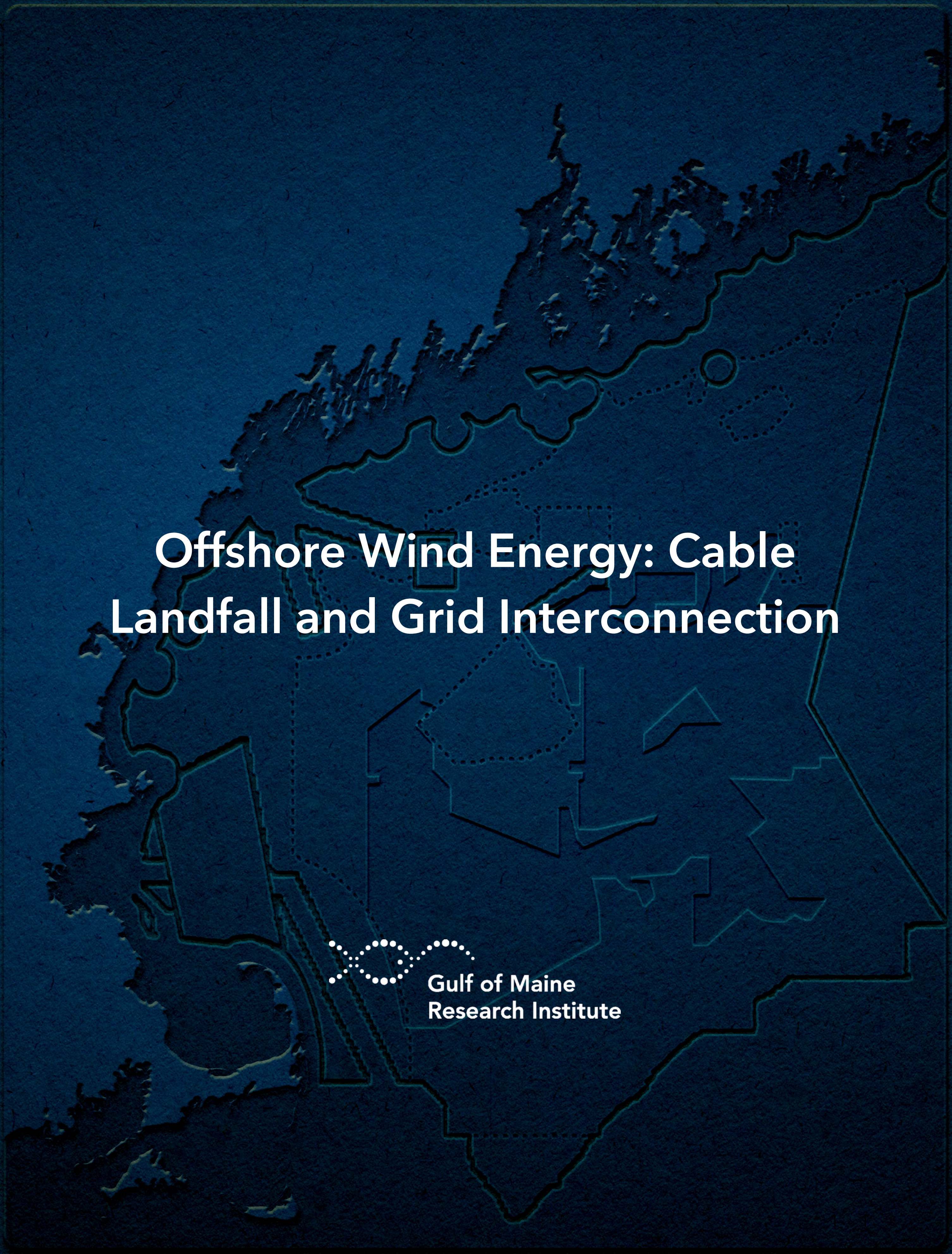
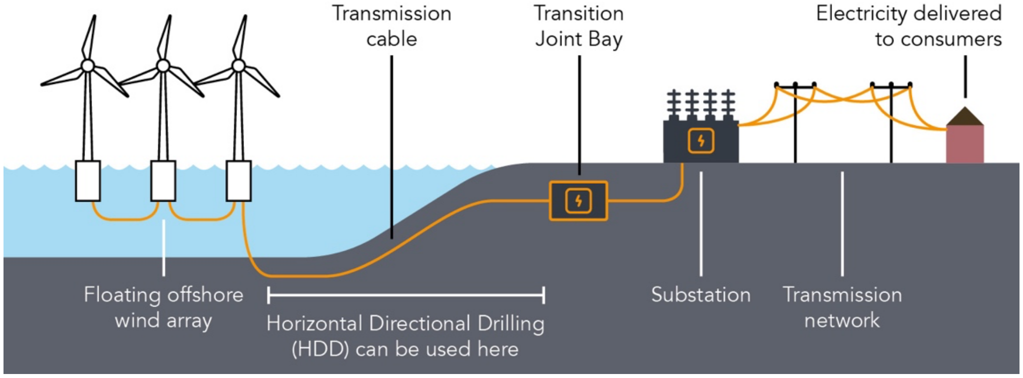


Offshore Wind Energy: Cable Landfall and Grid Interconnection

Gulf of Maine Research Institute

Introduction

For electricity generated by offshore wind turbines to be used by consumers, power must be brought to shore. This resource provides a simplified overview of the cable landfall and interconnection process for offshore wind energy.

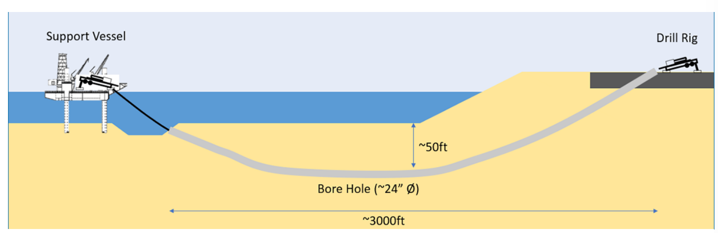


Cable landfall and interconnection process for a transmission cable from an offshore wind array (Figure courtesy of GMRI).

Cable Landfall

1. Both floating and fixed-bottom offshore wind arrays move electricity generated by turbines to shore through transmission export cables. These cables, which are typically buried 3-6 feet below the seabed, extend from an array to a cable landing site on shore.[1] In some cases, they may be routed through an offshore substation on their way to the cable landing site.

2. While cable landing sites vary, areas with minimal potential for environmental disturbance are prioritized. To bring a transmission cable to shore, developers can use horizontal directional drilling (HDD) – a process by which a tunnel is drilled underground to accommodate a pipeline.[2] Offshore wind transmission cables are pulled through the drilled tunnel, ensuring that they can run from the sea to shore without the disruptions associated with digging a trench.



Example of the Horizontal Direction Drilling process for an offshore wind transmission cable (Image: DEME Offshore US).

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[1] New York State Energy Research and Development Authority (NYSERDA), "Offshore Wind Submarine Cable Report," Offshore Wind Submarine Cabling Fisheries Technical Working Group, 2021. https://www.nyserda.ny.gov/About/Publications

[2] TETHYS, "Horizontal Directional Drill," Environmental Effects of Wind and Marine Renewable Energy, 2025. https://tethys.pnnl.gov/taxonomy/term/19937

3. The cables are then routed through a transition joint bay, an underground unit where the offshore transmission cables are connected to onshore cables. The transition joint bay is often buried below a parking area or another area with an existing use.

4. The underground onshore cables then run from the transition joint bay to a substation. While ultimately dependent on the site, the cable route often runs beneath public roadways. This is common practice as utilities across the country make use of these areas to lay wires, pipes, and cables.[3]

5. In the final step of this process, a substation converts the current of the electricity running through the onshore cables into the appropriate voltage. This electricity is then fed into the local grid at an interconnection point, where it is later distributed to consumers through distribution lines. Note, the interconnection process is complex, and it can often be several years until a project is approved to deliver power to the local grid.[4]

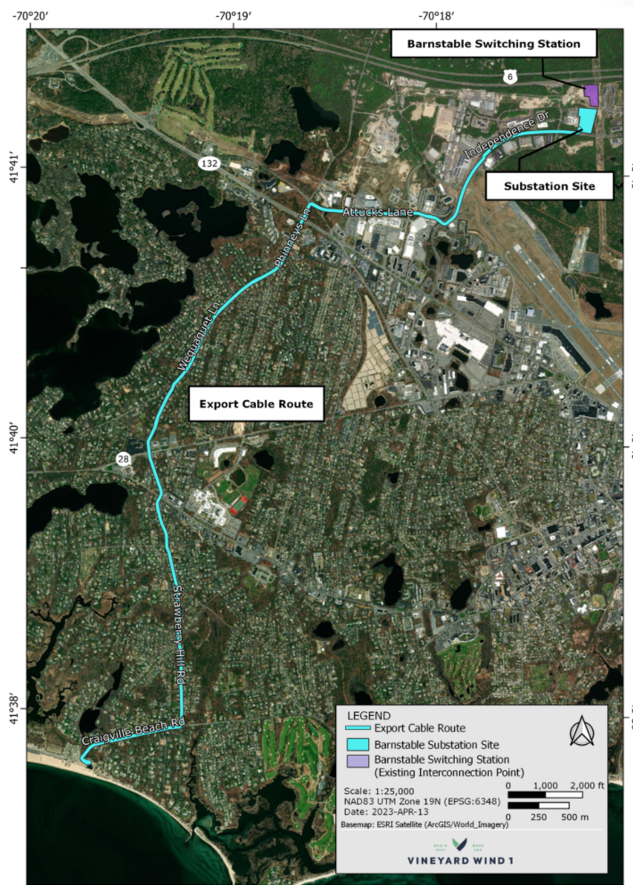
For more details on cable landfall, view this video.

Case Study

Vineyard Wind 1, an 800 MW fixed-bottom offshore wind array roughly 35 miles from mainland Massachusetts, offers an example of the transmission and interconnection process for offshore wind arrays.

Two offshore transmission cables, buried beneath the seafloor, run from an offshore substation in the wind array through a designated cable corridor to the cable landing site at Covell's Beach in Centerville, MA.

At the beach, developers used HDD to route cables beneath Covell's Beach to a transition joint bay. From there, the cables were buried along a designated export cable route following public roadways to the Barnstable Substation Site. Power generated by the wind turbines runs through the substation to the adjacent Barnstable Switching Station, where electricity is connected to the local grid and routed to consumers through the existing transmission network.[5]



Map of Vineyard Wind 1 transmission cable route from the landfall location to the point of interconnection (Vineyard Wind, 2023).

[3] U.S. Department of Transportation, "Highway/Utility Guide," 1993. https://www.fhwa.dot.gov/utilities/010604.pdf
[4] American Clean Power, "Interconnection 101," 2023. https://cleanpower.org/resources/interconnection/
[5] Vineyard Wind, "Vineyard Wind 1 Project Overview," n.d. https://www.vineyardwind.com/barnstable

A support vessel for the horizontal directional drilling and cable-laying process for the South Fork Wind Farm ([Image: Michels, 2024]).

Offshore wind transmission cable from the Vineyard Wind 1 project in the transition joint bay ([Image: Robin Lubbock/WBUR, 2023]).

Onshore substation that receives power from Vineyard Wind 1 transmission cables ([Image: Robin Lubbock/WBUR, 2023]).

Permitting

The transmission and cable landfall process for offshore wind projects, as with most elements of offshore wind development, is subject to an extensive permitting process. Regulators from federal, state, and local entities can each require permits for different stages of the transmission process. To obtain these, developers must provide extensive analysis of various elements of their projects, which can include potential environmental or community impacts that may result from transmission and cable landfall activities.

Depending on the project, federal regulatory agencies including the Bureau of Ocean Energy Management (BOEM), National Oceanic and Atmospheric Administration (NOAA) Fisheries, U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), U.S. Coast Guard (USCG), U.S.

Department of Defense (DoD), Federal Aviation Administration (FAA), and U.S. Environmental Protection Agency (EPA) may each play a role in regulating transmission development.[6]

State and local governments also require permits, but oversight depends on the cable landfall and transmission route. In Massachusetts, for instance, Massachusetts Environmental Policy Office, the Massachusetts Department of Environmental Protection, the Energy Facilities Siting Board, the Massachusetts Office of Coastal Zone Management, the Massachusetts Division of Marine Fisheries, and the Massachusetts Department of Fish and Wildlife, and the Nantucket Conservation Commission were each involved in the permitting and review process for the transmission development of Vineyard Wind 1.[7][8]

Additional Relevant Resources

- Guide to a Floating Offshore Wind Farm – Onshore Export Cable Installation (Offshore Renewable Energy Catapult, 2025)
- Electromagnetic Fields (EMFs): What do we know about them? (GMRI, 2024)
- Interconnection 101 – The process of connecting new electricity generators to the grid (ACP, 2023)
- ISO New England Grid Interconnection Queue (ISO-NE, 2026)
- Maine Offshore Wind Analysis: Offshore Wind Transmission Technical Review (DNV, 2022)
- Offshore Wind Transmission Development in the U.S. Atlantic Region (U.S. Dept. of Energy, 2024)

[6] NYSERDA, "Offshore Wind Permitting & Approvals –– Understanding Federal and State Requirements," 2026. https://www.nyserda.ny.gov/All-Programs/Offshore-Wind/Focus-Areas/Permitting
[7] Vineyard Wind, "Vineyard Wind 1 Project Overview," n.d. https://www.vineyardwind.com/barnstable
[8] Vineyard Wind, "Vineyard Wind 1 Permitting," n.d. https://www.vineyardwind.com/project-permitting