BOEM Bureau of Ocean Energy Management

NREL Transforming ENERGY

Future Cost of Floating Offshore Wind Energy in Oregon

Background

Oregon uses over 48 million megawatt-hours (MWh) per year of electricity, which comes from a combination of hydroelectric (40%), coal (32%), natural gas (17%), land-based wind (7%), nuclear (3%), and other sources. Offshore wind is being considered as a possible energy option, as the State takes action to decarbonize its electricity supply. The National Renewable Energy Laboratory (NREL) assessed the present and future costs of floating offshore wind energy in Oregon where currently available technology would be technically feasible.

The offshore wind resource is the energy that is converted to electricity and helps determine the cost; the more wind there is, the more electricity will be produced. Offshore, the wind tends to blow stronger and steadier than on land.

The estimated generating potential in the ocean areas off the Oregon coast where offshore wind energy is technically feasible is 84,600 megawatts (MW), which is enough to supply a significant portion of Oregon's power.

A map of the offshore wind resource is shown in Figure 1, including the study area boundaries where costs were analyzed. The figure shows that the annual average wind speed varies from about 8 meters per second (m/s)[17.9 miles per hour (mph)] in the north to over 11 m/s [24.6 mph]in the south. These are some of the strongest offshore winds in the country.

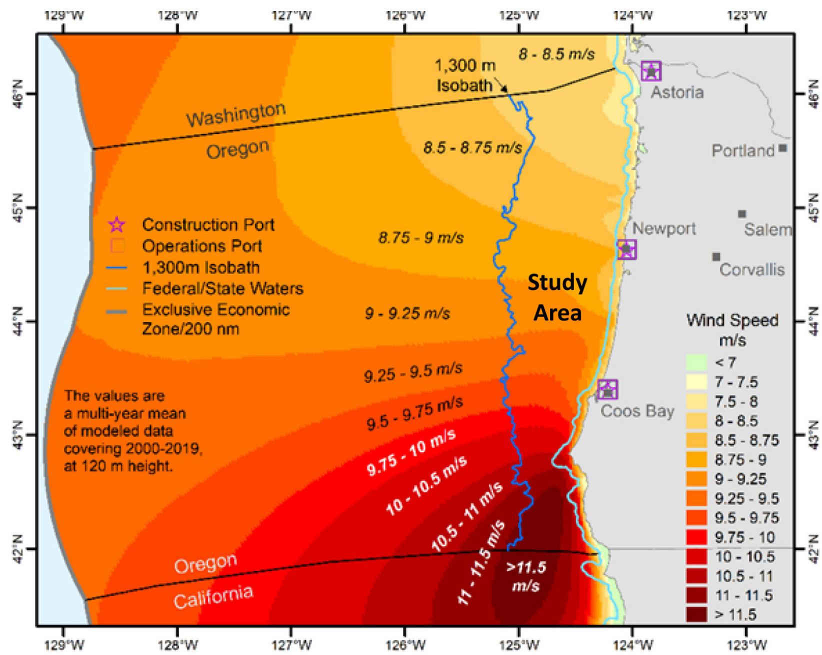

Figure 1. Oregon's Offshore Wind Resource and Study Area

The Oregon continental shelf drops off quickly; 97% of federal waters offshore Oregon has water depths greater than 60 meters (m). This means that floating wind turbines will be needed for wind energy development offshore Oregon. Between 20 and 40 miles from shore, water depths reach the outer technology limit of 1,300 m, beyond which mooring a floating wind turbine to the seafloor gets very difficult.

The study estimated the levelized cost of energy (LCOE), which is the cost to produce 1 MWh of electricity averaged over the estimated 25-year life of an offshore wind farm. For reference, the average household in Oregon uses about 10 MWh (10,000 kWh) of electricity per year. Therefore, a 1,000-MW wind farm, like the ones modeled in this study, would make enough electricity to power 400,000 Oregon homes.

Technology and Modeling Assumptions

The floating support structure modeled in this study is a semi-submersible, the most common substructure currently used by industry, and is shown in Figure 2. Floating wind technology is in a nascent stage and costs are still high. The study predicts future costs out to 2032 by benchmarking early pilot project costs, leveraging commercial trends for fixed-bottom turbines, and incorporating early-stage component cost data from industry pricing. This information is fed into a geospatial, techno-economic cost model developed by NREL. The model accounts for cost factors such as wind speed, water depth, technology type, distance from port and electrical grid interconnection, energy losses, finance costs, and a wide range of capital and maintenance costs. A major industry trend is that wind turbine size is increasing. The model starts with the 8-MW turbines that were available for the 2019 cost reference year and increases the turbine size to 15 MW by 2032. As turbine size increases, fewer installations are needed, less cable is needed to connect the turbines, and fewer turbines need to be maintained.

Figure 2. Floating semi-submersible foundation

Floating Offshore Wind Cost Results

The prevailing industry trends tend to drive future costs lower. As the industry for floating wind energy matures, infrastructure and supply chains to support the technology will be developed, and costs will further decline. There are no major cost components for floating wind that indicate floating wind will be more expensive than conventional fixed-bottom offshore wind in the long term. The LCOE for floating offshore wind in Oregon was estimated over the entire study area for a 1,000 MW sized wind farm from the 2019 reference year out to 2032. Figure 3 shows the "heat map" results for these hypothetical projects with commercial operations beginning in 2032.

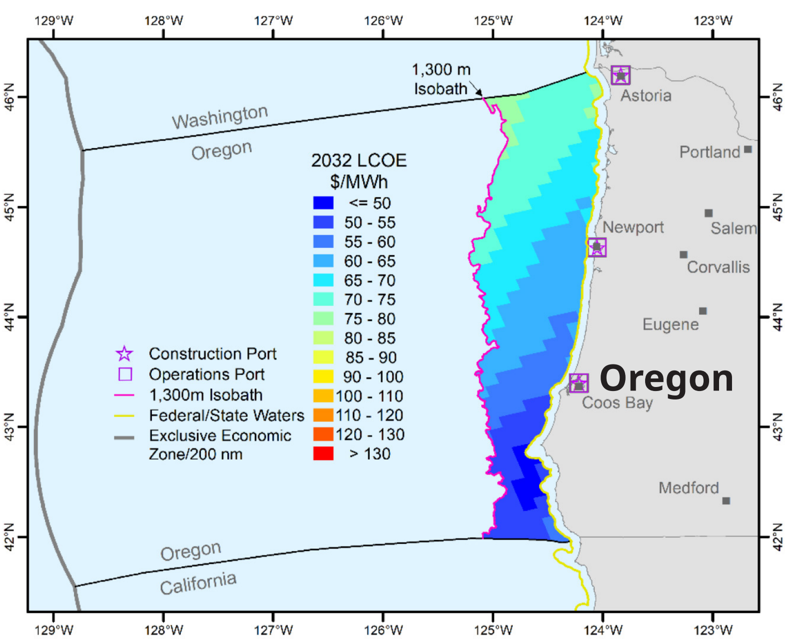

Figure 3. Heat map of floating wind LCOE in Oregon for commercial operations commencing in 2032

The LCOE values range from about $75/MWh (7.5 ¢/kWh) in the north to about $50/MWh (5.0 ¢/kWh) in the south.

The large cost gradient from north to south primarily follows the gradient in annual average wind speed shown in Figure 1. Costs also tend to increase as the distance to shore increases due to increased water depth and longer cable runs. Generally, the data show the potential for the long-term viability of offshore wind in Oregon.[1]

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