READING PASSAGE: OFFSHORE WIND DEVELOPMENT

Building wind farms offshore—several kilometers out to sea—is becoming more common. Offshore construction, maintenance/repairs, and transmission of electricity can be much more expensive and complicated than land-based wind development, but for a number of reasons offshore wind development is very attractive.

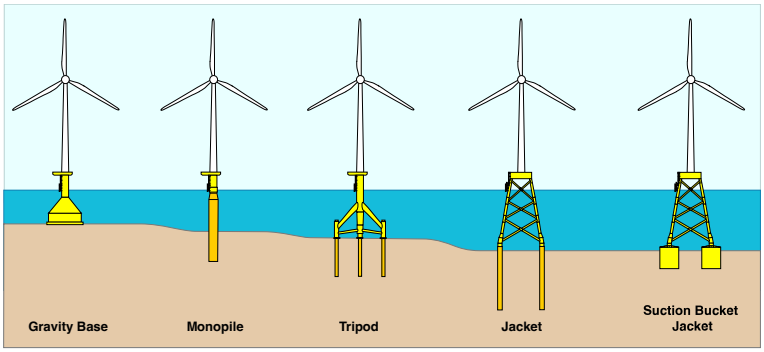
The wind offshore is outstanding in many locations. The smooth, flat surface of the oceans creates very little friction. Without surface roughness and obstructions, the wind blows very fast with very little turbulence. This fast and smooth wind is perfect for wind energy production, and offshore wind turbines are able to produce a lot of electricity very efficiently. The potential energy produced from the wind is directly proportional to the cube of the wind speed (V^3), so a small increase in wind speed will give a relatively large increase in power output.

Another benefit of offshore wind energy development is proximity to shoreline population centers. In the United States, for example, 40 percent of the total population lives in a coastal county.[1] It is most efficient and economical to produce power close to where it is used. Offshore wind energy has seen as having great potential to produce electricity close to large population centers.

Offshore wind turbines tend to be considerably larger than land-based turbines. This is because there are fewer physical constraints when transporting and installing large turbine components. Whereas a 60 meter blade is difficult to transport on roads, it can be moved with relative ease via water. Additionally, the cost of installing a turbine offshore does not change greatly based on the size of the machine, so it is more cost-effective to install a larger turbine that will produce more energy.

Installing an offshore wind farm requires a great deal of scientific data to guide the placement (siting) of the turbines. A developer must be familiar with water depth, wind resource, transmission access, seabed characteristics, wildlife migration, wave action, and many other factors before installing turbines offshore.

An offshore wind farm must be sited where the water is relatively shallow so that the turbine foundations can be secured to the ocean floor. While it depends on the type of foundation used to affix the turbine base to the ocean floor, the standard maximum seafloor depth is currently 60 meters. Because of this, developers seek locations that are very windy and have shallow waters.



Researchers and engineers are studying floating offshore wind turbine designs that would allow turbines to be placed in deeper waters—further from land and from the public eye, out where winds are stronger and more consistent. Many floating wind turbine prototypes are currently being tested in the North Sea and Asia.

[1] "Economics and Demographics." (2026). *NOAA Office for Coastal Management*. National Oceanic and Atmospheric Administration. noaa.gov/states/fast-facts/economics-and-demographics.html.

[2] Veers, P., Bottasso, C. L., Manuel, L., Naughton, J., Pao, L., Paquette, J., Robertson, A., Robinson, M., Ananthan, S., Barlas, T., Bianchini, A., Bredmose, H., Horcas, S. G., Keller, J., Madsen, H. A., Manwell, J., Moriarty, P., Nolet, S., and Rinker, J. (2023). "Grand challenges in the design, manufacture, and operation of future wind turbine systems." Wind Energy Science, 8, 1071–1131.