Opinion: The time has come for offshore wind power in the United States

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Offshore wind turbines have been successfully deployed in Europe since 1991, providing thousands of megawatts of clean energy for multiple nations. Ten years ago, it seemed that the United States would follow suit: The US Energy Policy Act of 2005 directed the Department of the Interior (DOI) to establish an offshore leasing regime in federal waters (generally oceanic waters 3–200 nautical miles from the coast). It appeared to be a crucial step in opening the door to the country's vast offshore wind resource: turbine installations in the Mid-Atlantic Bight alone could power all United States electricity, automobile transport, and building heat needs (1).

Despite recent progress at the demonstration-scale Deepwater Wind project off of Rhode Island, the United States is perhaps further from commercial-scale offshore wind deployment today than it was in 2005. Meanwhile, Europe went from 622 megawatts of offshore wind capacity in 2004 to more than 8,000 in 2014 across 74 wind projects, with those under construction to increase capacity to almost 11,000 megawatts (2). United States offshore wind has so far remained a missed opportunity, given its huge resource size and proximity to population centers, the magnitude of the climate change problem, and the public's hunger for a transformative energy policy with offshore wind as part of the vanguard (3).

Why has United States offshore wind struggled, while land-based wind and solar have reached new heights? How can a robust offshore wind power industry develop in the United States in the next 10 years?

Fig. 1. Europe has made great strides in developing offshore wind farms, such as this one in the Baltic Sea off of Copenhagen, Denmark. The United States has yet to follow suit, despite an enormous offshore wind resource. Image courtesy of Shutterstock/Tony Moran.

Here, seeking to glean lessons learned and find a path forward for the United States, we consider first how Europe advanced offshore wind in the face of impediments, such as comparatively small offshore exclusive economic zones (Germany), small populations (Belgium and Denmark) (Fig. 1), and late starts (United Kingdom and Germany). Among the reasons for Europe's success are political will, price and policy support, and spatial planning, although some European countries have been more successful than others (4).

With this comparison in mind, we propose a multipronged economic and policy model for the United States that incentivizes offshore wind, enabling the long-stalled industry to not only get off the ground but thrive.

Lessons Learned

In 2005, Europe put a price on carbon emissions through the adoption of carbon trading as part of its Kyoto Protocol commitment. Subsequently, in 2009 Europe aligned its renewable energy policy with its climate goals, setting ambitious targets and providing renewable energy sources with priority access to the grid (5). In so doing, European policymakers relied more on the adoption of clean energy than on switching between fossil fuels. Focusing specifically on electricity, in 2006 the United Kingdom, now undeniably the leading nation in offshore wind power (2), initially adopted a renewable electricity obligation of 20% by 2020; several years later it embraced an aspirational goal of 30% by 2020 (6). The United Kingdom also modified price support. Before 2008, it provided all renewable sources of electricity with the same support to avoid picking technology winners and losers. From that point forward, however, offshore wind began to garner greater price support than land-based wind in recognition of its higher costs, which had hampered its growth (7).

The United Kingdom essentially set up a market where offshore wind developers compete against one another rather than against other technologies, much as Germany

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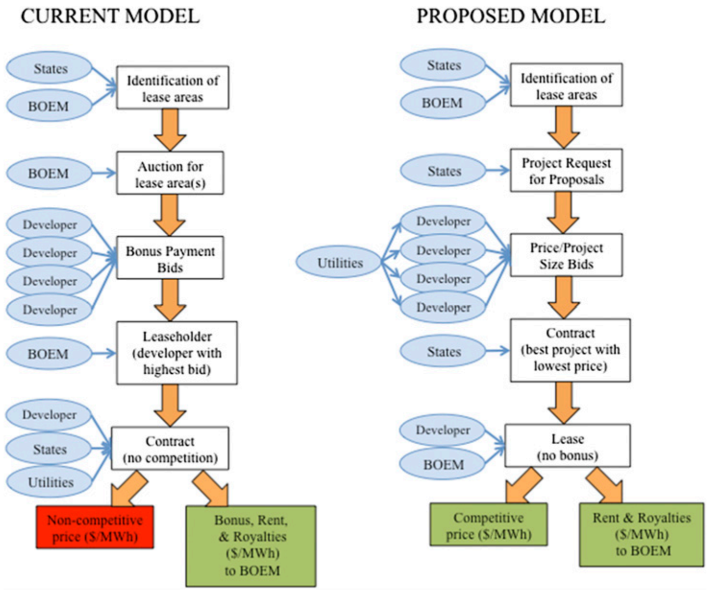

Fig. 2. Current and proposed models of offshore wind power competition. The current model has developers compete for ocean space resulting in noncompetitive contracts. The proposed model moves competition to the states resulting in potentially lower prices for consumers.

and other European countries had successfully done with technology-specific feed-in-tariffs (some US states use a similar strategy, with technology-specific renewable energy credit markets). The United Kingdom also actively promoted offshore wind power through a series of calls for proposals and, by 2013, it had come to consider offshore wind as the main source of renewable energy to meet its European commitments (7). Both the United Kingdom and Danish efforts are now, respectively, further driven by Scotland and Denmark's ambitious 100% renewable energy goals.

Marine spatial planning (MSP)—a public process of analyzing and allocating human activities to protect marine ecosystems and advance social and economic objectives (8)—also has played an important role in Europe (9–11). Although MSP can result in delay in offshore wind power deployment during the planning phase—as in the case of the slow German ramp-up—once instituted, it brings the promise of reduced conflict over the ocean commons shared by economic, recreational, ecological, and aesthetic uses, users, and interests. Reduced conflict in turns brings quicker development with a concomitant reduction in cost and increased investor interest.

In the United States, although the DOI has dedicated financial resources and human and political capital to offshore wind power and the Department of Energy (12) developed a 20% wind scenario by 2030 that included 54 gigawatts of offshore wind, there has been no overarching federal government vision of how to reach that goal. Instead, the DOI's Bureau of Ocean Energy Management has focused on issues *du jour*, such as a particular lease sale or how much money the federal government raised in a given auction. Meanwhile, the country has focused on advancing an "all-of-the-above" energy strategy rather than an urgent "renewables first" vision. To advance United States offshore wind development, we need changes to the regulatory regime, tax and finance policy, planning, and research, along with a shift in wind power communication.

The Way Forward

Right now, the regulatory regime that governs offshore United States wind projects employs a model originally established for offshore oil. But whereas oil is sold to refineries throughout the United States and its price influenced by global markets, electricity is administered by regional entities at the wholesale level and by state commissions at the retail level. Moreover, electricity from wind power must be brought by cable through state waters and come ashore in either beach communities or public parks before connecting to the land-based grid. The model is a bulky regulatory framework designed to minimize the risk of catastrophic failure, such as an explosion or spill from an offshore oil installation; maximize up-front federal government bonuses; and encourage competition for federal lease sites. Instead, competition should be centered in state commissions to obtain the lowest reasonable price for offshore wind-derived electricity that can be competently delivered to homeowners, renters, and businesses (Fig. 2).

The United States should look to maximize installed offshore wind capacity over the next 10 years responsibly (which also provides royalties), rather than maximize short-term revenue through lease auctions irrespective of whether or not they result in development. A legislative fix should be the first order of business.

Second, tax and fiscal policy needs reinvigoration. As the US federal government has done with other industries, it should launch offshore wind with a long-term tax credit. For example, in 2005 Congress sought to reinvigorate nuclear power with a 16-year planning horizon tax credit for new facilities. A tax credit that likewise recognizes offshore wind's long planning horizon and that is based on investment costs, as opposed to electricity production, is appropriate given the large capital costs associated with offshore wind power development.

There should also be a bigger emphasis on loan guarantees. When an entity like the US federal government promises to pay off the balance in the event that the borrower is unable, it is easier for the borrower to obtain financing. For example, although Cape Wind, the controversial planned wind farm off of Cape Cod, eventually received a small loan guarantee, its demise (and that of Bluewater Wind's Delaware project) can be traced to difficulties in securing financing. Moreover, a loan guarantee has the added benefit of lowering a loan's interest rate given greater repayment assurance. That lower rate in turn results in lower prices paid by consumers. Given that large-scale offshore wind power projects cannot be financed without long-term contracts for the sale of electricity, an offshore wind power loan guarantee has the benefit of being tied to a dedicated stream of revenue.

Third, more effort should be devoted to regional planning and across-state collaboration. The Administration has created state task forces and labeled waters that are held in trust for all Americans as Delaware's, Virginia's, Massachusetts', and so forth. Although well-intentioned, this policy, unfortunately, has been counter-productive, reinforcing competition among states when cooperation is needed. Electric grid infrastructure is shared regionally; there are regional reliability benefits from offshore wind power; and regional offshore backbone transmission systems, like that proposed by Google/Trans-Elect, would come with the benefit of fewer cables to shore (the place where offshore wind power has its most immediate effect on coastal residents) and less intermittency (13). States have interstate coastal development concerns on the one hand, but can benefit from economies of scale of large regional projects as well as from sharing whatever economic development benefits arise, on the other. It is thus time for Congress to create incentives for regional cooperation, such as greater sharing of royalties with those states that cooperate. States also might form regional interstate compacts similar to those for managed shared natural resources.

Research Required

Fourth, there is a need for more research to reduce social, economic, and technical barriers to offshore wind: for example, understanding how individuals and communities make sense of changes to familiar places and landscapes (14). Greater understanding of the role of community engagement and risk tolerance may be particularly germane to more distributed energy technologies, such as offshore wind power. Although technology development should generally be left to industry, there is a need for public sector work on aspects with low technology readiness or that lack attention in Europe, given differences in weather and climate (e.g., the impacts of hurricanes and Nor'easters in the Atlantic and ice-loading in the Great Lakes).

We need government investment in meteorological measurements at and above hub heights, using fixed towers or floating Lidar (15). Most data today are proprietary, held confidentially by developers. In contrast, high-quality validated public data would allow for objective comparisons and provide greater certainty regarding future revenues, which in turn would result in lower financing costs and lower consumer prices. In addition, large economic benefits could arise from gaining a better understanding through research of where and how to optimally locate wind turbines (15, 16), as well as from continued research on the needs of the electric grid to manage large penetrations of renewables, including improved wind forecasting (17).

An offshore wind project can have a myriad of consequences for wildlife, including displacement, barrier effects, habitat change, disturbance, and fatality (18). Fixed platforms can be used to gain a better understanding of fish, marine mammal, turtle, and seabird movements, decreasing risks through enhanced site selection, and by lowering the cost and shortening the time to investigate individual sites. Scientific studies in Europe, as part of preconstruction environmental assessments, and more importantly, dedicated construction and postconstruction research programs, have shed considerable light on the ways in which marine wildlife responds to the construction and operation of offshore wind turbines. These studies have shown that the environmental effects of properly sited, executed, and operated wind projects are, as a general rule, low level (18). For example, fatality rates of birds are lower than might have been anticipated given avoidance behavior (19), and impacts on dolphins and porpoises have been identified as being more of a short-term nature than resulting in long-term consequences (20–22). In light of the European findings, and given that electricity generated by wind power displaces fossil fuel generation (23), it is perhaps unsurprising that organizations, such as the National Wildlife Federation and Massachusetts Audubon, support offshore wind power.

However, areas of study that require inquiry and vigilance in United States waters remain: for example, northern European waters lack large migrating whales. Scientific research and related mitigation mechanisms

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will help to ensure that these unique United States marine populations are protected. In addition, such peaceful coexistence will be necessary if offshore wind power development is to sustain initial progress and continue to engender broad public support beyond the initial few projects. And, it will complement the MSP imperative, providing scientific justification for the demarcation of marine protected areas.

Finally, offshore wind development has been marketed piecemeal, lease-block-by-lease-block, auction-by-auction, or project-by-project, and as fostering jobs and economic development rather than positioned as a way to improve air quality, mitigate climate change, and suppress electricity prices. Early projects require above-market prices, as is typical when a "new" energy technology attempts to break into the market, and economic development requires a critical mass of projects (a market) rather than idiosyncratic development. By displacing coal and natural gas, offshore wind power also will directly reduce health costs, contribute to the mitigation of extreme temperatures, which have a large health impact on the most at-risk populations, and engender public support (23–26). Wind power also suppresses electricity prices for electricity more generally because hourly markets set prices at the margin. Because wind power is either delivered under contract or bids into the spot market near $0 given its low marginal cost (zero fuel costs), it lowers the spot (marginal) price for all electricity sales (27, 28). A change in offshore wind power communication to match its promise is thus needed.

Given the twin imperatives of addressing climate change and improving public health, as well as the sheer size of America's offshore wind resource, its proximity to population centers, and long history of deployment elsewhere, it is time for the United States to reinvent progress in offshore wind and plan intelligently for the next 10 years. Efforts now could put the United States on a path toward significant carbon mitigation by midcentury, provided the United States embraces carbon policies that are better informed by climate science.

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