THE BUSINESS NETWORK FOR OFFSHORE WIND

BUILDING A NATIONAL NETWORK OF OFFSHORE WIND PORTS

A $36B Plan for Domestic Clean Energy Infrastructure

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EXECUTIVE SUMMARY

Port infrastructure is one of the most significant bottlenecks impeding the advancement of the United States offshore wind industry. Without a concerted effort to change the trajectory of offshore wind port investment, the country is likely to fall short of both our short-term 30 GW by 2030 deployment goal, as well as our long-term planning targets, such as the ambition to deploy 110 GW by 2050.

Existing U.S. port infrastructure is largely unable to support offshore wind component manufacturing and project deployment. In an effort to meet industry needs, more than 35 new offshore wind port projects have gone into development over the last five years. These projects have already employed nearly a thousand people in professional and trades jobs and are case studies for how the offshore wind industry can create new family-sustaining careers.

Unfortunately, most offshore wind port projects under development are now facing material financing gaps due to construction cost escalation, which has increased between 30% and 40% over the last three years, and the commercial uncertainties associated with supporting a brand-new industry.

Perhaps now more than ever, it's clear that long-term infrastructure planning and investment are needed to enable sustainable industry growth and the creation of thousands of offshore wind manufacturing, logistics, and operations jobs. **Without additional government funding and policy supports that incentivize private investment into U.S. offshore wind port infrastructure, port capacity will continue to be a major offshore wind deployment constraint across the country.**

Based on an asset-level evaluation of the port developments required to achieve 30 GW by 2030 and create a pathway to the nation's long-term offshore wind goals, we estimate that the U.S. needs a total of 99 to 119 port development sites across the East Coast, West Coast, and the Gulf of Mexico. Approximately 35 offshore wind port sites are already in development — or have recently reached commercial operations — therefore, **we can determine the nation is currently facing an offshore port infrastructure gap of 64 to 84 projects.**

Funding and building this new domestic infrastructure are critical to enabling the U.S. energy transition and combating climate change. Doing so will also help ensure long-term national energy independence and enable the creation of up to 83,000 offshore wind industry jobs across the country.

We estimate that the total cost to address the nation's offshore wind port infrastructure gap, assuming 2023 construction prices and no financing costs, is between $22.5 billion and $27.2 billion. This construction funding gap is approximately 3.4% to 6.2% of the total capital needed for project deployment through 2050. Put another way, investing in offshore wind port infrastructure will unlock 16-to-29 times more investment in clean energy generation.

In addition to determining the overall port infrastructure funding gap, it is critical to understand the timing of when this funding is required to be committed and used. By utilizing typical distributions of project capital needs over the course of four-to-six-year development timelines, and then mapping out when each project is expected to be built, we can assess when infrastructure development capital is required.

After estimating the timing of projects over the next decade, and accounting for construction inflation, the upper bound of capital required to address the offshore wind port infrastructure gap escalates from $27.2 billion ($ 2023) to $36 billion ($ Year of Expenditure (YoE)). We estimate that the financial costs associated with developing these projects would be an additional $7.2 billion ($ YoE) over 10 years.

EXECUTIVE SUMMARY (cont.)

While factoring in construction escalation and financial costs increases the nominal amount of capital needed by nearly 48%, this is a far more accurate estimate for policymakers looking to implement programs to accelerate offshore wind infrastructure development. While much of the actual construction spending will take place in the latter years of this decade, **public and private project developers need firm commitments for the majority of that construction capital over the next several years to secure cost-efficient development financing and construction contracts.**

Looking ahead, it will take continued purposeful action from state and federal policymakers, as well as the private sector investment community, to close the current port infrastructure funding gap. Federal and state agencies fundamentally have two complementary approaches to choose from: subsidizing a substantial portion of these infrastructure costs through grants, concessional financing, or tax credits, and/or substantially derisking offshore wind port projects to incentivize cost-efficient private sector investment. **We encourage government policymakers to consider the following nine solutions to accelerate infrastructure development and "crowd-in" private capital:**

PROJECT FUNDING SOLUTIONS:

1. Set aside a dedicated portion of Port Infrastructure Development Program (PIDP) funding and increase typical award sizes for offshore wind port projects.
2. Create dedicated offshore wind port funding programs at the local, state, and federal levels that can provide significantly increased levels of grant funding.
3. Consider the issuance of federal government-backed Climate Bonds financing as a low-cost source of debt capital for port projects.
4. Add offshore wind generation and enabling infrastructure as a policy priority for Department of Energy (DOE) Major Demonstration and Deployment Financial Assistance.
5. Explore issuing state tax credits for successful offshore wind infrastructure developments.

PROJECT DERISKING SOLUTIONS:

6. Broaden the authorities of the DOE's Loan Program Office (LPO) to support the financing and derisking of offshore wind port and vessel development.
7. Accelerate commitments and actions to build an unfragmented, long-term offshore wind project market.
8. Investigate state and local mechanisms to reduce commercial offtake risk for offshore port projects.
9. Accelerate the permitting process for maritime construction projects that enable offshore wind deployment and operations.

Offshore wind ports play a critical role in addressing climate change, enabling the creation of thousands of new clean energy jobs, and unlocking hundreds of billions of dollars of new private sector investment. **Given the findings of our analysis, we encourage policymakers at the federal, state, and local levels to take action today and advance solutions to this critical funding gap.**

INTRODUCTION

It is an exciting time for the American offshore wind industry. Two commercial-scale offshore wind projects are under construction in the Northeast and are expected to start delivering clean, renewable power to onshore grids in the next several months. Shipyards in the Gulf of Mexico and Mid-Atlantic are starting to build a brand-new fleet of American offshore wind vessels. And the federal government and coastal states continue to expand the domestic offshore wind market with new lease areas and power purchase commitments.

While the rapid acceleration of the U.S. offshore wind industry will ultimately lead to more clean energy and a lower levelized cost of energy (LCOE), it has also created some well-documented and significant growing pains. After years of aggressive global market expansion, offshore wind projects and the worldwide component supply chain are under increased financial pressures. These pressures are driven by factors such as:

- The surge in demand for offshore wind projects globally.
- The rapid increase of turbine sizes over the last decade.
- The expansion of offshore wind into deeper waters which require more costly technical solutions.
- Historically high interest rates and commodity input prices.

In addition, there is now fierce competition for construction materials both within and outside of the offshore wind industry. For example, the steel that is needed to build offshore wind foundations is also needed for offshore wind ports and offshore wind vessels. That same steel is also being procured by the vast array of civil infrastructure projects (bridges, roads, broadband installations) across the U.S. that have been catalyzed by the 2021 Bipartisan Infrastructure Deal. This increased demand for construction materials has led to nationwide construction cost escalation of 30% to 40% over the last three years alone.

As we look forward, the offshore wind industry and government stakeholders remain focused on charting a pathway to a robust and sustainable domestic offshore wind supply chain. Perhaps now, more than ever, it's clear that long-term infrastructure planning and investment are needed to enable sustainable industry growth and the creation of thousands of offshore wind manufacturing, logistics, and operations jobs.

Port infrastructure is one of the biggest bottlenecks for the United States offshore wind industry.[1] Given the general pressure on available U.S. port space from existing cargo uses and the extremely large size and weight of offshore wind components, existing U.S. port infrastructure is largely unable to support offshore wind component manufacturing and project deployment.

As a result, more than 35 new offshore wind port projects have gone into development in the last five years, the majority of which are in the Northeast and Mid-Atlantic regions.[2] Each of these sites is a major infrastructure project within its region — complete with engineering, environmental, labor availability, and permitting challenges. Each also holds the opportunity to become a new economic engine for its host community.

Unfortunately, most offshore wind port projects currently in development are now facing material financing gaps due to construction cost escalation and the commercial uncertainties associated with supporting a brand-new industry. As a result, offshore wind port development has slowed at exactly the moment when it needs to be accelerating.

Without additional government funding and policy supports that incentivize private investment into U.S. offshore wind port infrastructure, port capacity will continue to be a major offshore wind deployment constraint across the country.

[1] The supply of purpose-built Jones Act vessels and transmission infrastructure are also major industry bottle necks that have been the focus of previous Business Network for Offshore Wind white papers.

[2] See Appendix A for a list of projects that are in development or commercial operations. These 35 projects include marshaling ports, staging and integration ports, manufacturing facilities, and operations and maintenance ports.

INTRODUCTION (cont.)

Ports turn billions of dollars of offshore wind project spending into opportunities for domestic workers, businesses, and communities. Projects underway today have already employed nearly a thousand professional and trades jobs and are case studies for how the offshore wind industry can create new family-sustaining careers. Perhaps just as importantly, much of this economic impact is happening in environmental justice communities that have previously borne the brunt of industrialization's downsides.

This white paper aims to establish a new national baseline for how much offshore wind port infrastructure needs to be developed over the next decade. It provides a high-level assessment of the number of port projects needed, the total funding required to build out new port capacity, and the timing of when that funding is needed. We conclude by outlining a series of solutions available to federal and state governments to accelerate successful port development, including cost-efficient ways to incentivize private capital to invest more in offshore wind port projects.

Our assessment is anchored first on the port infrastructure required to achieve the Biden Administration's 30 GW by 2030 goal; however, it also considers projects that need to be built in the latter half of this decade to achieve the numerous federal and state planning goals that currently stretch 25-plus years into the future. Examples of these goals include the DOE's long-term planning goal of 110 GW of offshore wind by 2050, the State of California's planning target of 25 GW by 2045, and the State of Louisiana's goal of 5 GW by 2035.

From a geographic standpoint, we limit our analysis to the East Coast, West Coast, and Gulf of Mexico. However, we acknowledge that regions such as Hawaii and the Great Lakes also have significant offshore wind potential. We fully expect to update this paper as offshore wind deployment plans for those areas of the country are solidified.

Types of Offshore Wind Ports Required in the United States

The offshore wind industry requires the development of a network of port facilities to efficiently manufacture, store, stage, install, and maintain offshore wind turbines. Port types include:

MARSHALING PORTS[3]:

These facilities are typically utilized on a project-by-project basis by offshore wind developers (or their Original Equipment Manufacturer (OEM) partners). They are expected to be primarily used for fixed-bottom offshore wind projects on the East Coast and in the Gulf of Mexico. These ports receive, store, and stage turbine components. Turbines components are then partially assembled at the quayside, loaded onto specialized installation vessels (or barges), and transported to installation sites at sea. These facilities are defined by having large amounts of storage acreage and the massive wharf weightbearing capacity needed to handle extremely heavy components.

STAGING & INTEGRATION (S&I) PORTS:

These facilities are typically utilized on a project-by-project by offshore wind developers (or their OEMs) to receive, store, and stage turbine and floating foundation components. S&I ports will initially be built in areas of the country that need to utilize floating foundations for their first projects, such as the West Coast and the Gulf of Maine. Turbine components are fully assembled at the S&I port and then installed onto floating foundations. Floating foundations may be fabricated and assembled at the S&I port, or they may be transported to the site partially or fully assembled. Once a turbine is installed on a foundation, specialty tugboats are used to tow the fully integrated turbine system to an installation site at sea. S&I ports need significant wharf weightbearing capacities and require even more acreage if floating foundations are assembled onsite. In addition, S&I ports must also have nearby "wet storage" areas where assembled foundations or fully integrated turbine systems can be temporarily stored in the water during the integration and installation processes.

FLEXIBLE LAYDOWN PORTS:

These facilities are utilized on a project-by-project basis by offshore wind developers or OEMs to store and stage the relatively smaller offshore wind components ahead of installation. Similar to marshaling and S&I ports, these sites are typically leased on a short-term basis for one to two years at a time. Examples of components that will be staged at flexible laydown facilities include array cables, export cables, mooring lines and chains, and anchors. These facilities may also store raw inputs or finished components for nearby OEM manufacturing facilities. Flexible laydown ports have acreage and weightbearing requirements that could be met by existing infrastructure with relatively modest levels of investment.

MANUFACTURING PORTS:

These facilities are used on an ongoing basis by OEMs and their sub-suppliers to receive raw inputs and sub-assemblies and then fabricate or manufacture large offshore wind components. These sites generally have long-term leases with one or more manufacturers and are comprised of fabrication, manufacturing, and testing facilities, warehouses, and storage areas for inputs and finished components. Due to the size and weight of the finished components, these facilities typically need to be on navigable waterways with heavy-lift wharves.

OPERATIONS AND MAINTENANCE (O&M) PORTS:

These ports are utilized by offshore wind developers as a long-term base of operations for about 25 years or more. They typically include: wharves for vessels that transport crewmembers and spare components to sea; refueling, recharging and reprovisioning facilities; warehouses for spare part storage; and office space. The size of these facilities varies depending on the O&M vessel solution chosen by the offshore project owner. Service Operation Vessels (SOVs) are typically 250-300-foot ships that can support maintenance operations at sea for one-to-two weeks at a time. Crew Transfer Vessels (CTVs) are smaller, 65-100-foot ships that bring crew members back and forth to the wind farm each day. Service Accommodation Transfer Vessels (SATVs) are a class of ship between SOVs and CTVs that can support crews on multi-day trips at sea. Close proximity to helicopter service is also an important feature that many developers look for in an O&M port, whether on site or at a nearby facility.

[3] Marshaling ports are also often referred to as Staging & Assembly ports or Pre-Assembly ports.

Current Offshore Wind Port Projects and Estimates for Future U.S. Development Needs

MARSHALING

Marshaling terminals are prerequisites for the deployment of fixed-bottom offshore wind projects. The majority of the nation's collective offshore wind port development efforts to date have focused on these facilities.

Currently there are eight marshaling facilities with nine installation berths under development or in operation in the United States. While most of these facilities can, or are planned to, only support construction of one offshore wind project at a time, a few are planning to support multiple projects concurrently with multiple installation berths. Marshaling terminals range in size, from approximately 30 acres per site up to nearly 80 acres per site, with an emerging industry preference for at least 50-acre facilities for new projects.

While the National Renewable Laboratory's (NREL's) 2023 report, *A Supply Chain Road Map for Offshore Wind Energy in the United States*,[4] outlined the need for approximately eight marshaling facilities on the East Coast based upon the national goal of 30 GW by 2030 and typical terminal throughput estimates, it's likely that in addition to the nine current berths, five additional installation berths will need to be built as the offshore wind industry expands into the Carolinas and Gulf of Mexico. Large waterfront parcels that fit the industry's needs are more available in these regions than they were in the Northeast and Mid-Atlantic, therefore we expect these berths to be built in regional ports that can support multiple, concurrent projects.

Table 1: *Current and anticipated offshore wind marshaling berths*

	Port Location	Rational for Inclusion
1	New Bedford Marine Commerce Terminal (MA)	Commercial operations
2	New London State Pier (CT)	Commercial operations
3	New Jersey Wind Port - Terminal A (NJ)	In development
4	New Jersey Wind Port - Terminal B (NJ)	In development
5	Portsmouth Marine Terminal (VA)	In development
6	Salem Wind Port (MA)	In development
7	Arthur Kill Terminal (NY)	In development
8	South Brooklyn Marine Terminal (NY)	In development
9	Tradepoint Atlantic (MD)	In development
10	Carolinas 1	Industry expert input
11	Carolinas 2	Industry expert input
12	Gulf of Mexico 1	Industry expert input
13	Gulf of Mexico 2	Industry expert input
14	Gulf of Mexico 3	Industry expert input

[4] Shields, Matt, et al. 2023. A Supply Chain Road Map for Offshore Wind Energy in the United States. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-84710. https://www.nrel.gov/docs/fy23osti/84710.pdf.

STAGING & INTEGRATION (S&I) AND FLOATING FOUNDATION ASSEMBLY[5]

S&I terminals are the most expensive type of port infrastructure required by the offshore wind industry. These facilities are used to deploy floating offshore wind projects. Currently one S&I facility is in development and another has been announced on the U.S. West Coast. Humboldt Bay Offshore Wind and Heavy Lift Marine Terminal and the Port of Long Beach's Pier Wind project are both designed to have multiple integration berths. In addition, the Port of Long Beach is planning for collocated assembly of floating foundations. The Port of San Fransisco was also included in the State of California's port readiness assessment[6] as a location for foundation assembly. S&I and floating foundation assembly port sites typically need to be larger than fixed-bottom marshaling terminals, usually at least 70 to 80 acres per project site, with an emerging industry preference for even larger sites.

Based on the current West Coast planning goals of 28 GW of floating offshore wind (California and Oregon's planning targets) as well as the U.S.'s long-term planning goal, which envisions floating offshore wind off the coasts of Washington State and Maine, it is likely that three additional S&I and Floating Foundation berths will be needed on the West Coast, potentially split into one or two sites. At least one S&I and Floating Foundation terminal will also be needed in the Gulf of Maine region.

Table 2: *Current and anticipated offshore wind S&I and floating foundation assembly berths*

	Port Location	Rational for Inclusion
1	Humboldt Bay 1 (CA)	In development
2	Humboldt Bay 2 (CA)	In development
3	Port of Long Beach 1 (CA)	Announced
4	Port of Long Beach 2 (CA)	Announced
5	Port of Long Beach 3 (CA)	Announced
6	Port of Long Beach 4 (CA)	Announced
7	Port of Long Beach 5 (CA)	Announced
8	Port of San Francisco 1 (CA)	Announced
9	Pacific Northwest 1	Industry expert input
10	Pacific Northwest 1	Industry expert input
11	Pacific Northwest 1	Industry expert input
12	Maine 1	Industry expert input

[5] Because most of the floating foundation assembly sites are currently planned to be co-located with S&I terminals on the West Coast and therefore have similar cost structures, they are be combined into a single port type within our analysis.

[6] Lim and Trowbridge 2023, California State Lands Commission AB 525 Port Readiness Plan – Final Report. https://www.slc.ca.gov/content-types/port-readiness-plan/

Current Offshore Wind Port Projects and Estimates for Future U.S. Development Needs (cont.)

FLEXIBLE LAYDOWN

As the offshore wind industry has moved toward project execution over the last few years, the need for additional flexible laydown facilities has emerged rapidly on the East Coast. Today, these needs are being met by ports such as Quonset Point and the Port of Providence, both in Rhode Island.[7] In addition, some Canadian facilities, such as the Port of Halifax, are being used as transfer and staging points for European-manufactured components bound for America. New projects, such as the Foss Marine Terminal in New Bedford, Massachusetts and Lambert's Point project in Norfolk, Virginia have also been announced to help fill this void.

Flexible laydown ports still require relatively heavy lift quaysides with deep water berths; however, these requirements are far below what is needed for marshaling and S&I ports and usually more aligned with the capacities of existing port facilities. In general, the investment levels required for facility upgrades of flexible laydown facilities are more modest compared to other offshore wind port asset types.

Moving forward, port authorities and owners will need to balance the ability to make these facilities available for offshore wind projects against demands from other project cargo and break-bulk users. Based on the 30 GW by 2030 goal and other long-term planning targets, we anticipate that, in addition to the facilities already in service or development, at least twelve more flexible laydown facilities are needed to support the country's offshore wind project pipeline. These facilities are expected to be spread out across the East Coast, West Coast, and Gulf of Mexico regions.

Table 3: *Current and anticipated offshore wind flexible laydown facilities*

	Port Location	Rational for Inclusion
1	Quonset Point (RI)	Commercial operations
2	Port of Providence (RI)	Commercial operations
3	Foss New Bedford Marine Terminal (MA)	In development
4	Lamberts Point, Norfolk (VA)	In development
5	New England 4	Industry expert input
6	Mid Atlantic 2	Industry expert input
7	Mid Atlantic 3	Industry expert input
8	Mid Atlantic 4	Industry expert input
9	Carolinas 1	Industry expert input
10	Gulf of Mexico 1	Industry expert input
11	Gulf of Mexico 2	Industry expert input
12	California 1	CA AB 525 Ports Readiness Report
13	California 2	CA AB 525 Ports Readiness Report
14	California 3	CA AB 525 Ports Readiness Report
15	Pacific Northwest 1	Industry expert input
16	Pacific Northwest 2	Industry expert input

[7] Portsmouth Marine Terminal also has a separate berth that is being used for monopile marshaling, which could also be considered as a flexible laydown facility based on our methodology.

MANUFACTURING

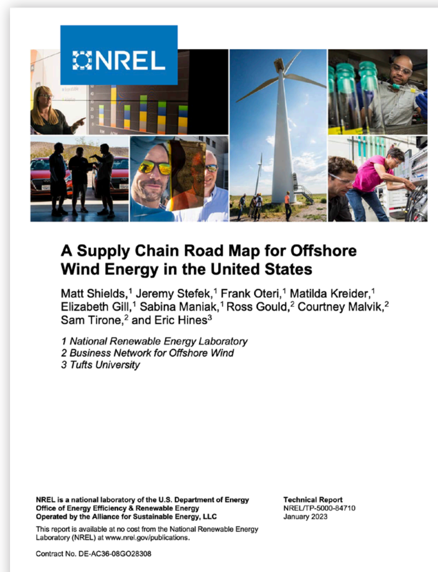
While other port types are essential to the construction and operation of U.S. offshore wind projects, manufacturing ports are critical to ensuring domestic job creation and long-term energy independence.

Demand for these facilities in the U.S. is largely determined by federal and state policies that encourage local supply chain development. However, local and domestic content requirements and incentives are only one factor considered by major OEMs when planning to invest in American manufacturing facilities. These companies also look at market factors such as global and regional supply and demand plans, whether the new American facilities can be cost effective long-term, and the need to also make investments in other offshore wind markets like Western Europe and East Asia.

Because of these factors, offshore wind component manufacturing is still in its nascency in the United States. The 2023 NREL Supply Chain Roadmap Report[8] outlined the need for at least 34 offshore wind component manufacturing facilities to support the country's supply chain ambitions. At least 32 of those facilities will require heavy lift wharves, deep-water berths, and access to navigable channels to transport finished components to marshaling and S&I terminals. Our analysis breaks these manufacturing sites into two categories. "Large" manufacturing sites require heavy-lift berths in the range of marshaling ports, while "medium" manufacturing sites require heavy-lift berths more in line with flexible laydown facilities.

So far, ten major offshore wind manufacturing facilities[9] have been announced on the East Coast. (See Tables 4 and 5 below for a complete list of facilities and locations). Looking forward, we anticipate that port infrastructure for 23 to 30 additional offshore wind manufacturing facilities will need to be built over the next decade. While this is a significant number in the context of the financial pressures facing much of the offshore wind supply chain in 2023, it is consistent with the number of facilities that have been developed in Europe. Without the development of these facilities, it will be difficult to meet the country's long-term deployment goals.

Access to competitively priced, fit-for-purpose port infrastructure will be a major factor in the pace of investment in American offshore wind component manufacturing. Policy supports such as allowing offshore project developers to include supply chain localization premiums in the cost of power procurement bids and the component-level tax credits included in the 2022 Inflation Reduction Act will help drive the creation of domestic manufacturing facilities in the years to come, but alone are likely insufficient to reach the desired level of domestic manufacturing.


NREL

A Supply Chain Road Map for Offshore Wind Energy in the United States

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NREL Supply Chain Road Map for Offshore Wind Enery in the United States

[8] Shields, Matt, et al. 2023. A Supply Chain Road Map for Offshore Wind Energy in the United States. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-84710. https://www.nrel.gov/docs/fy23osti/84710.pdf.

[9] Excludes vessels being built in existing shipyards. At least two of the facilities counted in the 2023 NREL report are likely to either move locations or be significantly delayed due to various reasons.

Current Offshore Wind Port Projects and Estimates for Future U.S. Development Needs (cont.)

MANUFACTURING (CONT.)

Table 4: *Current and anticipated offshore wind manufacturing facilities (large)*

	Port Location	Rational for Inclusion
1	Nacelles - GE, NJ Wind Port (also bid into NY)	In development
2	Nacelles - Vestas, NJ Wind Port	In development
3	Nacelles 3	NREL 2023 Supply Chain Report
4	Nacelles 4	NREL 2023 Supply Chain Report
5	Blades - SGRE, Portsmouth (VA)	In development
6	Blades 2	NREL 2023 Supply Chain Report
7	Blades 3	NREL 2023 Supply Chain Report
8	Blades 4	NREL 2023 Supply Chain Report
9	Blades 5	NREL 2023 Supply Chain Report
10	Tower - Marmen Welcon, Albany (NY)	In development
11	Tower 2	NREL 2023 Supply Chain Report
12	Tower 3	NREL 2023 Supply Chain Report
13	Tower 4	NREL 2023 Supply Chain Report
14	Monopile - EEW AOS, Paulsboro (NJ)	Commercial operations
15	Monopile - US Wind, Tradepoint (MD)	In development
16	Monopile 3	NREL 2023 Supply Chain Report
17	Jacket	NREL 2023 Supply Chain Report
18	Gravity Based Foundation	NREL 2023 Supply Chain Report
19	TPs - Smulders, Albany (NY)	In development
20	TPs 2	NREL 2023 Supply Chain Report
21	Floating Platform (sub-components) 1	NREL 2023 Supply Chain Report
22	Floating Platform (sub-components) 2	NREL 2023 Supply Chain Report
23	Floating Platform (sub-components) 3	CA AB 525 Ports Readiness Report
24	Floating Platform (sub-components) 4	CA AB 525 Ports Readiness Report
25	Floating Platform (sub-components) 5	Industry expert input
26	Floating Platform (sub-components) 6	Industry expert input

MANUFACTURING (CONT.)

Table 5: *Current and anticipated offshore wind manufacturing facilities (medium)*

	Port Location	Rational for Inclusion
1	Export Cables - Nexans, Charleston (SC)	Commercial operations
2	Export Cables - Prysmian, Brayton Point (MA)	In development
3	Export cables 3	NREL 2023 Supply Chain Report
4	Export cables 4	NREL 2023 Supply Chain Report
5	Array Cables - Hellenic - Tradepoint Atlantic (MD)	In development
6	Array Cables 2	NREL 2023 Supply Chain Report
7	Mooring Chains 1	NREL 2023 Supply Chain Report
8	Mooring Chains 2	Industry expert input
9	Mooring Ropes 1	NREL 2023 Supply Chain Report
10	Mooring Ropes 2	Industry expert input
11	Anchors 1	Industry expert input
12	Anchors 2	Industry expert input
13	Flange	NREL 2023 Supply Chain Report
14	Castings	NREL 2023 Supply Chain Report

Nexans produces high voltage subsea cables at their plant in Charleston, South Carolina. Photo courtesy Nexans.

Current Offshore Wind Port Projects and Estimates for Future U.S. Development Needs (cont.)

OPERATIONS AND MAINTENANCE (O&M)

To date, O&M facilities have gotten much less public and political attention compared to marshaling and manufacturing facilities, although they are just as critical to the construction and long-term operation of wind farms. While these facilities tend to be smaller in size and job concentration, the U.S. will need many of them. O&M facilities must also be located close to offshore installation sites and therefore have the power to become engines of long-term economic transformation for numerous coastal communities.

Most of the offshore wind projects that have secured offtake to date are planning to use CTV-based O&M approaches. These require smaller O&M port facilities that can reasonably be built under the umbrella of the larger offshore energy project. However, over the last two years, as projects have gotten larger and further offshore, there has been a clear shift in preference toward SOV-based O&M methodologies. The larger SOV ships require deeper draft channels and berths as well as larger wharves. Based on the infrastructure size required for SOV-based O&M, offshore developers are now looking for fit-for-purpose facilities with the potential to share infrastructure across multiple projects (and multiple developers and/or OEMs) to gain efficiencies.

Currently, eight sites have been identified for CTV-based operations on the East Coast. In addition, at least three sites have been identified for SOV-based O&M. All SOVs are also able to support CTVs and several are expected to be able to support multiple projects at once.

To meet the national and state-level long-term deployment goals, we estimate that the nation will need at least 26 additional O&M ports across the country, including ten CTV-based facilities and 16 SOV-based facilities. Many of these SOV facilities are expected to be able to support multiple projects at a time.

Table 6: *Current and anticipated offshore wind O&M facilities (CTV)*

	Port Location	Rational for Inclusion
1	Pope's Island, New Bedford (MA)	Commercial operations
2	South Brooklyn Marine Terminal (NY)	In development
3	Gardner Basin, Atlantic City 1 (NJ)	In development
4	Gardner Basin, Atlantic City 2 (NJ)	In development
5	Barnum Landing, Bridgeport (CT)	In development
6	Ocean City, MD	In development
7	Tisbury, Martha's Vineyard (MA)	In development
8	Brooklyn Navy Yard (NY)	Announced
9	New England 3	Industry expert input
10	New England 4	Industry expert input
11	Mid-Atlantic 6	Industry expert input
12	Carolinas 1	Industry expert input
13	Gulf of Mexico 1	Industry expert input
14	Gulf of Mexico 2	Industry expert input
15	California 1	CA AB 525 Ports Readiness Report
16	California 2	CA AB 525 Ports Readiness Report
17	Pacific Northwest 1	Industry expert input
18	Pacific Northwest 2	Industry expert input

Table 7: *Current and anticipated offshore wind O&M facilities (SOV)*

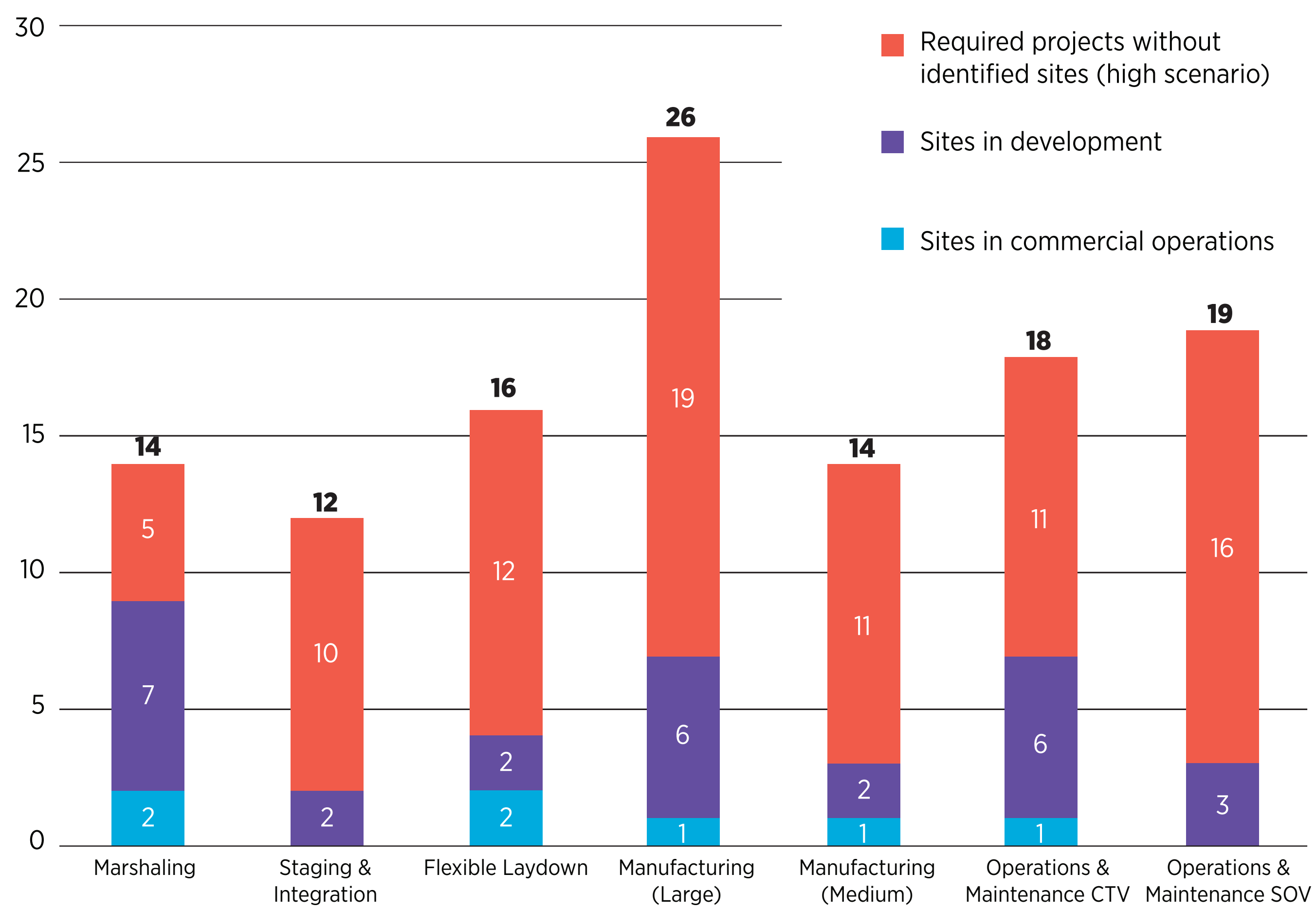
	Port Location	Rational for Inclusion
1	Foss New Bedford Marine Terminal (MA)	In development
2	Lambert's Point, Norfolk (VA)	In development
3	Port Jefferson (NY)	In development
4	New England 2	Industry expert input
5	New England 3	Industry expert input
6	Mid-Atlantic 3	Industry expert input
7	Mid-Atlantic 4	Industry expert input
8	Carolinas 1	Industry expert input
9	Carolinas 2	Industry expert input
10	Gulf of Mexico 1	Industry expert input
11	Gulf of Mexico 2	Industry expert input
12	Gulf of Mexico 3	Industry expert input
13	California 1	CA AB 525 Ports Readiness Report
14	California 2	CA AB 525 Ports Readiness Report
15	California 3	CA AB 525 Ports Readiness Report
16	California 4	CA AB 525 Ports Readiness Report
17	Pacific Northwest 1	Industry expert input
18	Pacific Northwest 2	Industry expert input
19	Pacific Northwest 3	Industry expert input

Summary of Projects Under Development and the Offshore Wind Port Infrastructure Gap

Based upon the above asset-level evaluation of the port developments required to achieve both 30 GW by 2030 and create a pathway to the nation's long-term offshore wind goals, **the U.S. needs a total of 99 to 119 port development sites across the East Coast, the West Coast, and the Gulf of Mexico.**

As approximately 35 offshore wind port sites are already in development — or have recently reached commercial operations — the nation is currently facing an offshore port infrastructure gap of 64 to 84 projects. Funding and building this new domestic infrastructure are critical to enabling the U.S. energy transition and combatting climate change. It will also help ensure long-term national energy independence and enable the creation of up to 83,000 offshore wind industry jobs across the country.[10]

Graphic 1: *Offshore wind port infrastructure requirements by port type and project status*



[10] American Wind Energy Association, 2020, U.S. Offshore Wind Power Economic Impact Assessment. https://cleanpower.org/wp-content/uploads/2021/01/AWEA_Offshore-Wind-Economic-ImpactsV3.pdf

Aggregate Cost of U.S. Offshore Wind Port Construction

Armed with new information on actual construction and financing costs for East Coast offshore wind port projects, we can now more accurately estimate the amount of capital required to close funding gaps on existing port projects and fully build out the network of sites needed across the East Coast and in the Gulf of Mexico.

In addition, federally funded, comprehensive port infrastructure studies, such as NREL's *West Coast Ports Study*,[11] and state-level reports, such as California's *AB 525 Port Readiness Plan*,[12] have helped us better estimate the cost of West Coast port development. Several port projects, such as the Port of Long Beach's Pier Wind development, have even published feasibility studies[13] that include detailed cost estimates and timelines to help create transparency on the true costs of regional infrastructure.

Using this new information, the Business Network for Offshore Wind's Port Working Group has developed top-down estimates[14] for both the total value of U.S. offshore wind port infrastructure and the incremental construction capital needed to fully build out the nation's network of offshore wind ports.

As the baseline to our analysis, we first estimated the cost to build out all 99 to 119[15] offshore wind ports using 2023 construction cost estimates. In total, this portfolio of infrastructure investments would cost $28.5 billion to $33.2 billion (unescalated $ 2023, excluding project financing costs).

Table 8: *Total U.S. offshore wind port project needs and estimated construction capital (unescalated $ 2023)*

	Total projects needed (sites)		Per-project cost estimate ($M 2023)	Total capital needed ($M 2023)	
Port type	**Low**	**High**		**Low**	**High**
Marshaling	12	14	$500	$6,000	$7,000
Staging & Integration	11	12	$800	$8,800	$9,600
Flexible Laydown	12	16	$40	$480	$640
Manufacturing (Large)	22	26	$350	$7,700	$9,100
Manufacturing (Medium)	11	14	$75	$825	$1,050
Operations & Maintenance CTV	16	18	$60	$960	$1,080
Operations & Maintenance SOV	15	19	$250	$3,750	$4,750
Total	**99**	**119**		**$28,515**	**$33,220**

[11] Report forthcoming from Shields, Matt, et al.

[12] Lim and Trowbridge 2023, California State Lands Commission AB 525 Port Readiness Plan – Final Report. https://www.slc.ca.gov/content-types/port-readiness-plan/

[13] Lim and Trowbridge 2023, Port of Long Beach: Pier Wind Project Concept – Final Conceptual Report.

[14] https://polb.com/download/547/pier-wind/17042/2023-04-20-pier-wind-concept-report-final.pdf

Instead of building up project cost estimates on a project-by-project basis using available public project cost information (a methodology that is highly prone to underestimating the true capital needs due to under reporting in public data), these analyses rely on utilizing cost-estimates, validated by industry experts, for typical projects and then applying those general estimates to a project-by-project market needs assessment. This approach may be less representative of each particular project's cost structure; however, we believe it is a more reliable estimate of the overall market need.

[15] These numbers include projects that are currently in development or recently reached commercial operations.

Aggregate Cost of U.S. Offshore Wind Port Construction (cont.)

Our top-down methodology utilizes indicative per-project cost estimates for each asset type. These per-project cost estimates were "triangulated" using a variety of sources of information, including: confidential disclosures of actual project development budgets, government estimates from recently published port planning and engineering studies, and input from a panel of port development experts primarily drawn from within the Business Network for Offshore Wind's Ports Working Group.[16]

These estimates include pre-construction development work (i.e., concept development, permitting, and engineering) as well as construction and commissioning of the core port infrastructure. They do not include financial expenses such as interest costs and return on capital invested requirements. These estimates also do not include tenant-specific buildings, such as factories or testing facilities at manufacturing ports, nor heavy lift equipment such as cranes or self-propelled modular transport equipment (SPMTs).

While these cost estimates may be lower than the actual realized cost for large regional greenfield projects, they may equally overestimate the cost for smaller brownfield projects. In aggregate, we believe these differences even out and yield a fair representation of the port infrastructure capital required for the U.S. offshore wind industry.

Offshore Wind Port Funding Gap Estimate

To estimate the gap in offshore wind port construction funding, we utilized the same per-project cost estimates as above but implemented a multi-step sizing process:

1. We removed projects that are currently in operation.
2. We estimated the current project funding gap across each of the offshore wind port types, taking into account the number of projects currently in development, the indicative project cost estimate amounts, and a top-down estimate of the average project financing gap for each project type. Similar to the indicative project cost estimates, the "in-development construction funding gap estimates" were "triangulated" from a variety of sources including confidential discussions about project budgets and industry expert input.
3. For projects without identified sites (and for projects with announced sites but that are not in full development) we estimated the funding gap using the full per-project cost estimates.[17]

[16] See Appendix D for a list of Working Group members.

[17] A more detailed walk-through of this analysis, including the in-development construction funding gap estimates, is included in Appendix B.

Table 9: *Current offshore wind construction funding gaps (unescalated $ 2023)*

Port type	In-development construction funding gap ($M 2023)	Unidentified project construction funding gap ($M 2023)		Total construction funding gap ($M 2023)	
		Low	High	Low	High
Marshaling	$1,050	$1,500	$2,500	$2,550	$3,550
Staging & Integration	$1,584	$7,200	$8,000	$8,784	$9,584
Flexible Laydown	$24	$320	$480	$344	$504
Manufacturing (Large)	$1,050	$5,250	$6,650	$6,300	$7,700
Manufacturing (Medium)	$45	$600	$825	$645	$870
Operations & Maintenance CTV	-	$540	$660	$540	$660
Operations & Maintenance SOV	$375	$3,000	$4,000	$3,375	$4,375
Total	**$4,128**	**$18,410**	**$23,115**	**$22,538**	**$27,243**

We estimate that the total cost to address the nation's offshore wind port infrastructure gap, assuming 2023 construction prices and no financing costs, is between $22.5 billion and $27.2 billion. While on their own these figures imply a significant level of investment in offshore wind port infrastructure, it is important to also put these numbers into context.

Between 35% and 40% of this infrastructure funding is needed for S&I ports, which are required in areas that have largely not started building offshore wind port infrastructure, such as the West Coast and the Gulf of Maine. Additionally, approximately 31% of this investment is needed for manufacturing sites, which will enable the creation of thousands of family-sustaining, clean energy manufacturing careers.

It's helpful to frame offshore wind port infrastructure spending in the context of the total amount of capital being deployed to build a domestic offshore wind industry. Assuming a rough benchmark range of $4 billion to $6 billion[18] per 1 GW of installed offshore wind capacity, the long-term national offshore wind deployment goal represents a total investment of between $440 billion to $660 billion by 2050 (unescalated $ 2023).

Given these estimates, **the current port infrastructure construction funding gap is approximately 3.4% to 6.2% of the total capital needed for project deployment through 2050.[19] Put another way, investing in offshore wind port infrastructure will unlock 16-to-29 times more investment in clean energy generation.**

Finally, it is worth noting that almost all new or redeveloped port assets are expected to be in service for at least 50 years, meaning this infrastructure will be able to support clean energy projects and other economic activity well into the second half of the century.

[18] These figures acknowledge recent construction cost escalations and the fact that floating projects will be more expensive to construct than fixed-bottom project while floating technology solutions are fully matured.

[19] This is a reasonable comparison to make given that the useful life of port assets will extend past 2050.

Project Timing, Construction Cost Escalation, and Financial Costs

In addition to determining the overall port infrastructure funding gap, it is critical to understand the timing of when this funding is required to be committed and used.

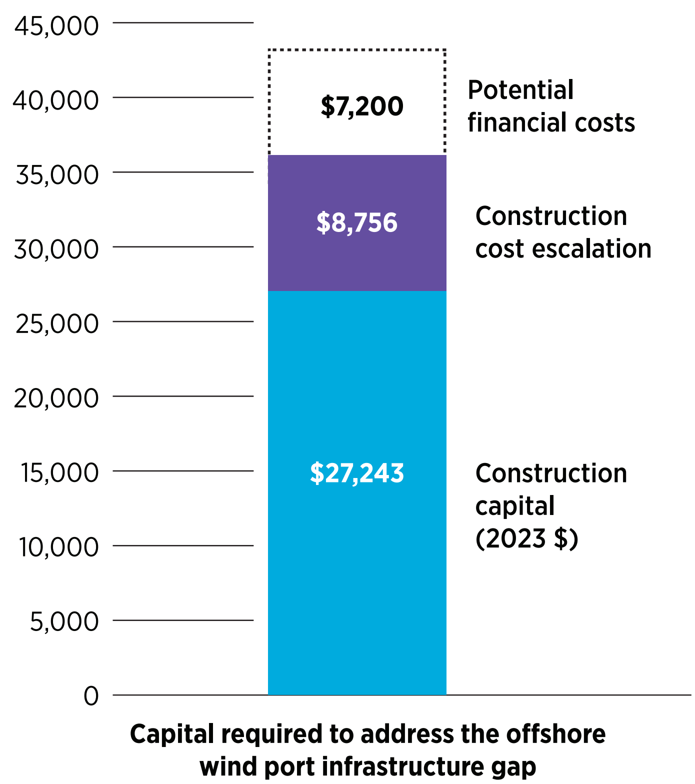
By utilizing typical distributions of project capital needs over the course of four-to-six-year development timelines,[20] and then mapping out when each project is expected to be needed, we can assess when infrastructure development capital is required.[21] *See Appendix C for the full project timing analysis.*

This approach also allows us to escalate the cost of development from constant 2023 dollars to a more realistic Year of Expenditure (YoE) dollar estimate that accounts for anticipated construction inflation. While construction escalation has a reach of over 10% per annum over the last three years, we have utilized 5% per year assumption in our analysis. This estimate is in line with current widely available construction escalation forecasts; however, it is above long-term, pre-COVID construction escalation rates of 2% to 4% per annum.

After estimating the timing of projects over the next decade, and accounting for construction inflation, **the upper bound of capital required to address the offshore wind port infrastructure gap escalates from $27.2 billion ($ 2023) to $36 billion ($ Year of Expenditure (YoE)).**

Additionally, since we believe that debt finance and private infrastructure development will play an important role in the buildout of this port infrastructure, we also estimated anticipated financial costs for these development projects (e.g., interest rates, capitalized rent and interest paid during construction, and required rates of return). Our 20% financial cost scaling factor still assumes that state and federal government agencies will ultimately provide a substantial amount of grants, guarantees, and/or concessional financing to support these projects (as they have for almost all other port infrastructure investments). However, if these funding and de-risking tools do not to come into reality, this scaling factor would likely need to be increased to something in the range of 50% for projects that are largely funded with private capital. Alternatively, if government agencies were to fully fund developments with grants or appropriations, these financial costs could drop into the low single digits.

Graphic 2: *Total capital needed to address the offshore wind infrastructure gap ($ M, YoE)*

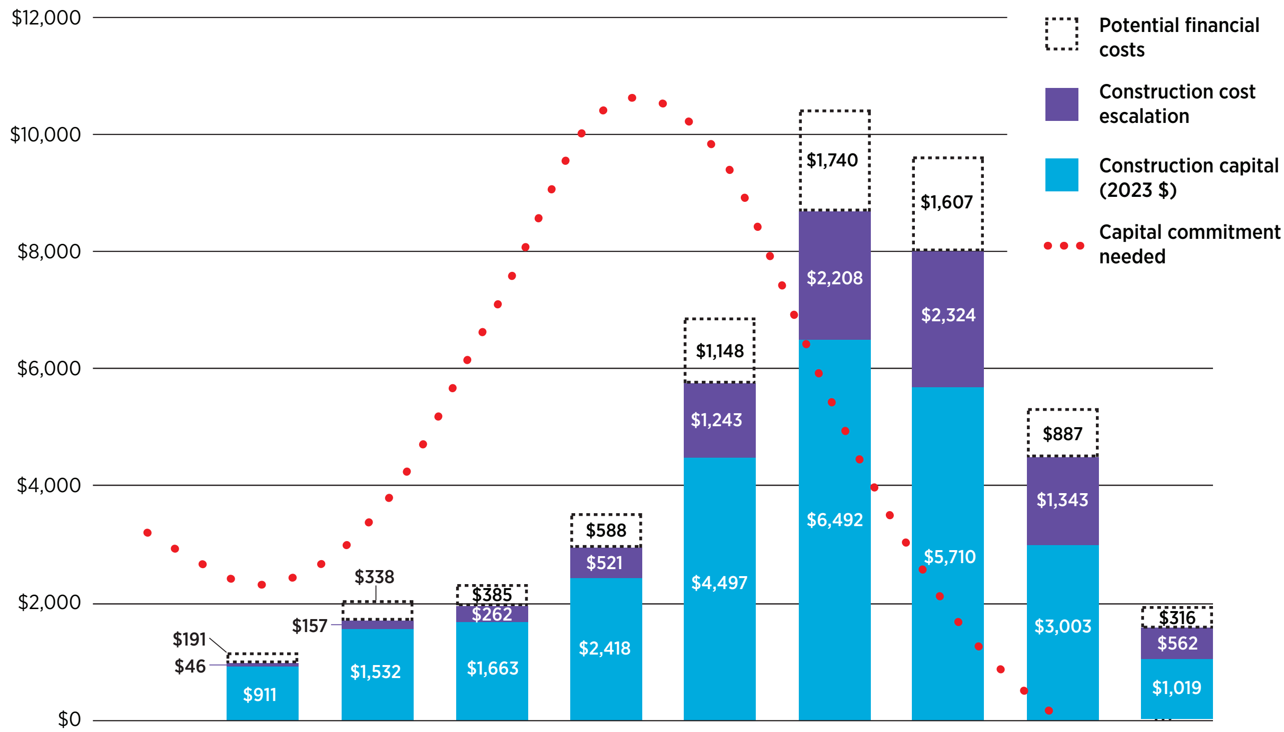


We estimate that financial costs would likely amount to an additional $7.2 billion of capital requirements over the next decade.

[20] Typical development timelines for each project-type were defined as part of our methodology (e.g., a flexible laydown facility will likely be faster to design and construct than a S&I terminal).

[21] For this analysis we focused only on the high-end of the funding gap range in an attempt to be conservative.

Graphic 3: *Escalated offshore wind port development capital needed ($ M, YoE)*



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Total used ($M, YoE)	-	$1,148	$2,026	$2,310	$3,526	$6,888	$10,439	$9,641	$5,323	$1,896
Total committed ($M, YoE)	$3,174	$2,310	$3,526	$6,888	$10,439	$9,641	$5,323	$1,896	-	-

While factoring in construction escalation and financial costs increases the nominal amount of capital needed by nearly 48%, this is a far more accurate estimate of funding requirements than unescalated figures. For policymakers looking to implement programs to accelerate offshore wind infrastructure development, this estimate provides a truer reflection of anticipated development costs.

It may be tempting to focus on the fact that much of the actual construction spending will take place in the latter years of this decade; however, project developers (whether public or private entities) need firm commitments for construction capital one to three years in advance of its use. Without this early commitment of capital, it can be difficult to secure cost-efficient development financing and construction contracts. We've included a red dotted line in the graphic above to indicate the quantum of funding commitments needed annually over the next decade to fully support offshore wind port development.

Given the results of our analysis, we encourage policymakers at the federal, state, and local levels to take action today to identify solutions to this funding gap. To support that work, we've provided some of our own suggestions in the section below.

Policy Solutions to Address the Port Infrastructure Funding Gap

As we consider potential pathways forward, we are excited that many government and industry stakeholders are already mobilizing to address the need for additional offshore wind port infrastructure funding. Examples include:

- New Jersey committed more than a billion dollars into state-owned infrastructure at the Port of Paulsboro and the New Jersey Wind Port.
- California and Massachusetts created grant programs to support public and private investments in marshaling, S&I, and manufacturing ports.
- New York is exploring innovative partnership approaches to fund port development linked to its power solicitations.
- The Department of Transportation, Maritime Administration's (MARAD's) Port Infrastructure Development Program (PIDP) has significantly increased funding support for offshore wind port developments, awarding nearly $130 million in grants to seven offshore wind port projects in the last two years, with additional offshore wind port applications currently under review.

These investments are further supported by the federal government's Buy America provisions for offshore wind components and the energy project investment and manufacturing tax credits offered through the 2022 Inflation Reduction Act.

We are also increasingly seeing indications that large and mid-market private sector infrastructure investors are considering investments in offshore wind port facilities, especially those that have been sufficiently de-risked and have a pathway to reasonable equity returns. For example, Morgan Stanley Infrastructure Partners recently announced a major investment into Crowley Wind Services' offshore wind port development portfolio.

Looking ahead, it will take continued, purposeful action from state and federal policymakers, as well as the private sector investment community, to close the current port infrastructure funding gap.

While it is difficult to pre-determine exactly how to much of the $36 billion financing gap each of these stakeholder groups will need to cover, it is clear that given the current financial pressures with the offshore wind industry, the policy objectives to decrease offshore wind LCOEs, and the commercial risks of developing infrastructure for a new industry, public sector entities need to take the lead in charting a course forward.

Federal and state agencies fundamentally have two complimentary approaches to choose from: subsidize a substantial portion of these infrastructure costs through grants, concessional financing, or tax credits, and/or substantially derisk offshore wind port projects to incentivize cost-efficient private sector investment. We acknowledge that determining the most politically feasible balance across those two approaches is not easy. However, if public sector leaders are unable to address the challenges of offshore wind port infrastructure financing, the nation's short-term and long-term deployment goals will be put at significant risk.

Specifically, we encourage government policymakers to consider the following nine solutions to accelerate infrastructure development and "crowd-in" private capital.

PROJECT FUNDING SOLUTIONS:

1. **Set aside a dedicated portion of Port Infrastructure Development Program (PIDP) funding and increase typical award sizes for offshore wind port projects.** The PIDP program has the benefit of already being a successful port funding tool. While this program has directed nearly $130 million over the last two years to offshore wind projects, the typical project grant sizes ($20 million to $50 million) are far below the amounts required by offshore wind port projects, both on a per project basis and in the aggregate. Despite being a brand-new and nationally significant industry with an emergent funding need, offshore wind port projects must compete for funding against other legacy port projects that have already benefited from years of federal investment. Dedicated PIDP funding specifically for offshore wind port development could help significantly reduce the short-term port funding gap, especially over the next two to three years while capital needs are still relatively modest and other policy solutions are developed.

2. **Create dedicated offshore wind port funding programs at the local, state, and federal levels that can provide significantly increased levels of grant funding.** Building a new industry requires dedicated industrial investment programs. We suggest developing port investment programs at both the federal and state levels to help accelerate offshore wind deployment and establish local supply chain facilities. Programs should support both pre-construction project development and material portions of construction. At the state level, Massachusetts' 2022 Offshore Wind Industry Ports Investment Challenge program, which was open to both public and private sector developers, provides a successful example to build upon. While a new grant program at the federal level may be politically challenging, it is hard to overstate what a committed, time-bound construction investment program could mean for accelerating offshore wind port development.

3. **Consider the issuance of federal government-backed Climate Bonds financing as a low-cost source of debt capital for port projects.** Concessional debt-based solutions that can be layered into a project's capital stacks to reduce the overall cost of borrowing could simultaneously offset the need for government grants and attract more private equity investments. Climate Bonds are designed to handle the types of risks associated with deploying large-scale, long-lead time clean energy infrastructure and ultimately provide large tranches of low-cost financing.

4. **Add offshore wind generation and enabling infrastructure as a policy priority for DOE Major Demonstration and Deployment financial assistance.** Under the Biden Administration, the DOE has made significant commitments to investing in America's long-term energy independence across a variety of clean energy technologies. While we are already seeing important investments in offshore wind research and development through DOE's new Office of Infrastructure, there is limited available financial assistance for major demonstration and deployment projects. Options include Cost Shares or application of Other Transactions Authorities (OTAs) that could be used flexibly to catalyze deployment, for example, through advance market commitments. New teams such the Office of Manufacturing and Energy Supply Chains already have the mandate to strengthen and secure manufacturing and energy supply chains and support a clean and equitable energy transition. Establishing a dedicated program that is focused on offshore wind deployment, much like they have already done for rare earth minerals and battery recycling technologies, could greatly improve the country's overall offshore wind industrial development approach.

5. **Explore issuing state tax credits for successful offshore wind infrastructure developments.** For state policymakers looking for alternatives to appropriating grant funding, pay-for-performance tax credits could be an alternative source of project financing for offshore wind port development. This approach has been tested in the State of New Jersey; however, the state program's direct linkage to job creation makes it difficult to utilize for core infrastructure development, and instead is better suited to manufacturing facility development. Regardless, tax credit financing is a well-established tool to incentivize the development of projects that would not otherwise be taken on by the private sector.

Policy Solutions to Address the Port Infrastructure Funding Gap (cont.)

PROJECT DERISKING SOLUTIONS:

6. **Broaden the authorities of the DOE's Loan Program Office (LPO) to support the financing and derisking of offshore wind port and vessel development.** The DOE's LPO is a powerful strategic policy driver that has accelerated the deployment of clean energy technologies and investment. Unfortunately, the LPO's mandate focuses on more traditional project lending, which is only one of the financial tools needed to accelerate the deployment of large-scale, long lead-time projects like offshore wind ports. In addition, supporting offshore wind supply chain and infrastructure investments, such as offshore wind ports, is not clearly included in the office's enabling statutory language. We recommend broadening the LPO's authorization to enable the office to support critical energy infrastructure projects, such as offshore wind ports, through both lending and guarantees. Finally, current LPO regulations prevent "double dipping" between loan supports and federal grants. Consideration should be given allowing project sponsors to access both subsidies and loan supports.

7. **Accelerate commitments and actions to build an unfragmented, long-term offshore wind project market.** Given the significant upfront investment cost, many private investors are concerned about the long-term use cases for offshore wind port assets. In many geographies, current procurement levels on their surface don't justify investment in a 50-plus-year design-life asset. While many offshore wind industry veterans look to the expansion of the European market for evidence that offshore wind ports will be utilized well beyond current federal and state policy commitments, these case studies do not hold weight in rigorous private investment underwriting processes. Federal and state governments have the unique ability to credibly commit to building broad, long-term markets for offshore wind port assets. Steps such as accelerating the availability of offshore lease areas, creating clear power purchase procurement mechanisms, establishing clear preferences for utilizing domestic facilities, and avoiding limiting the market for ports to projects within their home states, are all opportunities to derisk commercial offtake for ports.

8. **Investigate state and local mechanisms to reduce commercial offtake risk for offshore port projects.** The biggest risk hampering offshore wind port projects is the lack of long-term contracted offtake. While the federal government may be able to develop solutions to help provide offtake guarantees or revenue certainty, state and local agencies should endeavor to address this challenge as well. For example, some state-level green banks may be well positioned to creatively build risk-mitigation tools for offshore wind port projects. Alternatively, states could explore different P3 approaches to effectively manage project risk. Leasing agreements between private developers and smaller port authorities could be creatively structured to share revenue upsides as well downside risks. Similarly, these agreements could be designed to backload lease payments as an encouragement to long-term tenants, like OEMs, to commit sooner. Especially for smaller port authorities with smaller balance sheets, state governments should be ready to step in with funding assistance if needed.

9. **Accelerate the permitting process for maritime construction projects that enable offshore wind deployment and operations.** Permitting is a major risk factor in any large infrastructure project, and maritime projects face additional review due to potential in-water impacts. While robust and effective permitting creates significant value for infrastructure investors by ensuring a legally enforceable right to operate, federal and state government authorities should continue to investigate opportunities to execute this oversight role in ways that are less time intensive and more predictable for project sponsors. By their nature, offshore wind port projects take significant time to develop and construct. Permitting timeline risk can dissuade private investment, especially in early-stage development work. Reducing this uncertainty will help draw more capital into the offshore wind port sector and accelerate the overall pace of development. As a corollary, allowing more flexibility in federal, state, and local permitting processes for alternative asset uses in scenarios where longer-term offshore wind demand does not materialize could also significantly derisk investments to private sector investors.

Conclusion

Offshore wind port infrastructure plays a critical role in addressing the effects of climate change, but it also offers another unique opportunity for the nation. It is **a chance to invest in the creation of thousands of new clean energy economy jobs and unlock hundreds of billions of dollars of new private sector investment.** Further investment in offshore wind ports **has the potential to disproportionately benefit environmental justice communities,** an important equity objective as we build this new industry.

Over the last five years, we have come to realize that taking a patchwork approach to funding offshore wind port development — including asking offshore project developers to fully embed the cost of new or upgraded port infrastructure into generation projects — is at best economically and technically inefficient, and at worst a regressive policy approach.[22] Instead, we must identify a new set of fit-for-purpose infrastructure funding and derisking solutions that will accelerate port investment and development.

Deploying 110 GW of offshore wind energy by 2050 will require $440 billion to $660 billion of investment (unescalated $ 2023) to construct, maintain and operate offshore wind farms. Investing 3.4% to 6.2% of that amount into enabling port infrastructure to unlock these offshore projects is a common-sense policy approach. **Put differently, building offshore wind port infrastructure will directly unlock 16-to-29 times more investment in clean energy generation and ensure our nation's long-term national energy independence.**

While this white paper establishes a baseline for what is needed and provides potential policy solutions, federal and state policymakers and private sector investors must work collaboratively to put these recommendations into action. **Without a concerted effort to change the trajectory of offshore wind port investment, the United States is in great risk of falling short of our offshore wind deployment and supply chain goals.**

The Business Network for Offshore Wind's Ports Working Group anticipates updating this white paper in two-to-three years as new information on construction costs, market expansion, and public sector supports comes to light.

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[22] Embedding infrastructure project development costs for port assets with 30+ year useful lifespans into projects that may only use those facilities for several years unnecessarily inflates the cost of early offshore wind projects, increases burdens on rate-payers, and has led to a number of sub-scale projects. Further, given the limited number of viable offshore wind port project sites, having individual offshore developers build and control port infrastructure may lead to less robust competition in the power purchase markets in the long-term.

APPENDIX A
Stocktake of Current and Needed Port Developments

MARSHALING

	Port Location	Rational for Inclusion
1	New Bedford Marine Commerce Terminal (MA)	Commercial operations
2	New London State Pier (CT)	Commercial operations
3	New Jersey Wind Port - Terminal A (NJ)	In development
4	New Jersey Wind Port - Terminal B (NJ)	In development
5	Portsmouth Marine Terminal (VA)	In development
6	Salem Wind Port (MA)	In development
7	Arthur Kill Terminal (NY)	In development
8	South Brooklyn Marine Terminal (NY)	In development
9	Tradepoint Atlantic (MD)	In development
10	Carolinas 1	Industry expert input
11	Carolinas 2	Industry expert input
12	Gulf of Mexico 1	Industry expert input
13	Gulf of Mexico 2	Industry expert input
14	Gulf of Mexico 3	Industry expert input

STAGING & INTEGRATION (AND FLOATING FOUNDATION ASSEMBLY)

	Port Location	Rational for Inclusion
1	Humboldt Bay 1 (CA)	In development
2	Humboldt Bay 2 (CA)	In development
3	Port of Long Beach 1 (CA)	Announced
4	Port of Long Beach 2 (CA)	Announced
5	Port of Long Beach 3 (CA)	Announced
6	Port of Long Beach 4 (CA)	Announced
7	Port of Long Beach 5 (CA)	Announced
8	Port of San Francisco (CA)	Announced
9	Pacific Northwest 1	Industry expert input
10	Pacific Northwest 1	Industry expert input
11	Pacific Northwest 1	Industry expert input
12	Maine 1	Industry expert input

FLEXIBLE LAYDOWN

	Port Location	Rational for Inclusion
1	Quonset Point (RI)	Commercial operations
2	Port of Providence (RI)	Commercial operations
3	Foss New Bedford Marine Terminal (MA)	In development
4	Lamberts Point, Norfolk (VA)	In development
5	New England 4	Industry expert input
6	Mid Atlantic 2	Industry expert input
7	Mid Atlantic 3	Industry expert input
8	Mid Atlantic 4	Industry expert input
9	Carolinas 1	Industry expert input
10	Gulf of Mexico 1	Industry expert input
11	Gulf of Mexico 2	Industry expert input
12	California 1	CA AB 525 Ports Readiness Report
13	California 2	CA AB 525 Ports Readiness Report
14	California 3	CA AB 525 Ports Readiness Report
15	Pacific Northwest 1	Industry expert input
16	Pacific Northwest 2	Industry expert input

APPENDIX A (CONT.)
Stocktake of Current and Needed Port Developments

MANUFACTURING (LARGE)

	Port Location	Rational for Inclusion
1	Nacelles - GE NJ Wind Port (also bid into NY)	In development
2	Nacelles - Vestas NJ Wind Port	In development
3	Nacelles 3	NREL 2023 Supply Chain Report
4	Nacelles 4	NREL 2023 Supply Chain Report
5	Blades - SGRE, Portsmouth (VA)	In development
6	Blades 2	NREL 2023 Supply Chain Report
7	Blades 3	NREL 2023 Supply Chain Report
8	Blades 4	NREL 2023 Supply Chain Report
9	Blades 5	NREL 2023 Supply Chain Report
10	Tower - Marmen Welcon, Albany (NY)	In development
11	Tower 2	NREL 2023 Supply Chain Report
12	Tower 3	NREL 2023 Supply Chain Report
13	Tower 4	NREL 2023 Supply Chain Report
14	Monopile - EEW AOS, Paulsboro (NJ)	Commercial operations
15	Monopile - US Wind, Tradepoint (MD)	In development
16	Monopile 3	NREL 2023 Supply Chain Report
17	Jacket	NREL 2023 Supply Chain Report
18	Gravity Based Foundation	NREL 2023 Supply Chain Report
19	TPs - Smulders, Albany (NY)	In development
20	TPs 2	NREL 2023 Supply Chain Report
21	Floating Platform (sub-components) 1	NREL 2023 Supply Chain Report
22	Floating Platform (sub-components) 2	NREL 2023 Supply Chain Report
23	Floating Platform (sub-components) 3	CA AB 525 Ports Readiness Report
24	Floating Platform (sub-components) 4	CA AB 525 Ports Readiness Report
25	Floating Platform (sub-components) 5	Industry expert input
26	Floating Platform (sub-components) 6	Industry expert input

MANUFACTURING (MEDIUM)

	Port Location	Rational for Inclusion
1	Export Cables - Nexans, Charleston (SC)	Commercial operations
2	Export Cables - Prysmian, Brayton Point (MA)	In development
3	Export cables 3	NREL 2023 Supply Chain Report
4	Export cables 4	NREL 2023 Supply Chain Report
5	Array Cables - Hellenic - Tradepoint Atlantic (MD)	In development
6	Array Cables 2	NREL 2023 Supply Chain Report
7	Mooring Chains 1	NREL 2023 Supply Chain Report
8	Mooring Chains 2	Industry expert input
9	Mooring Ropes 1	NREL 2023 Supply Chain Report
10	Mooring Ropes 2	Industry expert input
11	Anchors 1	Industry expert input
12	Anchors 2	Industry expert input
13	Flange	NREL 2023 Supply Chain Report
14	Castings	NREL 2023 Supply Chain Report

OPERATIONS & MAINTENANCE (CTV)

	Port Location	Rational for Inclusion
1	Pope's Island, New Bedford (MA)	Commercial operations
2	South Brooklyn Marine Terminal (NY)	In development
3	Gardner Basin, Atlantic City 1 (NJ)	In development
4	Gardner Basin, Atlantic City 2 (NJ)	In development
5	Barnum Landing, Bridgeport (CT)	In development
6	Ocean City, MD	In development
7	Tisbury, Martha's Vineyard (MA)	In development
8	Brooklyn Navy Yard (NY)	Announced
9	New England 3	Industry expert input
10	New England 4	Industry expert input
11	Mid-Atlantic 6	Industry expert input
12	Carolinas 1	Industry expert input
13	Gulf of Mexico 1	Industry expert input
14	Gulf of Mexico 2	Industry expert input
15	California 1	CA AB 525 Ports Readiness Report
16	California 2	CA AB 525 Ports Readiness Report
17	Pacific Northwest 1	Industry expert input
18	Pacific Northwest 2	Industry expert input

APPENDIX A (CONT.)
Stocktake of Current and Needed Port Developments

OPERATIONS & MAINTENANCE (SOV)

	Port Location	Rational for Inclusion
1	Foss New Bedford Marine Terminal (MA)	In development
2	Lambert's Point, Norfolk (VA)	In development
3	Port Jefferson (NY)	In development
4	New England 2	Industry expert input
5	New England 3	Industry expert input
6	Mid-Atlantic 3	Industry expert input
7	Mid-Atlantic 4	Industry expert input
8	Carolinas 1	Industry expert input
9	Carolinas 2	Industry expert input
10	Gulf of Mexico 1	Industry expert input
11	Gulf of Mexico 2	Industry expert input
12	Gulf of Mexico 3	Industry expert input
13	California 1	CA AB 525 Ports Readiness Report
14	California 2	CA AB 525 Ports Readiness Report
15	California 3	CA AB 525 Ports Readiness Report
16	California 4	CA AB 525 Ports Readiness Report
17	Pacific Northwest 1	Industry expert input
18	Pacific Northwest 2	Industry expert input
19	Pacific Northwest 3	Industry expert input

APPENDIX B
Explanation of the Port Construction Funding Gap Methodology

The first step in estimating the current gap in offshore port construction costs was to remove projects that are in commercial operation. The second step was to estimate the funding gaps in existing projects. To find that amount, we multiplied the number of projects in development by the per-project cost estimate and then by the construction funding gap estimate. This calculation was performed on the project-type level across all categories of projects.

Table 10: *Construction funding gap for currently in-development projects (unescalated $ 2023)*

Port type	Commercial operations (sites)	Sites in-development	Per-project cost estimate ($M 2023)	In-development construction funding gap estimate (%)	In-development construction funding gap ($M 2023)
Marshaling	2	7	$500	30%	$1,050
Staging & Integration	0	2	$800	99%	$1,584
Flexible Laydown	2	2	$40	30%	$24
Manufacturing (Large)	1	6	$350	50%	$1,050
Manufacturing (Medium)	1	2	$75	30%	$45
Operations & Maintenance CTV	1	6	$60	0%	-
Operations & Maintenance SOV	0	3	$250	50%	375
Total	**7**	**28**			**$4,128**

Approximately 64% of the current project funding gap can be attributed to marshaling and staging & integration ports,[23] which typically face challenges with debt (public and private) and private equity financing solutions due to a lack of long-term tenant lease commitments.[24] Approximately 25% of this gap is driven by large manufacturing port projects, with the balance (approximately 11%) spread out across all other asset types.

The third step in our project gap estimation process was to determine the aggregate construction cost for projects that have been announced but are not in full development and for projects without identified sites. We estimated this funding gap by multiplying the high and low project site estimates by the same indicate project cost estimates used in the overall infrastructure cost sizing approach described above.

[23] The two S&I terminals in Humboldt Bay have recently submitted federal permits, however, only approximately ~$10M of funding has been committed to the project through a California State grant program.

[24] Offshore wind developers typically lease space at marshaling and S&I ports for 2-5 years at a time during offshore wind project construction, and can only make firm leasing commitments once their projects have secured power offtake.

APPENDIX B (CONT.)
Explanation of the Port Construction Funding Gap Methodology

Table 11: *Construction funding gap for projects without an identified site (unescalated $ 2023)*

Port Type	Per-project cost estimate ($M 2023)	Unidentified project construction funding gap ($M 2023)		Total construction funding gap ($M 2023)	
		Low	High	Low	High
Marshaling	$500	3	5	$1,500	$2,500
Staging & Integration	$800	9	10	$7,200	$8,000
Flexible Laydown	$40	8	12	$320	$480
Manufacturing (Large)	$350	15	19	$5,250	$6,650
Manufacturing (Medium)	$75	8	11	$600	$825
Operations & Maintenance CTV	$60	9	11	$540	$660
Operations & Maintenance SOV	$250	12	16	$3,000	$4,000
Total		**64**	**84**	**$18,410**	**$23,115**

The additional 64 to 84 offshore wind projects that are needed to meet our long-term national and state policy targets will require between $18.4 billion and $23.1 billion of construction capital (unescalated $ 2023, excluding project financing costs).

By combining these two project construction funding gaps, we are able to build a national viewpoint on the total gap in offshore wind port construction funding.

In total, we estimate that the total cost to address the nation's offshore wind port infrastructure gap, assuming 2023 construction prices and no financing costs, is between $22.5 billion and $27.2 billion.

Table 12: *Total offshore wind construction funding gaps (unescalated $ 2023)*

Port Type	In-development construction funding gap ($M 2023)	Unidentified project construction funding gap ($M 2023)		Total construction funding gap ($M 2023)	
		Low	High	Low	High
Marshaling	$1,050	$1,500	$2,500	$2,550	$3,550
Staging & Integration	$1,584	$7,200	$8,000	$8,784	$9,584
Flexible Laydown	$24	$320	$480	$344	$504
Manufacturing (Large)	$1,050	$5,250	$6,650	$6,300	$7,700
Manufacturing (Medium)	$45	$600	$825	$645	$870
Operations & Maintenance CTV	-	$540	$660	$540	$660
Operations & Maintenance SOV	$375	$3,000	$4,000	$3,375	$4,375
Total	**$4,128**	**$18,410**	**$23,115**	**$22,538**	**$27,243**

APPENDIX C

Capital Spread Analysis for Offshore Wind Port Infrastructure Gaps

Assumptions for shares of cost and timing by project stage

	Shares of project cost per project stage		Years per project stage	
Project Type	**Pre-construction**	**Construction**	**Pre-construction**	**Construction**
Gaps in existing projects	0%	100%	0	3
Marshaling	3%	97%	3	3
Staging & Integration	2%	98%	3	3
Flexible Laydown	7%	93%	2	2
Manufacturing (Large)	4%	96%	3	3
Manufacturing (Medium)	7%	93%	3	2
Operations & Maintenance CTV	8%	92%	3	2
Operations & Maintenance SOV	4%	96%	3	3

Construction escalation estimate: 5.00%

Financing cost scaling factor: 20%

Project type	Port / Project	Total ($M 2023)	Pre-con. share ($M 2023)	Construction share ($M 2023)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Marshaling	Gaps in current projects	1050.0		1050.0		350.0	350.0	350.0						
Marshaling	Carolinas 1	500.0	15.0	485.0		5.0	5.0	5.0	161.7	161.7	161.7			
Marshaling	Carolinas 2	500.0	15.0	485.0			5.0	5.0	5.0	161.7	161.7	161.7		
Marshaling	Gulf of Mexico 1	500.0	15.0	485.0		5.0	5.0	5.0	161.7	161.7	161.7			
Marshaling	Gulf of Mexico 2	500.0	15.0	485.0			5.0	5.0	5.0	161.7	161.7	161.7		
Marshaling	Gulf of Mexico 3	500.0	15.0	485.0				5.0	5.0	5.0	161.7	161.7	161.7	
Staging and Integration	Gaps in current projects	1584.0		1584.0			528.0	528.0	528.0					
Staging and Integration	Port of Long Beach 1 (CA)	800.0	16.0	784.0			5.3	5.3	5.3	261.3	261.3	261.3		
Staging and Integration	Port of Long Beach 2 (CA)	800.0	16.0	784.0				5.3	5.3	5.3	261.3	261.3	261.3	
Staging and Integration	Port of Long Beach 3 (CA)	800.0	16.0	784.0			5.3	5.3	5.3	261.3	261.3	261.3		
Staging and Integration	Port of Long Beach 4 (CA)	800.0	16.0	784.0					5.3	5.3	5.3	261.3	261.3	261.3
Staging and Integration	Port of Long Beach 5 (CA)	800.0	16.0	784.0					5.3	5.3	5.3	261.3	261.3	261.3
Staging and Integration	Port of San Francisco 1 (CA)	800.0	16.0	784.0		5.3	5.3	5.3	261.3	261.3	261.3			

CAPITAL SPREAD ANALYSIS CONTINUED ON NEXT PAGE

APPENDIX C (CONT.)

Capital Spread Analysis for Offshore Wind Port Infrastructure Gaps

Project type	Port / Project	Total ($M 2023)	Pre-con. share ($M 2023)	Construction share ($M 2023)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Staging and Integration	Pacific Northwest 1	800.0	16.0	784.0			5.3	5.3	5.3	261.3	261.3	261.3		
Staging and Integration	Pacific Northwest 2	800.0	16.0	784.0				5.3	5.3	5.3	261.3	261.3	261.3	
Staging and Integration	Pacific Northwest 3	800.0	16.0	784.0				5.3	5.3	5.3	261.3	261.3	261.3	
Staging and Integration	Maine 1	800.0	16.0	784.0			5.3	5.3	5.3	261.3	261.3	261.3		
Flexible laydown	Gaps in current projects	24.0	0.0	24.0		8.0	8.0	8.0						
Flexible laydown	New England 4	40.0	2.8	37.2		1.4	1.4	18.6	18.6					
Flexible laydown	Mid Atlantic 2	40.0	2.8	37.2		1.4	1.4	18.6	18.6					
Flexible laydown	Mid Atlantic 3	40.0	2.8	37.2		1.4	1.4	18.6	18.6					
Flexible laydown	Mid Atlantic 4	40.0	2.8	37.2			1.4	1.4	18.6	18.6				
Flexible laydown	Carolinas 1	40.0	2.8	37.2				1.4	1.4	18.6	18.6			
Flexible laydown	Gulf of Mexico 1	40.0	2.8	37.2				1.4	1.4	18.6	18.6			
Flexible laydown	Gulf of Mexico 2	40.0	2.8	37.2					1.4	1.4	18.6	18.6		
Flexible laydown	California 1	40.0	2.8	37.2			1.4	1.4	18.6	18.6				
Flexible laydown	California 2	40.0	2.8	37.2				1.4	1.4	18.6	18.6			
Flexible laydown	California 3	40.0	2.8	37.2					1.4	1.4	18.6	18.6		
Flexible laydown	Pacific Northwest 1	40.0	2.8	37.2					1.4	1.4	18.6	18.6		
Flexible laydown	Pacific Northwest 2	40.0	2.8	37.2						1.4	1.4	18.6	18.6	
Manufacturing (large)	Gaps in current projects	1050.0	0.0	1050.0		350.0	350.0	350.0						
Manufacturing (large)	Nacelles 3	350.0	14.0	336.0			4.7	4.7	4.7	112.0	112.0	112.0		
Manufacturing (large)	Nacelles 4	350.0	14.0	336.0				4.7	4.7	4.7	112.0	112.0	112.0	
Manufacturing (large)	Blades 2	350.0	14.0	336.0		4.7	4.7	4.7	112.0	112.0	112.0			
Manufacturing (large)	Blades 3	350.0	14.0	336.0			4.7	4.7	4.7	112.0	112.0	112.0		
Manufacturing (large)	Blades 4	350.0	14.0	336.0				4.7	4.7	4.7	112.0	112.0	112.0	
Manufacturing (large)	Blades 5	350.0	14.0	336.0					4.7	4.7	4.7	112.0	112.0	112.0

CAPITAL SPREAD ANALYSIS CONTINUED ON NEXT PAGE

Project type	Port / Project	Total ($M 2023)	Pre-con. share ($M 2023)	Construction share ($M 2023)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Manufacturing (large)	Tower 2	350.0	14.0	336.0		4.7	4.7	4.7	112.0	112.0	112.0			
Manufacturing (large)	Tower 3	350.0	14.0	336.0				4.7	4.7	4.7	112.0	112.0	112.0	
Manufacturing (large)	Tower 4	350.0	14.0	336.0					4.7	4.7	4.7	112.0	112.0	112.0
Manufacturing (large)	Monopile 3	350.0	14.0	336.0			4.7	4.7	4.7	112.0	112.0	112.0		
Manufacturing (large)	Jacket	350.0	14.0	336.0			4.7	4.7	4.7	112.0	112.0	112.0		
Manufacturing (large)	Gravity Based Foundation	350.0	14.0	336.0				4.7	4.7	4.7	112.0	112.0	112.0	
Manufacturing (large)	TPs 2	350.0	14.0	336.0		4.7	4.7	4.7	112.0	112.0	112.0			
Manufacturing (large)	Floating Platform (sub-components) 1	350.0	14.0	336.0		4.7	4.7	4.7	112.0	112.0	112.0			
Manufacturing (large)	Floating Platform (sub-components) 2	350.0	14.0	336.0		4.7	4.7	4.7	112.0	112.0	112.0			
Manufacturing (large)	Floating Platform (sub-components) 3	350.0	14.0	336.0			4.7	4.7	4.7	112.0	112.0	112.0		
Manufacturing (large)	Floating Platform (sub-components) 4	350.0	14.0	336.0				4.7	4.7	4.7	112.0	112.0	112.0	
Manufacturing (large)	Floating Platform (sub-components) 5	350.0	14.0	336.0				4.7	4.7	4.7	112.0	112.0	112.0	
Manufacturing (large)	Floating Platform (sub-components) 6	350.0	14.0	336.0					4.7	4.7	4.7	112.0	112.0	112.0
Manufacturing (medium)	Gaps in current projects	45.0	0.0	45.0		15.0	15.0	15.0						
Manufacturing (medium)	Export cables 3	75.0	5.3	69.8			1.8	1.8	1.8	34.9	34.9			
Manufacturing (medium)	Export cables 4	75.0	5.3	69.8				1.8	1.8	1.8	34.9	34.9		
Manufacturing (medium)	Array Cables 2	75.0	5.3	69.8		1.8	1.8	1.8	34.9	34.9				
Manufacturing (medium)	Mooring chains 1	75.0	5.3	69.8		1.8	1.8	1.8	34.9	34.9				
Manufacturing (medium)	Mooring chains 2	75.0	5.3	69.8			1.8	1.8	1.8	34.9	34.9			
Manufacturing (medium)	Mooring ropes 1	75.0	5.3	69.8			1.8	1.8	1.8	34.9	34.9			

CAPITAL SPREAD ANALYSIS CONTINUED ON NEXT PAGE

Capital Spread Analysis for Offshore Wind Port Infrastructure Gaps

Project type	Port / Project	Total ($M 2023)	Pre-con. share ($M 2023)	Construction share ($M 2023)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Manufacturing (medium)	Mooring ropes 2	75.0	5.3	69.8				1.8	1.8	1.8	34.9	34.9		
Manufacturing (medium)	Anchors 1	75.0	5.3	69.8			1.8	1.8	1.8	34.9	34.9			
Manufacturing (medium)	Anchors 2	75.0	5.3	69.8				1.8	1.8	1.8	34.9	34.9		
Manufacturing (medium)	Flange	75.0	5.3	69.8			1.8	1.8	1.8	34.9	34.9			
Manufacturing (medium)	Castings	75.0	5.3	69.8			1.8	1.8	1.8	34.9	34.9			
O&M CTV	Gaps in current projects	0.0	0.0	0.0		0.0	0.0	0.0						
O&M CTV	Brooklyn Navy Yard	60.0	4.8	55.2		1.6	1.6	1.6	27.6	27.6				
O&M CTV	New England 3	60.0	4.8	55.2			1.6	1.6	1.6	27.6	27.6			
O&M CTV	New England 4	60.0	4.8	55.2				1.6	1.6	1.6	27.6	27.6		
O&M CTV	Mid-Atlantic 6	60.0	4.8	55.2		1.6	1.6	1.6	27.6	27.6				
O&M CTV	Carolinas 1	60.0	4.8	55.2				1.6	1.6	1.6	27.6	27.6		
O&M CTV	Gulf of Mexico 1	60.0	4.8	55.2			1.6	1.6	1.6	27.6	27.6			
O&M CTV	Gulf of Mexico 2	60.0	4.8	55.2				1.6	1.6	1.6	27.6	27.6		
O&M CTV	California 1	60.0	4.8	55.2			1.6	1.6	1.6	27.6	27.6			
O&M CTV	California 2	60.0	4.8	55.2				1.6	1.6	1.6	27.6	27.6		
O&M CTV	Pacific Northwest 1	60.0	4.8	55.2				1.6	1.6	1.6	27.6	27.6		
O&M CTV	Pacific Northwest 2	60.0	4.8	55.2					1.6	1.6	1.6	27.6	27.6	
O&M SOV	Gaps in current projects	375.0	0.0	375.0		125.0	125.0	125.0						
O&M SOV	New England 2	250.0	10.0	240.0		3.3	3.3	3.3	80.0	80.0	80.0			
O&M SOV	New England 3	250.0	10.0	240.0			3.3	3.3	3.3	80.0	80.0	80.0		
O&M SOV	Mid-Atlantic 3	250.0	10.0	240.0		3.3	3.3	3.3	80.0	80.0	80.0			
O&M SOV	Mid-Atlantic 4	250.0	10.0	240.0			3.3	3.3	3.3	80.0	80.0	80.0		
O&M SOV	Carolinas 1	250.0	10.0	240.0			3.3	3.3	3.3	80.0	80.0	80.0		
O&M SOV	Carolinas 2	250.0	10.0	240.0				3.3	3.3	3.3	80.0	80.0	80.0	
O&M SOV	Gulf of Mexico 1	250.0	10.0	240.0		3.3	3.3	3.3	80.0	80.0	80.0			
O&M SOV	Gulf of Mexico 2	250.0	10.0	240.0			3.3	3.3	3.3	80.0	80.0	80.0		

CAPITAL SPREAD ANALYSIS CONTINUED ON NEXT PAGE

Project type	Port / Project	Total ($M 2023)	Pre-con. share ($M 2023)	Construction share ($M 2023)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
O&M SOV	Gulf of Mexico 3	250.0	10.0	240.0				3.3	3.3	3.3	80.0	80.0	80.0	
O&M SOV	California 1	250.0	10.0	240.0		3.3	3.3	3.3	80.0	80.0	80.0			
O&M SOV	California 2	250.0	10.0	240.0			3.3	3.3	3.3	80.0	80.0	80.0		
O&M SOV	California 3	250.0	10.0	240.0				3.3	3.3	3.3	80.0	80.0	80.0	
O&M SOV	California 4	250.0	10.0	240.0					3.3	3.3	3.3	80.0	80.0	80.0
O&M SOV	Pacific Northwest 1	250.0	10.0	240.0			3.3	3.3	3.3	80.0	80.0	80.0		
O&M SOV	Pacific Northwest 2	250.0	10.0	240.0				3.3	3.3	3.3	80.0	80.0	80.0	
O&M SOV	Pacific Northwest 3	250.0	10.0	240.0					3.3	3.3	3.3	80.0	80.0	80.0
Total unescalated construction cost		**27,243**	**785**	**25,958**	**-**	**911**	**1,532**	**1,663**	**2,418**	**4,497**	**6,492**	**5,710**	**3,003**	**1,019**
Total escalated construction cost		**35,999**			**-**	**956**	**1,689**	**1,925**	**2,938**	**5,740**	**8,699**	**8,034**	**4,436**	**1,580**
Estimated financing costs		7,200			-	191	338	385	588	1,148	1,740	1,607	887	316
Escalated total with financing costs		**43,198**			**-**	**1,148**	**2,026**	**2,310**	**3,526**	**6,888**	**10,439**	**9,641**	**5,323**	**1,896**

APPENDIX D
Business Network for Offshore Wind Ports Working Group Members

Company	Name
ABS	Liz Kretovic
Advisian	James Frolich
Advisian	Phil Zito
AECOM	Jason Smeak
AFL-CIO	Patrick O'Meara
Aker	Kevin Pearce
Anchor QEA	Walter Dinicola
Anchor QEA	Mark Mahoney
Anchor QEA	Chris Moelter
Atlantic Offshore Terminals	Charles Dougherty
Atlantic Offshore Terminals	Boone Davis
Atlantic Shores	Valerie Maurel
Avangrid	Jay Borkland
Baird	Ed Liegel
Baird	Jack Haynie
Boskalis	Jamie Lescinski
Clean Energy Terminals	Brian Sabina
COWI	Brent Cooper
Crowley	John Berry
Crowley Wind Services	Otto Candies
Crowley Wind Services	Evan Matthews
DEME	Jan Klaassen
DEME	Sidney Florey
DNV	Craig Reid
Floventis	Robert Collier
Floventis/SBM	Nicolas Mac Ferran
Foss	Sloane Perras

Company	Name
Great Lakes Dock & Dredge	Andrew Trojani
Haugland Group	Michael Paci
Invenergy	Elizabeth Basista
IUPAT (International Union of Painters & Allied Trades)	John Doherty
Jones Walker	Will Baldwin
Kleinschmidt Group	Kim Fitzgibbons
Manson Construction	Jeff Arviso
Manson Construction	Michael Warwick
McCallister Towing	Martin Masterson
Moffatt Nichol	Joshua Singer
Moffatt Nichol	Jordan Greer
Mott MacDonald	Aaron Porter
NJEDA	Jonathan Kennedy
Orsted	John Pauling
Port of Long Beach	Suzanne Plezia
Port of Seattle	Ryan Calkins
Port of Seattle	Vy Nguyen
Siemens Gamesa	Fernando Corona
Smulders	Dirk Kassen
Stantec	John Crowther
SW Carpenters	Manly McNinch
SW Carpenters	Josh Raper
T Parker Host	Jeff Keever
Tetratech	Nathalie Schils
TOTAL Energies	Brian Lefebvre
Trident Winds/Castle WInds	Alla Weinstein