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WHITE PAPER

7 Questions to Consider for Offshore Wind Transmission in the U.S.

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The U.S. offshore wind market has potential to supply vast amounts of clean, renewable energy to millions of homes and businesses. Turning it into reality will involve addressing many challenges. Among them: convincing power industry stakeholders to agree on how to connect this offshore generation to the onshore electric grid.

The U.S. offshore wind market has the potential for annual production of more than 2,000 gigawatts of capacity, according to the National Renewable Energy Laboratory. That total, equal to 7,200 terawatt-hours (TWh), would nearly double the nation's current energy use.

The transmission system for this offshore wind generation has yet to be master planned in the U.S., but it must be. Because it will take years, perhaps decades, to build this transmission system, long-term planning is critical. The power industry has already learned this lesson on onshore wind projects, including the Electric Reliability Council of Texas (ERCOT)'s Competitive Renewable Energy Zones (CREZ) projects, Southwest Power Pool (SPP)'s Priority Projects and the Midcontinent Independent System Operator (MISO)'s Multi-Value Project Portfolio.

The value of planning and developing offshore power generation and transmission in concert can also be demonstrated by projects that are being considered elsewhere in more established markets. Consider the North Sea market, where a giant wind farm and related infrastructure (totaling up to 9 GW) is now being proposed, with 4.8 GW to provide power to the U.K. and the balance to generate power for European countries on the eastern side of the North Sea. There are many options for the construction and maintenance of this wind farm being considered and one option is the North Sea Wind Power Hub. Due to the proposed location of the wind farm at Dogger Bank, a relatively shallow sand bank, the construction of synthetic islands in the middle of the North Sea is being considered. These islands would serve as a base of operations for thousands of wind turbines, while also doubling as a hub that would connect to the electricity grids of countries bordering the North Sea. In time, more islands

could be added and daisy-chained together with underwater cables, creating a supersized array of wind farms.

Projects of this scope demonstrate the critical nature of planning generation and transmission together. If the U.S. is to realize offshore wind's potential to help address many of the nation's long-term energy challenges, it will require multiple state, regional and federal stakeholders to work together to consider and make decisions about how a large-scale generation and transmission system would be built.

In short, the U.S. needs an offshore wind transmission master plan. In creating one, stakeholders should address many critical questions, especially the following.

1. Where will offshore generation connect to the onshore grid?

In the U.S., there are a limited number of locations that are well-suited to connect offshore generation to the onshore grid. These include several soon-to-be-shuttered nuclear power plants on the Atlantic Coast with existing infrastructure that can be efficiently repurposed to accept offshore power and deliver it to the grid.

Because these connection points — some of which are privately owned — are in finite supply, they must be prioritized and allocated wisely. The question is, who will assess potential locations and rank their value and priority? Should a small, early offshore wind project have first rights to these sites? Many say no. They say these Tier 1 and Tier 2 sites should be held in abeyance and reserved for greater purposes. The question is, will these decisions be made by government mandate or based on free-market economics?

Discussions about connections should also consider system design. Does a hub-and-spoke concept similar to the one being considered for the North Sea — where island "hubs" are connected to surrounding offshore projects by "spokes" of cables — make sense for the U.S.? Or would the nation be better suited for a backbone trunk line built offshore that individual wind farms then could connect to? What about a hybrid combination of both?

Finding answers to these questions is critical because once systems are in place and connection points are used, it will be very difficult to change course later.

2. How would an offshore grid integrate with the onshore grid?

The benefit offshore wind transmission offers to the U.S. grid is almost incalculable. If done properly, it would make it possible to build transmission that would improve reliability

and resiliency, reduce congestion and add capacity, while providing economic access for offshore wind. Also notable: It would do all this in places that are out-of-sight to populations that do not want new infrastructure added in their own backyards.

But this added capacity also would impact the onshore grid. To not also plan onshore upgrades when addressing offshore generation and offshore-to-onshore ties would be short-sighted. There is not infinite capacity at each location.

3. Who will be responsible for transmission development?

As generally planned today, the first wave of offshore wind developers building new wind turbines will also construct the interconnecting power lines — called gen-tie lines — and related equipment needed to bring the power onshore. These developers sell the power they generate through state-sponsored offshore wind renewable energy certificate (OREC) programs or other similar vehicles. Over the long-term, this "every man for himself" strategy is likely to be unsustainable.

To encourage further development and improve efficiency, some argue for the construction of an offshore grid that generation developers could tie into. While not restricting offshore wind developers from developing and owning an offshore grid, many assert that other transmission-only entities should also be invited to enter the market. This offshore grid would presumably be funded through some sort of traditional utility rate-based vehicle.

It's quite possible that the best long-term answer will offer a combination: transmission for certain gen-tie assets could be developed and owned by wind developers, while transmission for certain offshore grid assets could be developed and owned by transmission developers.

4. Who will manage the design, construction and interconnection process?

Arranging the multistate solicitations and determining cost allocation for constructing these assets would present major challenges, given that the U.S. does not have a national energy policy. It will be necessary for states — each with its own state energy policy — to work together and coordinate with FERC, the Department of Energy (DOE), independent system operators (ISOs), regional transmission organizations (RTOs) and other stakeholders to develop common goals and strategies.

Given the varying interests of these parties, an agreed-upon framework is needed to guide the decision-making process. This framework will need to define and memorialize roles and responsibilities. It will also need to address issues that may arise when transmission is split from generation. If, for example, either the connection is not available or generation does not come online per agreement, rules need to be in place to define the financial consequences.

In other words, it may be in the best interest of consumers to split transmission from generation. But it will take significant policy and regulatory development to document how that will happen.

5. How will states and regional organizations coordinate together?

The New England states, along with New York, New Jersey and other states along the Atlantic Coast, have struggled with mutual projects in the past, including interstate electric transmission. To date, these states have taken few steps to address interstate coordination of offshore wind transmission.

ISOs and RTOs also have a significant stake in these projects — especially offshore grid projects that cross multiple states. ISO New England, New York ISO and PJM, a Mid-Atlantic region power pool, all share interests in wholesale energy markets and grid stability but have struggled to work together on onshore transmission. To date, little inter-ISO/RTO coordination related to offshore wind transmission has taken place.

That will need to change. Interstate and ISO/RTO coordination is without question challenging, given the variation in individual state energy policies and stakeholder priorities. But it is essential. A plan is needed to make it happen.

6. How will offshore transmission be regulated?

Currently, owners of wind power generation have the requirement to develop transmission along with their generation projects. But what will happen if and when generation and transmission are separated? Any master plan for offshore transmission must include rules of engagement.

First, a framework is needed to define and clarify roles for all stakeholders, including the DOE, FERC, NERC, ISO/RTOs, state commissions, state executive and legislative branches, and the U.S. Congress and president. The Bureau of Ocean Energy Management (BOEM), which is responsible for leasing underwater lands for energy production, is also involved. The role of nongovernmental organizations (NGOs) must also be defined. Assurances are also needed that policies governing the transmission system will be unaffected by changes in elected and appointed governmental officials.

These stakeholders will face the challenge of creating national and/or regional plans for offshore wind transmission without also creating a national/regional energy policy — a tall order indeed. They will also need to consider difficult questions related to cost allocation, including the ramifications of FERC 1000, which requires a regional planning process for allocating transmission construction costs to regional entities roughly proportional to the benefit received.

A framework is also needed to determine the routing, siting and permitting process for these projects. Who is in charge? Is there a "lead agency"? How will transmission developers get permission to develop projects if transmission is separated from generation? These are difficult questions to answer for busy stakeholders.

7. How will transmission projects be financed?

Because offshore projects will all likely require financing, a master plan should also address the role that the financial sector will play in defining parameters and making go/no-go decisions on these projects.

To obtain private financing, developers must be able to demonstrate that these are good, bankable projects that will deliver an acceptable return on investment. If underwriters are skeptical, transmission construction could potentially be constrained. If the development costs for transmission infrastructure are either unknown or deemed to be prohibitively expensive, it could lead banks to deny financing for generation projects as well.

A master plan will need to address how such issues will be handled, should they arise.

More to Come

These, of course, are not the only questions the burgeoning U.S. offshore wind industry faces. Issues like supply chain,

ports, workforce development and Jones Act compliance also demand significant attention. There are also questions about how offshore wind and energy storage can work together.

There is recent indication that the industry may be paying closer attention to offshore wind transmission issues. In his annual State of the State address in 2019, New York Gov. Andrew Cuomo announced plans to significantly upgrade the state's renewable energy targets, including quadrupling its offshore wind target to 9 gigawatts (GW) by 2035. To reach that goal, the plan says offshore wind transmission would need to initiate "a first of its kind effort to evaluate and facilitate the development of an offshore transmission grid that can benefit New York ratepayers by driving down offshore wind generation and integration costs." This seems like a great first step in the right direction.

In other places, the industry is analyzing the grid's ability to host distributed energy resources, such as solar, without adversely impacting power quality or reliability. The market then shares with developers where capacity is available and connections can be made. Does the principle of hosting capacity also make sense for offshore wind?

Only time — and much work on this and many offshore wind topics — will tell.

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