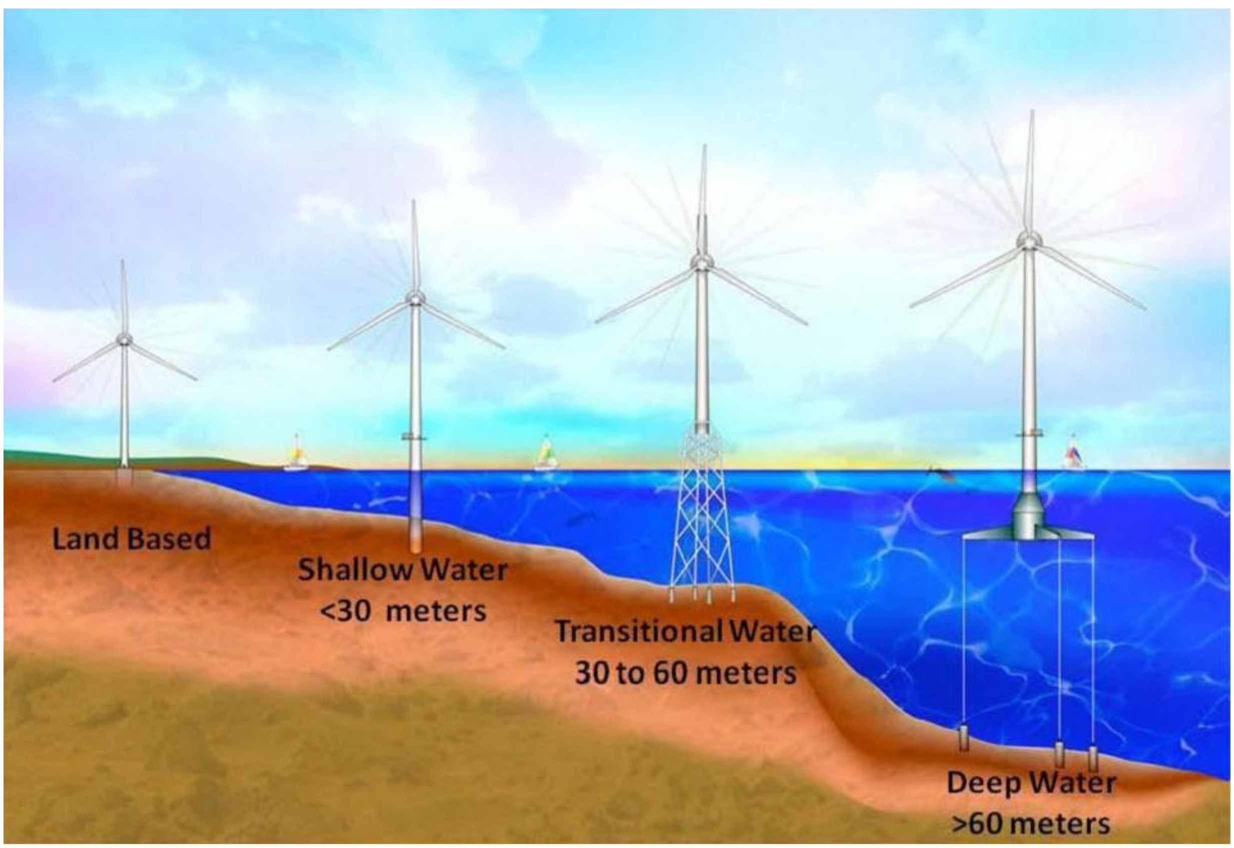
Policy Brief: Offshore Wind

Offshore wind is a term used to describe technologies that generate electricity from wind powered turbines located offshore and away from land. The characteristics, materials, and technologies used to construct offshore wind projects are similar to onshore (land-based) wind projects, with a few notable differences.

Costs

Currently, offshore wind is more costly than its land-based cousin. Unlike land turbines, offshore wind turbines must be anchored to the seafloor. In the case of the Oregon coastline, that anchoring is more complex and expensive due to the significant depth of the ocean floor along the coast. To date, nearly all global offshore wind development has been fixed-bottom, which is only feasible in shallower waters (depths less than 60 meters),[1] where offshore wind towers can be directly bored into underwater floors and fixed in place. Deeper waters (depths greater than 60 meters)[2] require even more complicated support systems consisting of anchored, floating platforms that indirectly fix wind towers to a targeted location, but allow for some movement.

Figure 1: Fixed-bottom Foundation versus Floating Offshore Wind[3]



The potential need for significant local transmission upgrades can also make offshore wind more expensive than land-based wind development, which contributes to the overall economic viability of a project. However, offshore wind does have an advantage of economies of scale that can increase economic viability because turbines can be built using higher towers, larger generators, and longer blades than wind turbines built on land. As offshore wind technology matures and costs decline, these economies of scale may enable offshore wind to be more cost competitive in the coming decade. A National Renewable Energy Laboratory study forecast the levelized cost of energy for offshore wind to decline from $74 to $53 per MWh by 2032, which could be cost competitive in some market conditions described in more detail below.[4]

Benefits

Learn more in the Offshore Wind Technology Review

Despite the generally higher costs, offshore wind projects can have several advantages over onshore wind. For example, offshore wind projects can generate larger and more consistent power outputs than land-based wind because offshore wind speeds are generally stronger and more constant. Open ocean surfaces in deep waters far from shore can provide flexibilities that can promote scaling up of floating offshore wind turbines relative to fixed-bottom and land-based wind turbines.[5] In addition, to the extent offshore wind can generate electricity at different times of the day compared to land-based solar and wind resources, offshore wind can add diversity to renewable resource mixes and be used to complement onshore renewables.[6] [7] Offshore wind can also provide more localized generation to coastal communities, which can improve power quality, reliability, and resilience when coastal communities – like many in Oregon – are located at the ends of long radial transmission lines that supply power from distant, inland generation resources. Figure 2 below provides a comparison of offshore wind and onshore wind.

Figure 2: Comparing Offshore Wind and Onshore Wind

Onshore Wind

Larger Turbines & Blades →

More Complicated Tower Anchoring →

Higher Wind Speeds →

More Consistent Wind Speeds →

More Complicated Transmission Access →

← Lower Capital & Maintenance Costs

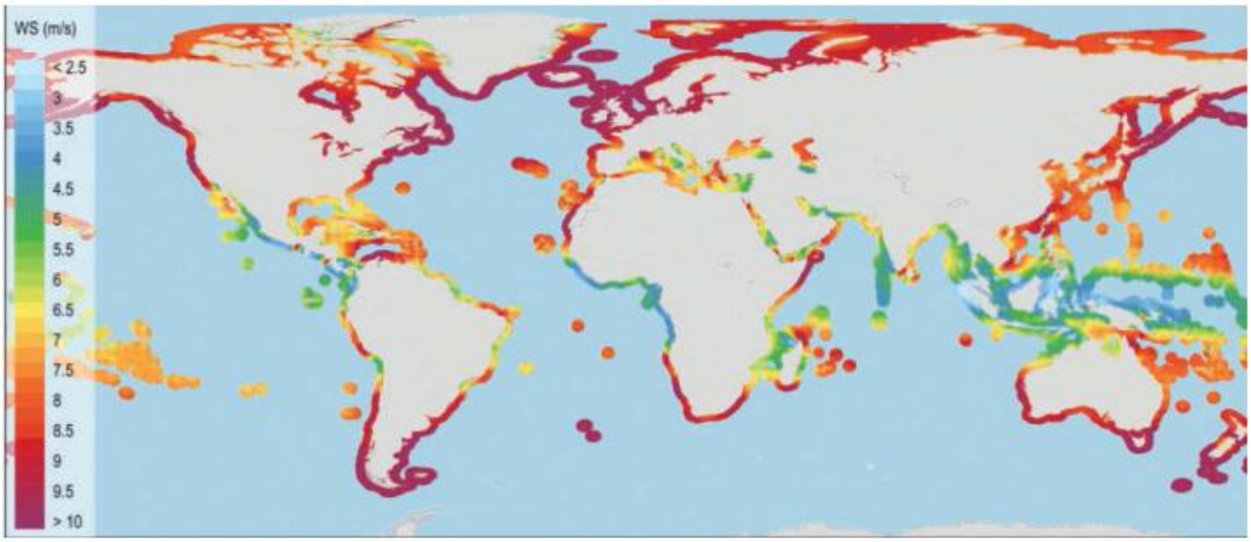
Offshore Wind

Current State of Offshore Wind

Offshore wind is still in its early days of market penetration because of its higher costs. Global development of offshore wind has largely been limited to fixed-bottom offshore wind in locations near large population centers with shallower waters.[8] As of 2018, the world has 22,546 MW of operating nameplate capacity from 168 fixed-bottom offshore wind projects, compared to only 46 MW from eight floating offshore wind projects, with 30 MW coming from a single floating project near Peterhead, Scotland.[9] As of 2018, there are 4,888 MW of floating offshore wind in the global pipeline of project development, suggesting the construction of floating offshore wind projects may increase in the years ahead.[10]

As of 2018, total offshore wind capacity (fixed-bottom plus floating) accounts for only 0.3 percent of total global electricity supply.[11] Offshore wind does, however, play a larger role in other countries – for example, 15 percent of Denmark's 2018 generation came from offshore wind.[12] A map showing the global potential for total offshore wind (fixed and floating) can be seen in Figure 3 below.

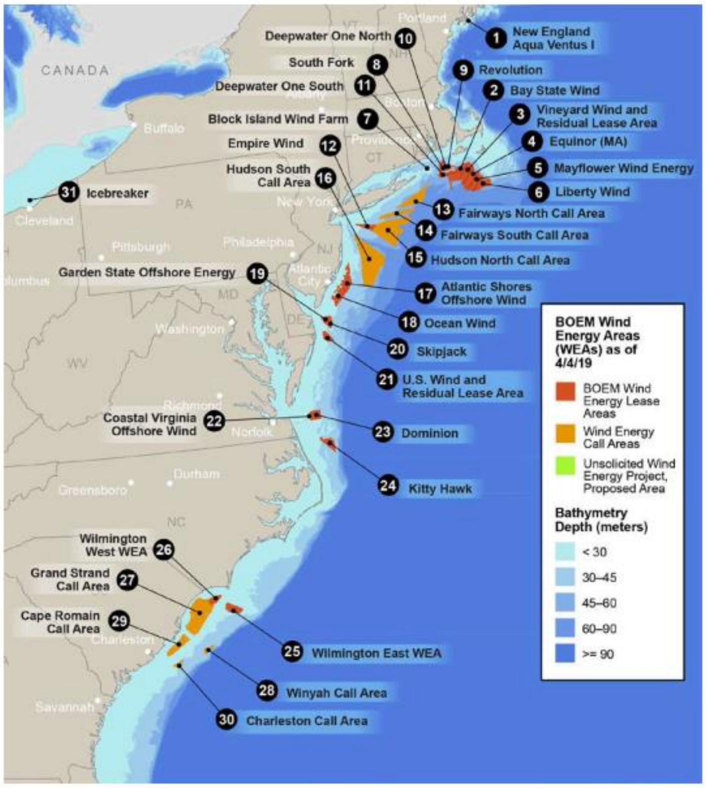
Figure 3: Global Map of Areas w/ High Offshore Wind Speeds (Fixed and Floating)[13]



Floating offshore wind costs are forecasted to fall precipitously over the next 10 years,[14] due in part to scaling up from small, single-turbine pilot projects to larger demonstrations, potential knowledge transfers from fixed offshore wind, and potential automation of the production of floating platforms – with some floating projects already being built where they are cost competitive for some localities (e.g. remote and island locations).[15] [16] As floating offshore wind costs continue to decline, new markets are likely to emerge.[17] The global potential for over 6,950 GW of floating offshore wind capacity has been identified in areas with very strong and consistent wind speeds (i.e. locations with "high energy resource values").[18] In 2015, the Carbon Trust – a leading European offshore wind consultant – forecasted that 80 percent of the entire potential for offshore wind in Europe and 60 percent of the potential for offshore wind in the United States is for floating offshore wind in deep waters.[19]

As of 2018, the U.S. had 30 MW of fixed-bottom offshore wind in the Block Island Wind Farm, the first project operating in state-controlled waters off the coast of Rhode Island.[20] The U.S. Department of Energy identified another 25,794 MW of fixed offshore wind projects in various planning and development stages in the U.S. as of 2018, indicating the U.S. could be poised for significant fixed offshore wind development in the future.[21] For example, in summer 2020, the first fixed-bottom wind turbines were installed in U.S. federal waters off Virginia Beach for the Coastal Virginia Offshore Wind Project.[22] While the U.S. has not developed any floating offshore wind projects, significant efforts to do so are already underway in windy, deep water areas offering high energy resource values (*discussed in next section*).

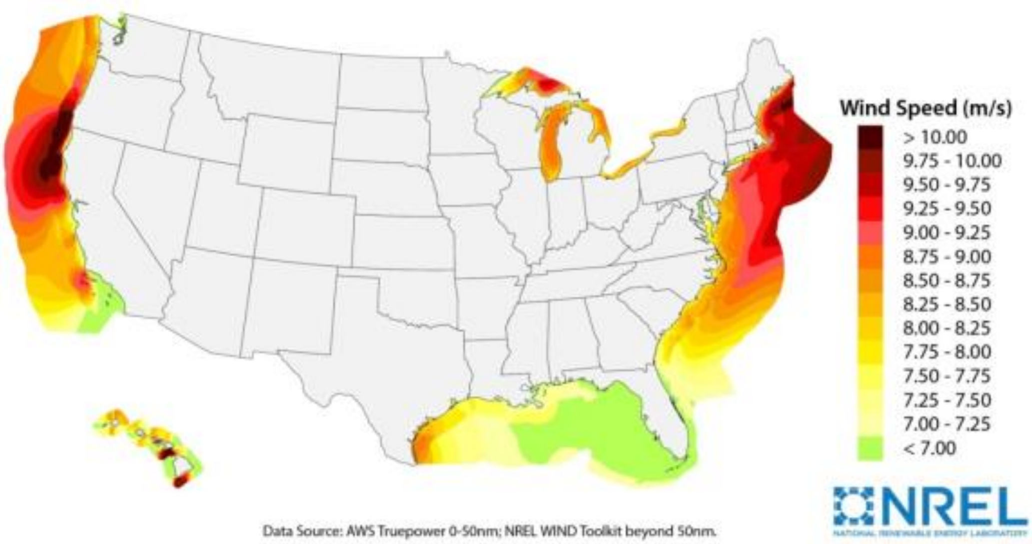
Figure 4: Map of U.S. Activity in Fixed Offshore Wind[23]



Factors Influencing Floating Offshore Wind Development on the West Coast and Oregon

Due to very strong average wind speeds, ocean locations off the California and Oregon coastlines offer the highest potential resource values for floating offshore wind in federal waters surrounding the U.S. coastline. A 2016 assessment by the National Renewable Energy Laboratory reported that ocean depths of 60 to 1,000 meters have a net technical potential for approximately 107 GW of nameplate capacity off California's coast, and 60 GW off Oregon's coast – and that these technical potentials closely correspond with distances from shore ranging from 3 to 50 nautical miles.[24]

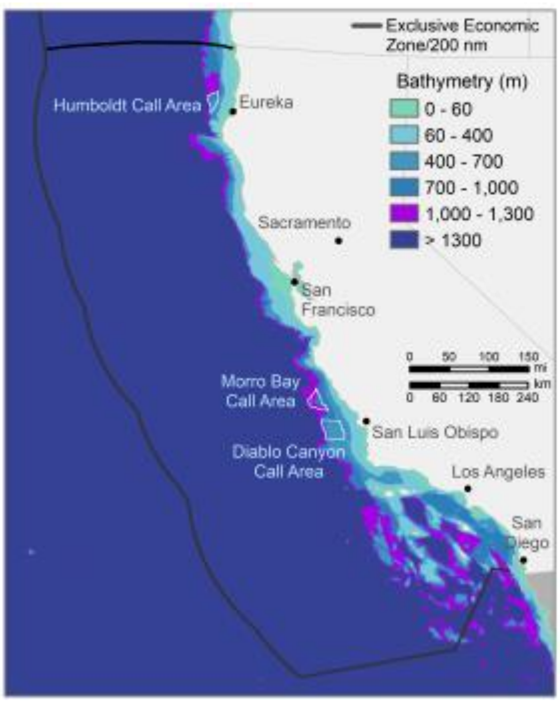
Figure 5: U.S. Wind Map of Areas w/ High Offshore Wind Resource Values[25]



Although Oregon and the most northern part of California have some of the best offshore wind resources in the U.S., as shown above, the overall populations in these coastal areas are relatively low compared to the East Coast of the U.S., where offshore wind is further along in development. Because of the lower populations, a substantial portion of the West Coast does not have a robust network of onshore transmission infrastructure close to the shoreline necessary to interconnect floating offshore wind to the grid. However, in high population load centers farther south in California, there is more transmission infrastructure.

Floating offshore wind could be a more attractive procurement option for California utilities, compared to utilities in Oregon, because they can leverage existing coastal transmission infrastructure. In locations where new transmission lines that tie generation to the bulk transmission system (gen-tie lines) can interconnect new offshore wind projects with existing coastal transmission infrastructure, the "all-in" costs to build offshore wind can be lower. For windy, deep water areas that are far from large coastal load centers, like the Humboldt area shown in Figure 6 below, the idea of sinking long underwater transmission lines to reach interconnection points with coastal infrastructure is under examination.[26] [27] [28]

Figure 6: Identified Areas of Potential for Offshore Wind Development – California[29]



Without expensive new investments in onshore transmission infrastructure in Oregon, the overall scale and location at which floating offshore wind projects could be developed is likely more limited. For example, production cost modeling in a 2020 Pacific Northwest National Laboratory study indicated up to 2-3 GW (compared to the technical potential of 58 GW) of floating offshore wind could be accommodated along the Oregon coast before running into onshore transmission constraints.[30]

This means development of more than 2-3 GW begins to overwhelm the onshore transmission infrastructure. Without additional upfront investment in transmission, this begs the question of whether the cost of developing up to 2-3 GW of floating offshore wind is competitive with land-based electricity supply resources. If not, then floating offshore wind projects would likely need to be scaled even larger to become cost competitive, which could trigger the need for expensive new investments in onshore transmission infrastructure.[31] [32] This can increase the costs associated with interconnecting offshore wind to the grid even more, and can increase upfront project development costs, but could increase overall cost-effectiveness.

Studies have also shown offshore wind ramps up its power production in the evenings,[33] [34] and California's need for power in evening hours (when solar generation decreases and loads increase) is larger than Oregon's need. To the extent offshore wind can generate electricity at different times than onshore wind and solar, and because offshore wind can be more consistent than onshore wind, it can complement these resources. Therefore, offshore wind can potentially be more valuable for utilities that already have large amounts of onshore wind and solar in their resource mixes.

The 2020 Pacific Northwest National Lab study showed that, because of the relatively cold and dark winters in Oregon, floating offshore wind could potentially be used to serve Oregon's evening winter loads as regional solar production diminishes in late afternoon, and could also reinforce variable regional onshore wind generation in the spring, summer, and fall.[35] To date, however, Oregon utilities have not identified offshore wind as cost-effective to meet these types of needs.[i] [36] [37]

Oregon's electricity costs are also among the lowest in the nation.[38] This is a benefit for ratepayers, but it makes the case for investing in more expensive, newer technologies such as floating offshore wind more challenging. California's electricity costs are among the highest in the nation,[39] with very large spikes in evening wholesale electricity prices.[40] With power costs significantly higher than those in Oregon, especially during the evening hours, and with more robust coastal transmission already in place in certain areas, floating offshore wind may be more economical for California utilities.

Permitting and Jurisdictional Authorities for Offshore Wind

Jurisdiction over ocean waters is split between state and federal authorities depending on the distance from a state's coastline. Ocean waters within three nautical miles of the coastline are covered under state jurisdiction, and areas from three nautical miles to 200 nautical miles are covered under federal jurisdiction.

Oregon Jurisdiction

At the state level, there are a broad range of governing authorities involved with the permitting of energy development projects within Oregon's three nautical mile ribbon of ocean jurisdiction (roughly 1,000 square nautical miles or 1,400 square standard miles), including state and local agencies. State agencies include the Oregon Departments of State Lands, Fish and Wildlife, Parks and Recreation, Environmental Quality, Land Conservation and Development, Water Resources, Energy, and Geology and Mineral Industries. Some state and local agencies may participate in the review and approval of the generation component of an energy project in the ocean itself, and others may engage in the review and approval of any transmission lines necessary to connect the ocean resource to land.

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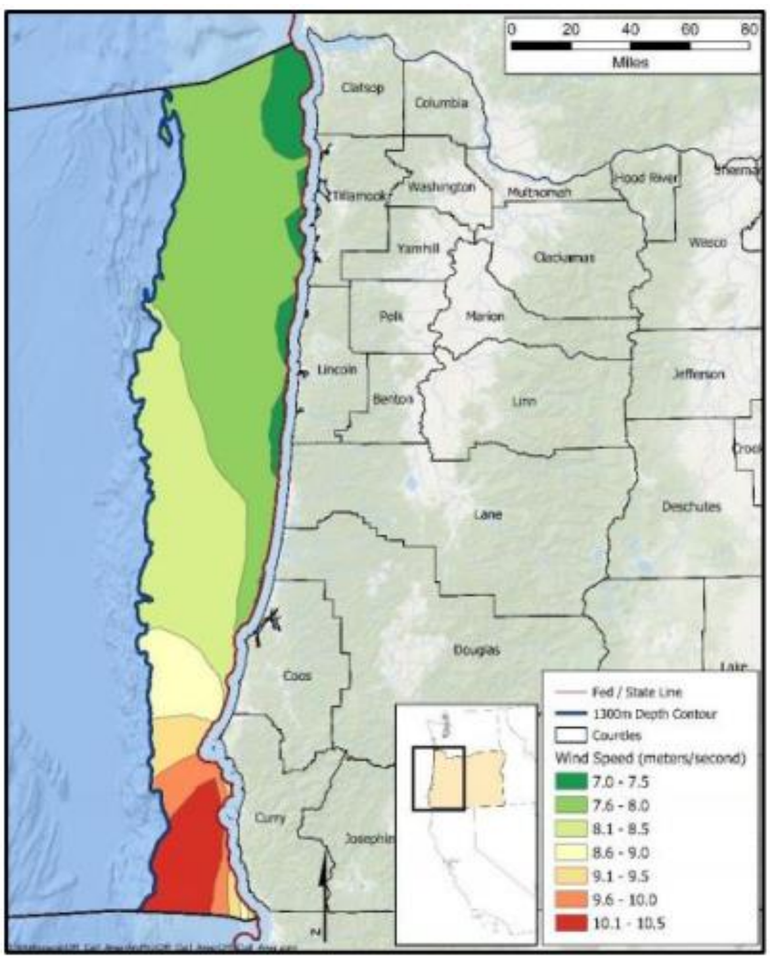
[i] Utility Integrated Resource Plans have a 20-year planning horizon. Portland General Electric's 2019 IRP has no mention of offshore wind. PacifiCorp's 2019 IRP has only a brief mention of offshore wind – "[O]ffshore wind remains expensive and requires government policy support and subsidization."

The Oregon Territorial Sea Plan, first adopted in 1994, acts as a coordinating framework for the wide range of governing authorities likely to be involved with the review and approval of any ocean energy projects located within the state's territorial ocean jurisdiction.[41] Under the Oregon Coastal Management Program, the Department of Land Conservation and Development also performs federal consistency reviews for proposed renewable energy projects that fall within an area described as the Marine Renewable Energy Geographic Location Description, which covers the areas of the outer continental shelf between the western edge of the territorial sea and the 500 fathom depth contour. [42] These reviews provide analyses of the reasonably foreseeable adverse effects that the development of marine renewable energy projects can have on important natural resources of the state.

With weaker winds and greater concerns over coastal wildlife and viewsheds in the state's shallower waters closer to shore, the potential for fixed offshore wind development off Oregon's coast has not been identified as potentially viable.[43] However, the potential for economically viable floating offshore wind projects have been identified where the winds are stronger above the deeper waters of the outer continental shelf, far from the Oregon coast, where permitting authority falls under Federal jurisdiction.[44] Floating offshore wind turbines can be located at distances far enough from shore that they are not seen or heard from land,[45] which may help address concerns about noise and visual aesthetics that the development of onshore wind has prompted.

Figure 7: High Oregon Offshore Wind Resource Values in Federal Waters[46]



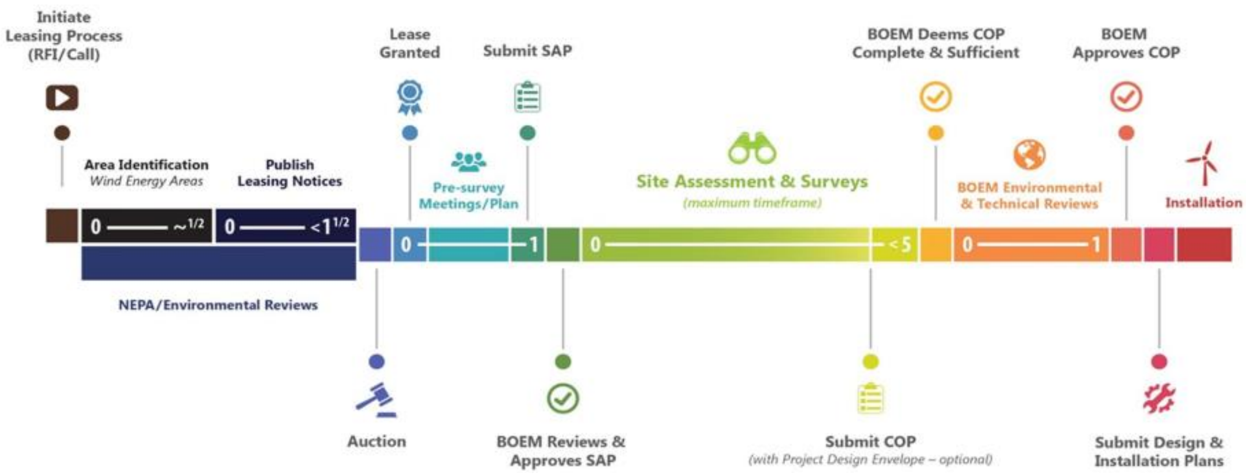
Federal Jurisdiction

Development of energy projects in federal waters (i.e. outer continental shelf) is under the jurisdiction of the Federal Bureau of Ocean Energy Management. BOEM has authority under the U.S. Department of the Interior for issuing leases, easements, and rights-of-way for renewable energy projects located on the outer continental shelf. The BOEM leasing process requires consideration of a host of factors, including interagency coordination, public comment, safety, environmental protection, competition, conservation and prevention of waste, fair return, and prevention of interference with other reasonable uses.

BOEM's planning and leasing process consists of various phases over several years and includes multiple opportunities for public input. BOEM, the State of Oregon, and other federal, tribal, and local entities – such as the Department of Defense, Coquille Indian Tribe, and Coos County Board of Commissioners – are currently coordinating through an Intergovernmental Renewable Energy Task Force (see below for more info). Specifically, BOEM and the State of Oregon are engaging in a process to gather data and conduct outreach to understand the opportunities and challenges of offshore wind, which will inform future leasing and development decisions.[ii]

Figure 8 below gives a general overview of the milestone steps and timelines (numbers indicating years) associated with BOEM's competitive leasing approval process. A deeper dive into BOEM's interagency coordination, review, and leasing processes can be found in its publication, "A Citizen's Guide" (Dec. 2016).[47]

Figure 8: BOEM's Renewable Energy Outer Continental Shelf Leasing Process (in Years)[48]



Offshore Wind Activities in Oregon

In 2011, in response to a request from former Governor Ted Kulongoski, BOEM initiated the BOEM Oregon Intergovernmental Renewable Energy Task Force with the Department of Land Conservation and Development. This Task Force provides coordination regarding potential renewable energy activities (i.e. offshore wind and wave energy) on the outer continental shelf off of Oregon. Task Force membership includes representation from federal and state agencies and Tribal and local governments. The purpose of the Task Force is to share information, coordinate project review processes, and discuss opportunities and information needs.

From 2011 to 2014, the BOEM Oregon Task Force met six times and considered intergovernmental and public comments. In 2013, Principal Power, an offshore wind developer based in Seattle, WA, submitted an unsolicited request for a commercial wind lease to BOEM. The project was proposed to be located roughly 16 nautical miles (30 km) away from Oregon's shore and adjacent to the Coos Bay area, yet far beyond Oregon's Territorial Sea.[49] In 2014, BOEM issued a Request for Interest and later determined there was no competitive interest in the area requested by Principle Power. BOEM then proceeded with the non-competitive leasing process, including issuing a Notice of Intent to prepare an Environmental Assessment for the project and holding public scoping meetings. After many months of negotiations with Oregon utilities, Principle Power could not come to a purchasing agreement for the project.[50] In short, the project was too costly and not economical for Oregon

[ii] The Oregon Renewable Energy Siting Assessment project, funded by U.S. Department of Defense and led by the Oregon Department of Energy, is due for completion in 2021 and will provide additional insight into Oregon wind energy potential. https://www.oregon.gov/energy/energy-oregon/Pages/ORESA.aspx

ratepayers.[51] Principle Power did not submit a Construction and Operations Plan to BOEM, which was the next step in the authorization process. In September 2018, BOEM determined that Principle Power no longer retained its non-competitive interest status with the project and is no longer processing the unsolicited lease request.[52]

The cost for floating offshore wind technology has continued to decline since 2016, and forecasts as recent as 2019 have projected that floating offshore wind is becoming increasingly cost competitive with other generation technologies.[53] This has renewed the interest of some offshore wind developers to explore the viability of developing floating offshore wind on the outer continental shelf off the Oregon and California coasts.

In September 2019, based on this renewed interest, BOEM organized and initiated a re-convening of its Oregon Task Force. Its seventh public meeting (first in this renewed effort) was held on September 27, 2019, and the eighth public meeting was held on June 4, 2020.[54] Similar to its prior efforts, BOEM's Oregon Task Force continues its communication, education, collaboration, coordination, and consideration of input from a broad set of intergovernmental representation to inform BOEM's decision-making process.

The goal of the June 4 meeting was to review the "Data Gathering and Engagement Plan for Offshore Wind Energy in Oregon" created by BOEM and DLCD, and the meeting outcomes included Oregon's commitment to a planning process to determine the location(s) of a wind energy call area.[55] A cornerstone of this planning effort is how BOEM will collaborate and coordinate with DLCD. The engagement plan was finalized in October 2020 with input received from the Task Force and members of the public, and it outlines how BOEM and DLCD will: 1) engage with research organizations and potentially interested and affected parties, and 2) gather data and information to inform potential offshore wind planning and leasing decisions on the outer continental shelf adjacent to Oregon's coastline.[56] The plan includes the following goals:

1) Interested and affected parties are informed of the data and information gathering process for offshore wind planning and have meaningful opportunities to provide input.[57]
2) The best available data and information are collected to inform potential offshore wind planning and leasing decisions in Oregon.[58]
3) That BOEM and the State build partnerships and a sense of shared ownership in offshore wind planning with interested and affected parties.[59]

BOEM and Oregon have begun offshore wind planning with a data gathering and engagement process expected to run into Fall 2021.[iii]

[iii] For more information and to stay apprised of BOEM's Task Force activities, please see BOEM's Oregon's Activities website at https://www.boem.gov/Oregon

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