Offshore Wind

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The United State has a large but untapped offshore wind resource. The National Renewable Energy Laboratory (NREL) estimates that in the Atlantic Ocean alone, there are 212,000 MW of viable offshore wind potential in shallow waters.[1] The United States Department of Energy (DOE) has recently supported the development of 10,000 MW of commercially competitive offshore wind by 2020 and 54,000 MW by 2030, largely on the Atlantic Ocean and Great Lakes.[2] The DOE estimates that building 54,000 MW of offshore wind energy facilities would generate $200 billion in new economic activity and create more than 43,000 permanent, high-paying jobs in manufacturing, construction, engineering, operations, and maintenance. Based on European studies, NREL estimates that offshore wind in the United States can create more than 20 direct jobs for every megawatt produced.[3]

According to the U.S. Offshore Wind Collaborative, 18 states including Delaware, Maine, Maryland, Massachusetts, New Jersey and New York currently have offshore wind initiatives or proposed projects under development. On the Atlantic Coast alone, offshore wind projects totaling over 3,000 MW are advancing through the permitting process.[4]

The 2010 National Renewable Energy Laboratory Assessment lists New York's combined Atlantic and Great Lakes offshore wind resource at 147,200 MW within 50 nautical miles of the coast.[5] How much of this potential ultimately gets tapped will depend on economic, environmental, and technical factors.

Global Status

Although offshore wind projects are new to the U.S., the world's first offshore wind farm began operating in Denmark in 1991. Since that time approximately 41 offshore wind projects have been developed throughout Europe and Asia by countries including Belgium, China, Denmark, Finland, Germany, Ireland, Italy, Japan, the Netherlands, Norway, Sweden, and the United Kingdom. These projects represent an estimated 2,377 MW in global installed capacity.[6]

Currently, an additional 54,000 MW of offshore wind projects in 20 different countries, including the U.S. and Canada, are in some stage of permitting, approval, or construction.[7]

1. Fisher et al., 2010. *Offshore Wind in the Atlantic*, National Wildlife Foundation. 1.
2. U.S. Department of Energy Office of Energy Efficiency and Renewable Energy's Wind and Water Power Program, *Creating an Offshore Wind Industry in the United States: A Strategic Work Plan for the United States Department of Energy (Predecisional Draft)*, (September 20, 2010), http://www.windpoweringamerica.gov/pdfs/offshore/offshore_wind_strategic_plan.pdf.
3. Musial and Ram, 2010. *Large-Scale Offshore Wind*, National Renewable Energy Laboratory. 2.
4. Fisher et al., 2010. *Offshore Wind in the Atlantic*, National Wildlife Foundation. 2.
5. Fisher et al., 2010. *Offshore Wind in the Atlantic*, National Wildlife Foundation. 40.
6. Walter Musial and Bonnie Ram, *Large-Scale Offshore Wind Power in the United States: Assessment of Opportunities and Barriers*, NREL-TP-500-40745 (Golden, CO: National Renewable Energy Laboratory, September 2010), 22-24.
7. "Global Offshore Wind Farms Database," 4C Offshore Ltd, accessed January 14, 2011, http://www.4coffshore.com/offshorewind.

ISSUES OVERVIEW

Offshore wind farm development is different in a number of ways from wind development on land:

Wind Resources

Generally speaking, offshore winds tend to blow more consistently than those on land and wind speeds are often higher. Larger turbines, which can capture more energy, are often feasible because there are no land-based transportation constraints, and because offshore turbines are placed at much greater distances from residences, so that visual impacts are less. Because there are no landforms or built structures to create wind turbulence, offshore turbines generally operate more efficiently than onshore turbines; in addition, the power generated offshore is more coincidental with daytime peak electricity demand, because offshore winds blow during the day (as opposed to onshore winds, which are usually more powerful at night). For these reasons, offshore wind development generally offers greater potential electricity generation than land-based wind development.

Transmission

Unlike land-based wind turbines, which tend to be located in remote and sparsely-populated areas, offshore wind turbines could in many cases be sited close to coastal urban load centers; for this reason, offshore wind development is seen as a way to provide large-scale renewable energy generation in areas of high demand. Offshore wind could be very valuable in helping to alleviate overland electrical transmission constraints. However, no transmission lines currently exist to connect offshore wind farms to the grid, and these lines would have to be developed.

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In October 2010, Google announced an agreement with Good Energies and Marubeni Corporation to finance the development of a submerged transmission line off the Mid-Atlantic coast. The proposed Atlantic Wind Connection would stretch 350 miles from New Jersey to Virginia and be able to connect 6,000 MW of offshore wind turbines to the grid, or enough to serve approximately 1.9 million households. While the transmission project as currently proposed stops just short of New York, an interconnection to the Atlantic Wind Connection project could be added to serve future projects offshore of New York City. The proposed transmission project is seen as a way to enable and encourage wind development off the Mid-Atlantic coast.

Environmental & Socioeconomic Concerns

Challenges unique to the offshore environment include potential impacts to marine wildlife and ecosystems. While research on European offshore wind farms has shown no apparent long-term or large-scale wildlife impacts, major data gaps for the U.S. still exist.[8] Aesthetics, property values, tourism, shipping, boating and boater safety also must be considered.

Costs/Technology and Infrastructure

From an economic perspective, a primary challenge for offshore wind is upfront capital costs for construction. In the U.S., offshore wind projects require specific local support infrastructure, such as customized vessels, port and harbor upgrades, manufacturing facilities and trained, specialized workforces; these infrastructure upgrades will require significant capital investment. However, developing offshore wind resources could grow the economy and create jobs in fields such as research and development, wind turbine and platform construction, and marine transport vessel construction and operation. The higher capital costs of offshore wind projects may be partially offset by potentially higher energy yields, as offshore

8. U.S. Department of Energy, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*, DOE/GO-102008-2567 (Golden, CO: National Renewable Energy Laboratory, July 2008), 124.

wind turbines can produce as much as 30% more energy than onshore wind turbines.[9] As project sizes increase, costs are expected to decrease due to economies of scale. Mature technology and supporting infrastructure should also lead to declines in costs over time.[10]

Studies indicate that offshore wind farms could become a substantial and economically viable electricity source in the U.S., although a comprehensive assessment has not yet been completed.[11] The most viable offshore wind resources tend to be located near congested coastal regions with traditionally high electricity rates, such as New York, New England, the Mid

Atlantic states, which means offshore wind might be able to compete economically in these areas, even with higher initial development costs.[12] This is especially true if the costs of pollution from fossil fuel-burning plants are included in the calculations; for example, an economic assessment from the Virginia Coastal Energy Research Consortium found that when carbon capture and sequestration is assumed as an added cost for new fossil fuel projects, Virginia utilities can anticipate a new offshore wind project would be more cost competitive than a new coal-fired project, and might be competitive with a new combined-cycle gas turbine project.[13]

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Permitting and Siting

While regulatory and permitting requirements remain largely untested, a process has begun to unfold. The former federal Minerals Management Service, which is now the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), recently released its final rule governing the development of alternative energy projects on the Outer Continental Shelf. Since that time, several offshore wind projects have begun the early stages of permitting.[14] The industry reached a major milestone in April, 2010 when the Department of the Interior issued the first commercial offshore wind lease to the Cape Wind project in Massachusetts. Cape Wind received its final federal permit from the EPA in January, 2011, and is expected to complete construction in 2012.[15] Several newly formed BOEMRE state task forces and the Atlantic Offshore Wind Energy Consortium, which includes New York State, are promoting further collaboration among interested and affected parties and could help advance the regulatory and stakeholder engagement processes.[16]

Other Issues

Any proposed offshore wind development project would include careful consideration of many potential impacts, including:

A. Vessel traffic: Sensitive planning will be needed to ensure that established transportation routes are not interrupted.

B. Commercial and recreational fishing: The fishing community is one of the largest existing users of lake and near-shore ocean waters, and is a major stakeholder for offshore wind development. While experience in Europe has shown minimal effects on fishing, site-specific characteristics will need to be explored.

9. Musial and Ram, *Large-Scale Offshore Wind*, 4.
10. Musial and Ram, *Large-Scale Offshore Wind*, 6.
11. Musial and Ram, *Large-Scale Offshore Wind*, 127.
12. Musial and Ram, *Large-Scale Offshore Wind*, 14.
13. Patrick Hatcher, Jonathan Miles, Kenneth Newbold and George Hagerman, Jr., *Virginia Offshore Wind Studies, July 2007 to March 2010: Final Report*, (Norfolk, VA: Virginia Coastal Energy Research Consortium, April 2010), 3.
14. American Wind Energy Association, 2011. "Offshore Wind Energy."
15. American Wind Energy Association, 2011 "Offshore Wind Energy," accessed January 14, 2011, http://www.awea.org/documents/factsheets/Offshore_Factsheet.pdf.
16. Musial and Ram, *Large-Scale Offshore Wind*, 8.

C. Turbine placement: Artificial reefs, sewer outfalls, dump sites, shipwrecks, danger areas, cables and submerged pipelines and other similar hazards may affect turbine placement. The small size of shipwrecks compared to turbine spacing may not preclude development in these areas, but chartered military zones and dump sites are not recommended for development.

D. Land use: Existing land use along shorelines is varied and diverse and can influence many aspects of project planning, from transmission interconnection points and aviation airspace to impacts on viewsheds and onshore wildlife habitats.

E. Infrastructure: Infrastructure needs include ports with deep draft facilities, large staging areas with appropriate loading equipment, a dedicated fleet of maintenance and construction vessels, transmission system availability, reliable communication systems, skilled personnel, and safety and rescue provisions.

F. The aquatic environment: Lake and ocean waters present unique challenges such as severe weather conditions, ice, salt, and complex logistics for installation, operation and maintenance. Foundation design is site-specific and represents a significant portion of cost. It is determined by water depth, the maximum loads the structure will experience, and geology. Freshwater structures would incorporate design features to alleviate ice pressure, while saltwater structures would incorporate corrosion-resistant materials.

G. Contaminated sediment: In some areas, existing contamination may be an issue. For example, the International Joint Commission has identified 43 Areas of Concern, or "toxic hotspots," within the Great Lakes, with five in New York waters. Locating facilities or anchoring vessels in these areas may stir up contaminated sediment, and should be avoided.

H. Wildlife impacts: The environmental impact of a project is routinely assessed through an Environmental Impact Statement. Concerns arise when a proposed project has the potential to significantly affect local or migratory fish and wildlife populations. Potential impacts from construction activities, turbine placement, and operation should be avoided, minimized, or mitigated through pre-construction studies. In addition, post construction studies and ongoing adaptive management are necessary to address issues that arise during operation, and will help inform future offshore wind development. Examples of issues that will require special consideration include:

   1. North American birds: Many species migrate along shorelines. As migration patterns vary in route, time of day, and flight altitude depending on the species, only some species may potentially be affected by offshore wind development. Many birds, including raptors, tend to avoid crossing large bodies of water and stay close to the shore; however, areas along shorelines are important bird areas, including habitat for some endangered and threatened species. Birds that do cross the open water tend to fly at higher altitudes than those over land, in most cases above the height of wind turbines.

   2. Fishery Resources and Habitat: These resources vary in different waters, and site specific analysis is necessary to avoid impacts to fish migration and spawning areas, endangered or threatened fish, and sensitive or unique habitat. Identifying these areas will allow development to avoid, minimize, or mitigate impacts to fisheries and habitat.

I. Aesthetics: Visibility of wind projects from the shoreline or from recreational boats is a common concern; the degree to which turbines will be visible may depend on how far offshore the project is located, and on weather conditions.

While there are many challenges to be overcome, development of offshore wind resources holds great potential for the production of clean, renewable energy near to areas of high demand. Offshore wind development can help New York meet its renewable energy goals, combat climate change, and create jobs.

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