic, geographical (near load centers) and environmental (reduced GHG) benefits of integrating offshore wind into the grid are not well understood and communicated.
  - Transmission planning to manage multiple offshore wind farms' variability
  - Inconsistencies of energy policies across jurisdictions
  - Existing policies are not necessarily favorable to internal-rate-of-return-driven investors (as opposed to venture capital)
- Proposed Solutions
  - Conduct CBA focusing on financial benefits of OSW and positive externalities, particularly as it relates to individual states
  - Multistate initiatives to coordinate market development activities and expand overall offshore wind access to markets
  - Support study for identifying potential interconnection locations

## Bounds of Discussion

**What's in?**

- How DOE/DOI can play a role in quantifying or capturing electric system benefits given limitations
- Quantification priorities for industry
- Discussion of:
  - Interconnection
  - Transmission
  - Capacity Value
  - Congestion Relief
  - Resiliency
  - Grid Flexibility
  - Etc.

**What's out?**

- Technology Advancement
- *Communicating* the Impacts
- Power Purchase Mechanisms
- Policy Reform
- Capital Cost Reduction

## Guiding Discussion Questions

1. ***What are the industry's key priorities with respect to quantifying electric system benefits over the next five years to expedite development?***
   *a) For immediate impact?*
   *b) For long term impact?*

2. ***What can DOE and DOI do to achieve these priorities, including in cooperation with industry and stakeholder groups?***

## Scope of Discussion Topics

- Are the types of studies that DOE/DOI have done useful to the industry? How could they be more useful?
- What are the studies that DOE/DOI could do?
- How can DOE/DOI help to capture and potentially monetize the benefits and positive externalities of offshore wind?
  - Capacity value, congestion, diversity, load access, and price suppression, etc.
  - Near term impacts v. long term impacts
- Beyond reports and studies, how can DOE/DOI help educate the public/stakeholders/decision makers?
  - Workshops
  - Other

## Detailed Discussion Topics

- What are the key electric sector impacts (+/- externalities) of integrating large amounts of OSW into the U.S. Power Grid? Is the current list (slide 5) inclusive? Which are most important?
- Which of these impacts are not valued appropriately in electricity markets?
- Are there differences between how these impacts are valued between ISOs?
- How can Federal Agencies support efforts to ensure that these impacts are valued by markets and can be monetized? How do we treat diversity between ISOs?(draw from slides 3 & 5 to break out into individual categories)
- Where are the strategic gaps in the DOE and DOI portfolios?

# *Wind Vision Report* (2015) Benefits and Externalities

## Offshore Wind Benefits

| GHG (Cumulative) | Air Pollution (2050) | Water (2050) |
|---|---|---|
| 1.8% reduction in cumulative GHG emissions (1,600 million tonnes $CO_2$-equivalents), saving $50 billion in avoided global damages | $2 Billion in avoided mortality, morbidity, and economic damages from cumulatie reductions in emissions of $SO_2$, $NO_x$ and fine PM | 5% less water consumption and 3% less water withdrawals for the electric power sector |

| Energy Diversity | Jobs | Local Revenues |
|---|---|---|
| Increased offshore wind power adds fuel diversity in key regions of the country, including populous coastal metropolitan areas, ultimately reducing sensitivity to changes in fossil fuel costs.<br><br>Similarly, by reducing demand for fossil fuels offshore wind can support fuel cost savings for consumers based on lower prices outside of the electric sector. | Offshore wind investments could support approximately 160,000 gross jobs in coastal regions and around the nation | By 2050, $440 million annual lease payments and approximately $680 million in annual property tax payments |

Note: Cumulative benefits are reported on a Net Present Value basis for the period of 2013 through 2050; annual benefits reflect the impact in current dollars for the specific year noted (e.g., 2050). GHG, Air Pollution, and Water benefits are estimated from the combined land-based and offshore wind system impact and proportionately allocated to offshore based on its share of total wind generation; this approach does not represent an explicit analysis of offshore wind benefits and does not capture all relevant potential impacts or locational considerations for these metrics. In contrast, gross jobs, lease payments, and property taxes are estimated specifically for offshore wind based on expected capacity additions and servicing requirements anticipated in the Wind Vision *Central Study Scenario*.

# Appendix L


**Communicating the Benefits and Creating Power Purchase Mechanisms**

2016 DOE/DOI Offshore Wind Strategy Workshop

December 10, 2015

**DOI: Abigail Hopper**

**DOE: Greg Matzat**

## DOE Request for Information Response Summary

# #1 Challenge Indentified:

# Establishing Market Value and Creating Power Purchase Mechanisms

## Guiding Discussion Questions

1. ***What are the industry's key priorities with respect to power purchase mechanisms over the next five years to expedite development?***
   *a) For immediate impact?*
   *b) For long term impact?*

2. ***What can DOE and DOI do to achieve these priorities, including in cooperation with industry and stakeholder groups?***

## Defining the Topic

**What's in?**

- Definitive resources to help "sell" the benefits of offshore wind:
  - Capacity markets
  - Locational Marginal Pricing
  - Environmental benefits
- Workshops and/or trips for State, utility commissions and utilities
- Models, heat maps, RPS calculators
- Studies on potential value adders, i.e. storage
- "Out-of-the-Box" Ideas

**What's out?**

- PTC/ITC
- Federal procurement
- Loan guarantees

## Discussion Topics

- **What studies are required?**
  - Capacity markets
  - Locational Marginal Pricing
  - Environmental benefits
- **Definitive references by National Labs or others**
- **Regional Electric Power Markets/ISO benefits vs. State benefits vs. local benefits**
  - Multiplying effects
  - Grid reliability
- **Funding Opportunities**
  - DOE State Energy Program Funding Opportunity for State Energy Planning, Multi-State/ Regional Collaboration
- **Roadmap for creating offshore wind and renewable energy policies**
- **Outreach and Education**
  - Workshops
  - DOE Wind Energy Regional Resource Centers