Report to the Governor's Energy Office

# Offshore Wind Supply Chain & Workforce Opportunity Assessment

## Task 3 Report - Identification of Strategies to Support Supply Chain Diversification and Attraction

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XODUS


Boston

99 Summer Street
Suite 1720 . Boston
MA 02110 . USA

T +1 (0)8572 631772
E jamie.macdonald@xodusgroup.com

www.xodusgroup.com

# REVISIONS & APPROVALS

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# 1 INTRODUCTION

## 1.1 Overview

With an estimated project pipeline in excess of 28GW in awarded lease areas and 14 projects, equating to over 9GW in capacity, currently expected to be operational by 2026, the US offshore wind market now represents a sizeable portion of the global offshore wind market.

Maine has set out a thoughtful and bold agenda for their ambitions to realize the economic opportunities of the emerging industry along the East Coast. With multiple projects estimated for deployment in the region before the end of the decade, offshore wind presents a significant opportunity to help the state meet its greenhouse gas emission reduction mandates and goals, address the retirement of aging power plants, provide economic development opportunities for Maine businesses, and create thousands of jobs for Maine residents.

However, in order to realize this market potential, overcoming the hurdle of establishing a local and/or regional supply chain to support the industry needs to be achieved. Federal approval of the first US commercial scale projects should, in theory, foster confidence that a sustainable and reliable pipeline of projects will come to fruition and, as such, investment in building the capabilities of the local supply chain will follow.

The current delivery model for the first commercial US offshore wind farm is built on the import of the main components from overseas. Components for early projects will be imported to local ports to be staged before being transported to the project site for installation. Some components will be taken directly to the wind farm project site, foregoing local staging. Even though the large majority of project infrastructure will be imported initially, these projects are still generating significant economic activity in the project development phases. The projects will require significant support and services from local business during their construction and installation.

However, it is recognized that this delivery model will become increasingly inefficient and detrimental to the development of a local industry. Therefore, Maine's Governors Energy Office (GEO) is supporting efforts to develop of a robust local supply chain in Maine that can offer products and services across the complete development, manufacturing, installation and operations phases of the offshore wind project lifecycle.

To support this ambition, GEO have contracted the support and insights from Xodus Group in order to learn more about supply chain needs and the specific supply chain capabilities that exist in Maine. The objective is to use these deeper supply chain insights to inform future strategic state-level investments, initiatives and policies that will enable companies throughout the supply chain to make more targeted and meaningful connections that lead to fruitful partnerships.

The economic benefit which Maine can realize from offshore wind will depend to a great extent on the success of the local supply chain in winning and delivering work on offshore wind projects. While the Maine market is expected to provide opportunities for the local supply chain, there will also be further economic benefit to Maine should local suppliers be successful in supporting projects along the entire US east coast and beyond.

In order to achieve this, a clear path must be found for Maine companies and workforce to develop further capabilities and facilities needed to be best in class, ensuring that those procuring products and services for projects in Maine, the US and overseas have good visibility of local companies and their offerings. This study aims to identify local supply chain companies that will be able to match their capabilities to the opportunities presented by this growing industry both in Maine and in export markets.

Due to the deep-water nature of the Gulf of Maine it is expected that floating offshore wind sites will be developed. The strong wind resource in the Gulf, deep waters close to shore and marine industry heritage make Maine a logical place to develop a thriving floating offshore wind industry. Maine is soon to become home to the first US floating offshore wind turbine in the New England Aqua Ventus project followed by potentially the first US multi-turbine floating project in the proposed Maine Research Array. In addition, future developments and leases along the US East Coast will shift to floating foundations as the areas with attractive wind resource suitable for fixed foundations become saturated and push development into deeper water further offshore.

Floating wind is a nascent industry, but one considered to have significant potential for growth. Planned installed capacity of fixed-based offshore wind currently far exceeds floating due in part to the wind technology evolution taking place in markets where shallow water sites with good wind resource were readily available. However, these site conditions are not the standard across the globe. Offshore areas with strong winds, close to human populations with high electricity demand, are more likely to be in deeper water locations. Floating offshore wind will therefore play an increasing role in the future to meet a growing global renewable energy demand. Thus, it presents a substantial opportunity to companies that are capable of supporting the sector.

## 1.2 Objective

The objective of this study is to identify and enhance Maine's offshore wind supply chain and workforce to maximize economic benefits to Maine from offshore wind development in the Gulf of Maine and along the US East Coast. This effort seeks to optimize Maine's supply chain and workforce to fully realize the economic opportunities of offshore wind.

Specifically, the objectives of this project are to:

- Deliver an assessment of the offshore wind supply chain opportunity for Maine to inform an action plan to enhance Maine's offshore wind supply chain position. [Performed by Xodus – reported separately]
- Deliver an assessment of the offshore wind workforce opportunity for Maine to inform an action plan to strengthen Maine's workforce to serve the offshore wind industry. [Performed by BW Research – reported separately]
- [This Report] Develop strategies and plans to:
  - Support existing Maine offshore wind companies;
  - Attract existing offshore wind companies to Maine; and
  - Engage Maine companies not already engaged in offshore wind.
- Develop a strategy for partnership building between Maine companies and workforce and the offshore wind industry. [Performed by Xodus and Karp Strategies – reported separately]
- Engage with Maine working groups and relevant public stakeholders and organizations.

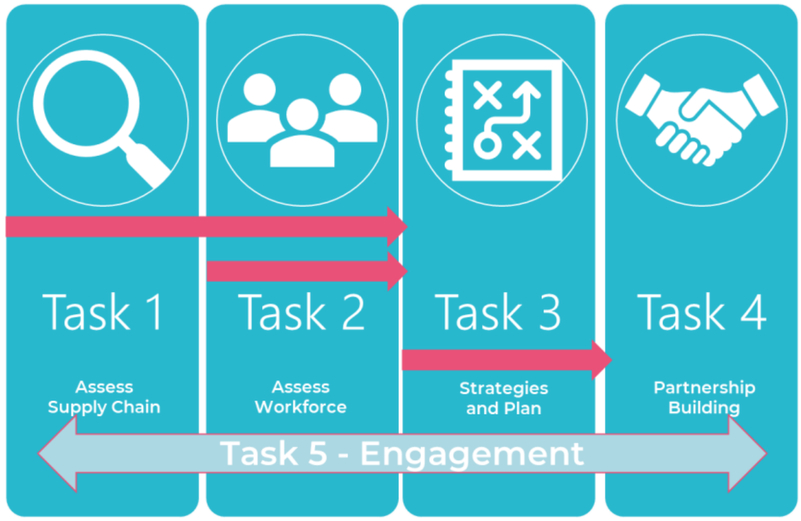


*Figure 1.1 - Project Overview*

# 2 US OFFSHORE WIND PROJECT SUPPLY CHAIN LANDSCAPE

## 2.1 Project Pipeline

The US annual and cumulative installed offshore wind capacity has been forecasted through 2040 in Figure 2.1. The projected offshore wind project pipeline represents currently established lease areas, those under permitting by a developer, and future wind energy areas (WEAs) that BOEM has announced for leasing in 2022. Carolina Long Bay, Oregon, and the two WEAs of California (Morro Bay and Humboldt Bay) are included, as well as potential future leasing areas necessary to meet States' offshore wind procurement targets through 2040, as summarized in Table 2.1. Due to the level of uncertainty associated with project capacities and timelines, projections beyond 2030 are highly subject to change.

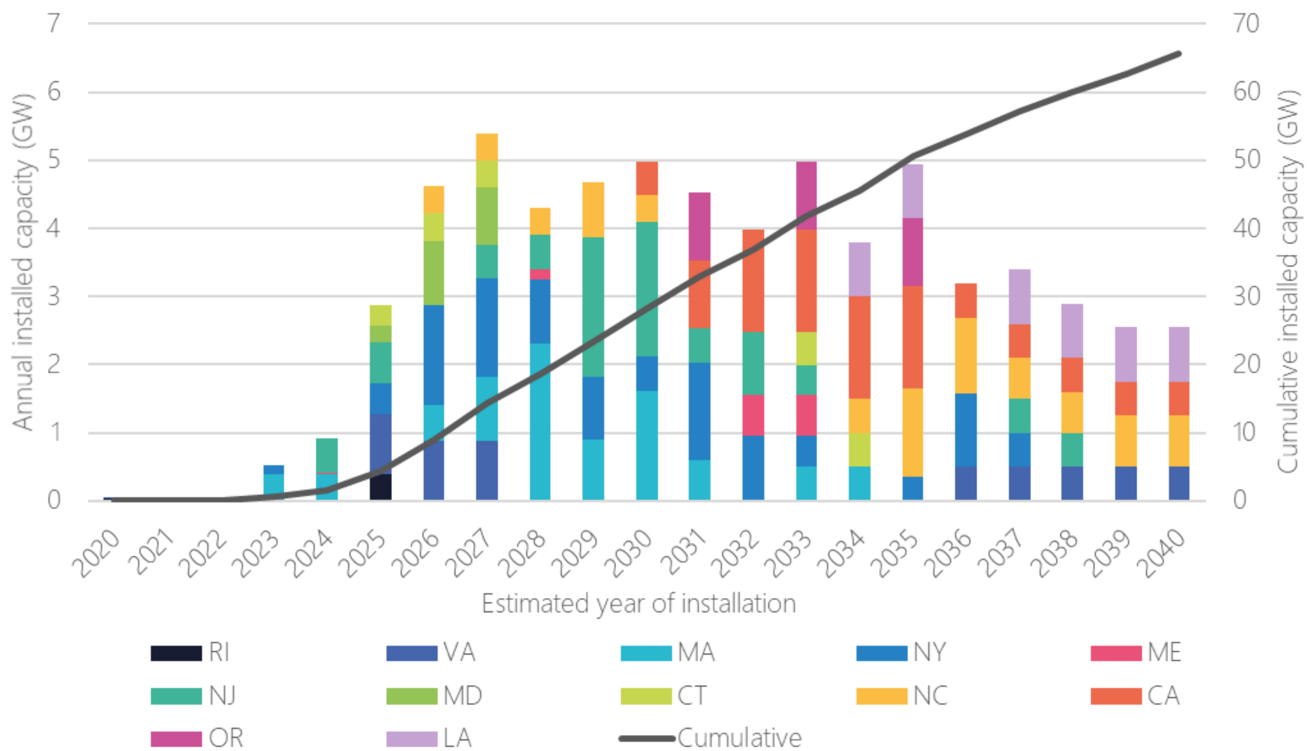


*Figure 2.1 - US annual and cumulative offshore wind installation timeline by state*

For the US to meet the 30GW by 2030 capacity targets it is likely necessary for some of the NY Bight lease areas to be delivering power by the end of 2030, supported by an accelerated project development timeline with no conflicts in permitting or delays in development. From Figure 2.1, a peak in annual installed capacity is predicted to be in year 2027 with over 5GW anticipated to be installed. The installed capacity is predicted to follow a consistent growth rate between

2025 and 2035. This trend can be expected to follow through 2035 as BOEM announces additional seabed leasing rounds.

The New England Aqua Ventus 11MW pilot project is currently anticipated to be installed and operational in 2024, followed by a 144MW research array in 2028. The projects in Maine represent the first floating offshore wind presence in the US. Due to further seabed leasing in the Gulf of Maine not anticipated to occur until mid- to late-2024, the first commercial-scale floating offshore wind project is not estimated to be fully commissioned until 2033.

To better understand the future of floating offshore wind projects, a forecast considering additional future lease areas to meet States' procurement targets have been included and the foundation type is considered. Figure 2.2 shows the future forecast for fixed and floating projects.

*Table 2.1 - Anticipated additional leasing capacity deployment post-2030*

| LOCATION | DATE OPERATING | PROJECT CAPCITY (MW) | FOUNDATION TYPE |
|---|---|---|---|
| Gulf of Mexico | 2036 | 1,600 | Fixed |
| | 2038 | 1,600 | Fixed |
| | 2040 | 1,600 | Fixed |
| Central Atlantic | 2035 | 1,000 | Fixed |
| | 2037 | 1,000 | Floating |
| | 2040 | 1,500 | Floating |
| Hawaii | 2040 | 500 | Floating |
| California | 2040 | 5,000 | Floating |
| North Carolina | 2040 | 3,300 | Fixed/Floating |
| New England Region | 2040 | 4,000 | Fixed |

The first commercial scale floating wind projects are expected to be installed on the US West Coast, with BOEM announcing a California seabed leasing round will take place by the end of 2022 and in Oregon by the end of 2023. While California legislation is ambitiously aiming for 3GW of installed capacity by 2030, this study has taken a more conservative approach to account for potential obstacles in permitting along the West Coast and has considered the first 3 GW to be installed by 2033 with an additional 7 GW installed by 2040.

Along the East Coast, additional capacity was considered in the New England region, assuming states will continue to increase their ambitions for installed offshore wind capacity. The Central Atlantic region is projected to develop floating projects next decade and a portion of North Carolina's future leasing areas may be floating, from future Central Atlantic

WEAs. While only a portion of the projects are floating, this presents an opportunity for Maine companies to establish themselves as suppliers to the US East Coast floating wind market.

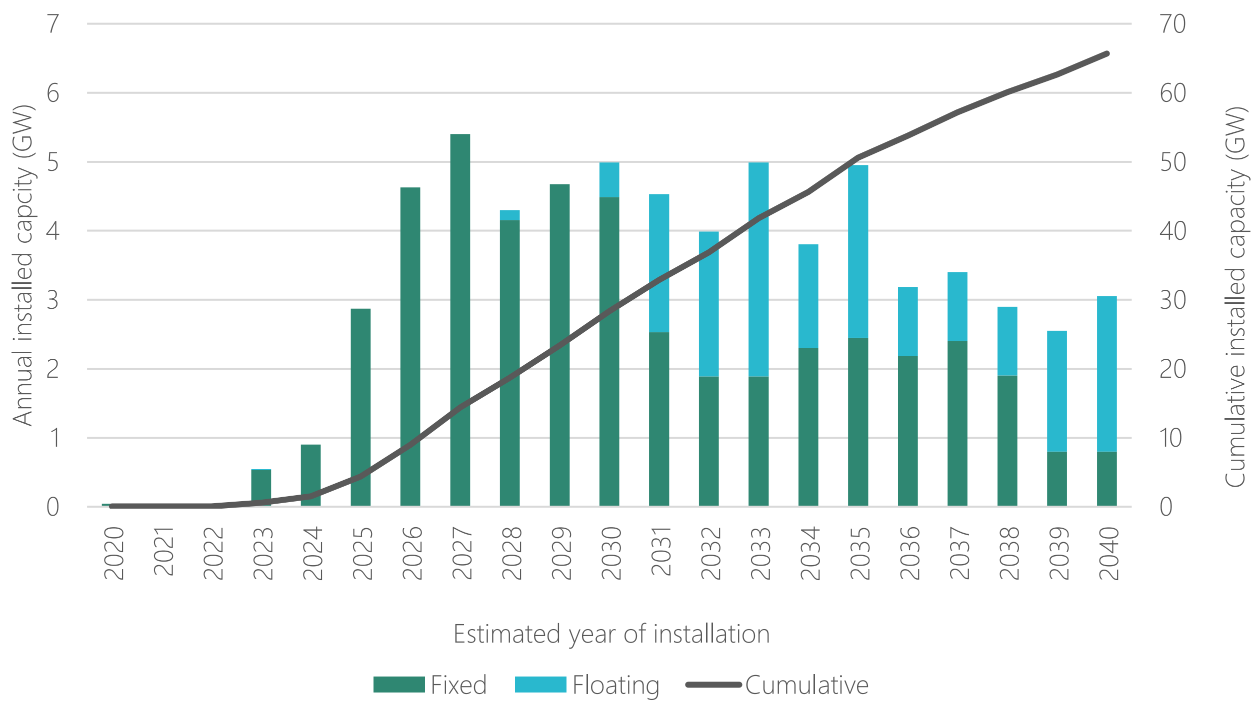


*Figure 2.2 – Forecast project pipeline for US fixed and floating foundation projects*

## 2.2 US Supply Chain

**Component demand**

The anticipated growth of the US offshore wind market from 42MW to 30GW by 2030 will require significant investment in the domestic supply chain. To better understand bottlenecks in the supply chain, the annual demand for main components per year is given in Figure 2.3, considering the installation capacity timeline from Figure 2.1. This forecast assumes all supply will be needed by ahead of project commence operations date (COD).

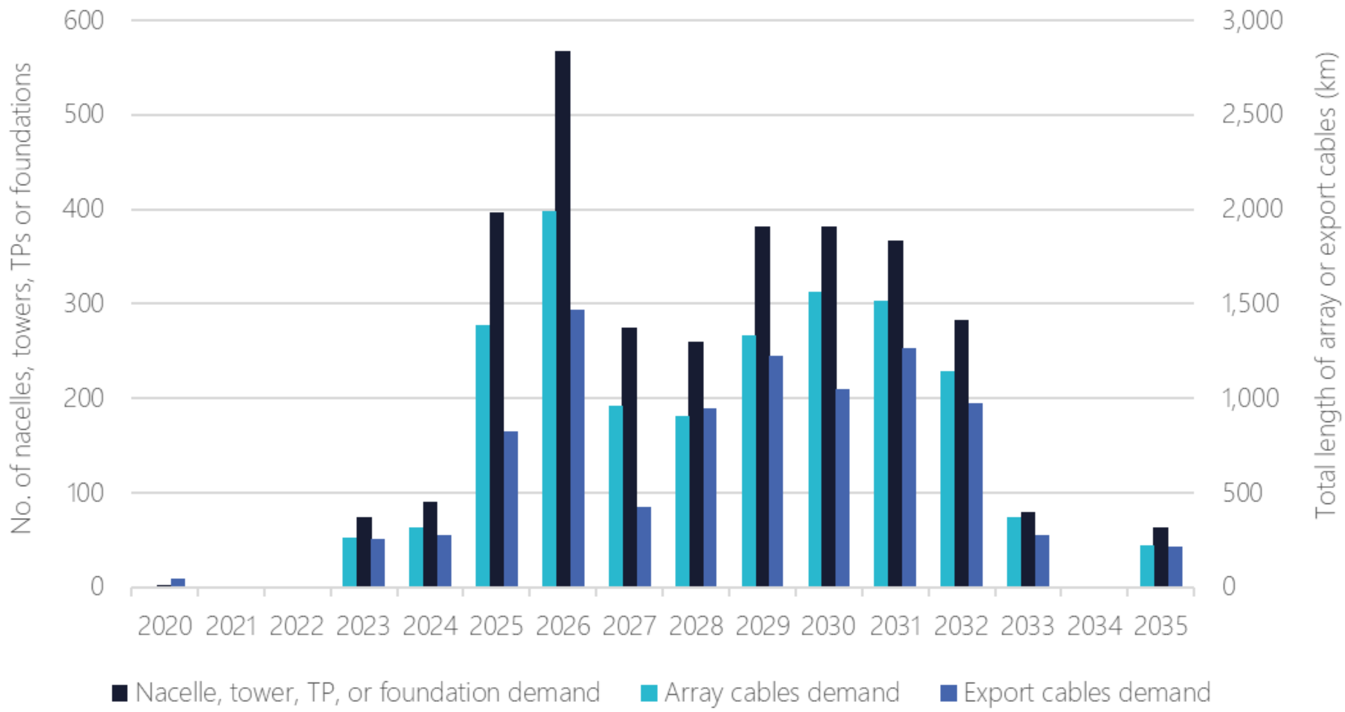


*Figure 2.3 – Annual US offshore wind major component demand*

**Component supply**

The size and visibility of the anticipated US project pipeline has enabled the establishment of an initial native East Coast US Tier 1 supply chain. Table 2.2 summarizes the supplier, facility location, and projects' information that the facility has announced to support, including capacity and estimated commence operations date (COD). Known US original equipment manufacturers (OEMS) are mapped out geographically by facility type in Figure 2.4.

*Table 2.2 - Summary of anticipated US offshore wind OEM supplier locations and project commitments*

| SUPPLY ELEMENT | SUPPLIER | LOCATION | PROJECT | CAPACITY (MW) | COD |
|---|---|---|---|---|---|
| Turbine | Vestas | Wind Port, NJ | Atlantic Shores 1 | 1,510 | 2027 |
| | | | Empire Wind 2 | 1,260 | 2027 |
| | | | Atlantic Shores 2 | 1,425 | 2030 |
| | GE | Wind Port, NJ | Ocean Wind 2 | 1,148 | 2029 |
| Blade finishing | SGRE | Portsmouth, VA | CVOW | 2,640 | 2026 |
| Tower, Transition Piece | Marmen Welcon | Port of Albany, NY | Empire Wind 1 & 2 | 2,076 | 2026/27 |
| | | | Beacon Wind | 1,230 | 2026 |
| | | | Beacon Wind 2 | 1,510 | 2029 |
| | TBA | Sparrows Point, MD | Skipjack 1 | 120 | 2026 |
| | | | Skipjack 2 | 864 | 2026 |
| Foundation | EEW | Paulsboro Marine Terminal, NJ | Ocean Wind 1 | 1,100 | 2024 |
| | | | Atlantic Shores 1 | 1,510 | 2027 |
| | | | Ocean Wind 2 | 1,148 | 2029 |
| | Sparrows Point Steel | Sparrows Point, MD | Momentum Wind | 808 | 2026 |
| Secondary Steel | TBA | ProvPort, RI | Revolution Wind | 704 | 2025 |
| | | | South Fork | 130 | 2023 |
| | Riggs Distler & Co. | Port of Coeymans, NY | Sunrise Wind | 880 | 2025 |
| | Ljungstrom | Wellsville, NY | | | |
| | Crystal Steel | Federalsburg, MD | Skipjack 1 & 2 | 984 | 2026 |
| | | | Ocean Wind 2 | 1,148 | 2029 |
| Array Cable | Hellenic Cables | Sparrows Point, MD | Skipjack 1 & 2 | 984 | 2026 |
| | Kerite | Seymour, CT | Park City Wind | 804 | 2026 |
| Export Cable | Nexans | Charleston, SC | Empire Wind 1 & 2 | 2,076 | 2026/27 |
| | | | Mayflower 1 & 2 | 2,314 | 2027/28 |
| | Prysmian | Brayton Point, MA | Park City Wind | 804 | 2026 |
| | | | Commonwealth | 1,350 | 2028 |
| Onshore Cable | Southwire | Huntersville, NC | Vineyard Wind | 800 | 2023 |

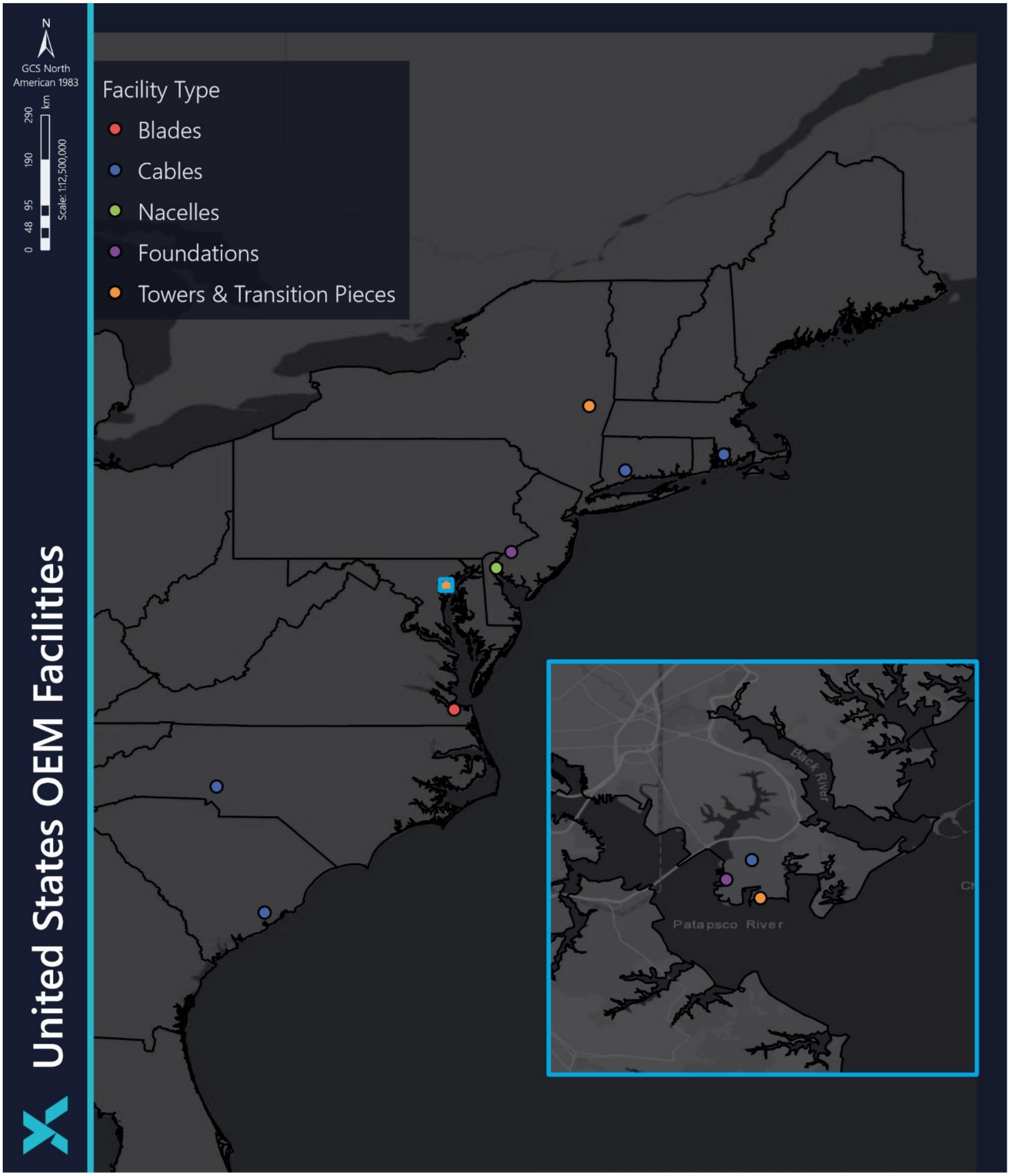


*Figure 2.4 - Location of US Tier 1 OEMs*

The locations of upcoming large-scale offshore wind manufacturing facilities have been influenced by a number of driving factors, including: the presence of existing infrastructure and/or availability of quayside area; explicit and implicit state local content goals; and the availability of financial support from project developers (including order book) and/or state agencies. While these facilities are yet to be established in time to supply the first commercial scale offshore wind projects in the US, the expectation is that the majority will be online around the middle of the decade and available to supply future projects along the US East Coast.

Figure 2.5 shows when US supply for various major components is expected to be contracted for projects in the pipeline with most of these being supplied domestically from around 2026. While the EEW monopile facility in Paulsboro, NJ will be supplying Ocean Winds 1 with an estimated COD as early as 2024, this could be delayed as they have not yet reached FID and construction has not yet begun. All four cable facilities are anticipated to be supplying projects with CODs in 2026. It is to be noted the two nacelle facilities at Wind Port, NJ are facilities for final assembly with major turbine subcomponents expected to be sourced from established suppliers in Europe. Vestas are anticipated to provide assembled nacelles in 2027 and GE in 2029.

Figure 2.6 shows the projected volumetric capabilities of the anticipated US OEM supply chain against the expected project demand, approximated through supplier press releases and commitments from project developers. Where there are spikes in demand beyond the estimated volumetric output of US facilities this indicates a likelihood that non-US supply will be required to meet the shortfall. In each supply element there is anticipated demand for additional US supply capacity, particularly around the time commercial floating offshore wind projects are expected to be developed. In the case of floating foundations this will almost certainly necessitate the use of alternative manufacturing infrastructure to that being used in the East Coast fixed offshore wind market. Array cable lengths for floating offshore wind projects will also require dynamic sections not supplied for fixed foundation offshore wind projects.

Where there are times when it appears the US supply capacity is sufficient to meet project demand this does not necessarily make a case for no new additional manufacturing to be established in the US. In the more mature European offshore wind market there is overcapacity for manufacturing of elements where facilities can also be utilised to support other industries (such as European cable suppliers also providing interconnector cables for subsea transmission and distribution between and within European states). Typically, a market can support multiple suppliers operating below full capacity at all times and doing so enables cost reduction through competitive pricing to secure orders. Given the US project pipeline is also anticipated to grow from that shown as additional future leasing rounds are defined, there is almost certainly opportunity for further US-based suppliers to the market to become established.

As has been seen with the initial announced East Coast offshore wind manufacturing facilities, the location of any additional future infrastructure will likely be driven by location of project demand alongside available financial support to mitigate risks of establishing a new facility. With upcoming offshore wind solicitation rounds in NY and NJ it is possible these states could see further OEM commitments ahead of other regions not yet procuring offshore wind generation capacity. A principle benefit of any potential regional collaboration initiative would be to pool manufacturing resources on a larger offering of total regional project capacity whilst also increasing efficiency and lowering the competitive tension between states to attract new facilities.


*Figure 2.5 – Current US project component demand timeline and currently anticipated US supply*

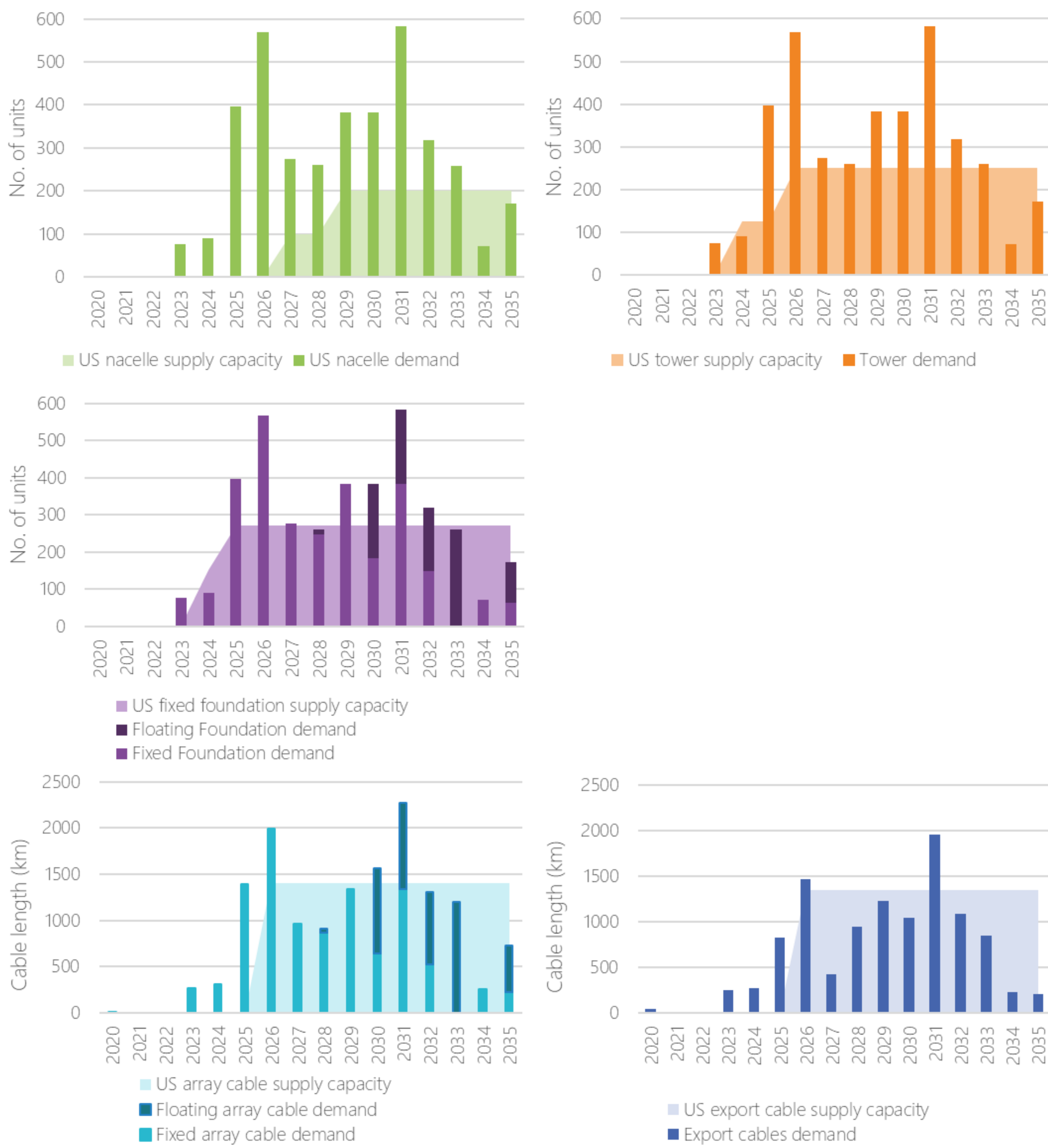


*Figure 2.6 - Future US component demand and estimated US-based volumetric supply capacities*

# 3 MAINE SUPPLY CHAIN OPPORTUNITY ASSESSMENT

With the US offshore wind project pipeline expected to continue to grow beyond 2030 with additions from new lease areas further supplier demand is anticipated. In the case of elements such as the supply, installation and O&M of turbines, towers and foundations this growth will be slightly less than directly proportional to project capacity over time as increasing turbine ratings allow for total project capacity to be met with fewer machines. In the case of subsea cables, the volume requirement will primarily depend on distance to shore (for export cables) and water depth (for array cables) in addition to project capacity. With future offshore wind projects anticipated to be installed further from shore and in deeper water depths the component demand can be expected to increase relative to project capacity. The requirement for project development services is generally proportional to the number of projects regardless of capacity.

The opportunity for Maine to attract additional suppliers to the state will depend on the position of their specific product or service within the wider US offshore wind supply landscape. Porter's five forces framework is a tool for assessing the competitive intensity, and therefore attractiveness, of a business within a market. This type of analysis enables identification of risks and barriers to success for companies attracted to a new market and considers five primary forces that influence opportunity for success.

**Industry rivalry**

Typically, the intensity of competitive rivalry is the biggest determinant of the competitiveness of an industry. An organization must be aware of its competitors' capabilities, strategic approach and pricing and also be reactive to any changes made. Rivalry among competitors tends to be fierce and industry profitability low. Potential factors include:

- Sustainable competitive advantage through innovation
- Powerful competitive strategy (low-cost vs differentiation)
- Market share

**Threat of new entrants**

New entrants put pressure on organizations within an industry through their desire to gain market share. This in turn puts pressure on prices, costs, and the rate of investment needed to sustain a business within the industry. The threat/opportunity of new entrants is particularly intense if they are diversifying from another market where they can leverage existing expertise, cash flow, and brand identity.

This can also be measured in terms of barriers to entry. Barriers to entry restrict the threat of new entrants. If the barriers are high, the threat of new entrants is reduced and conversely if the barriers are low, the risk of new companies venturing into a given market is high. Barriers to entry are advantages that existing, established companies have over new entrants.

- Capital requirements
- Government policy
- Customer switching cost

- Supply-side economies of scale (spreading fixed costs over larger volume of units)
- Demand-side benefits of scale (network effect, buyers' willingness to purchase increases with other's willingness to purchase)
- Incumbency advantages independent of size (e.g., customer loyalty, brand equity)

**Threat of substitutes**

A substitute product uses a different technology to try to solve the same economic need. Potential factors include:

- Buyer propensity to substitute
- Relative price performance of substitute
- Buyer switching costs
- Perceived product differentiation
- Number of substitute products
- Availability of close substitutes
- Ease of substitution

**Supplier bargaining power**

Suppliers of raw materials, components, labor, and services (such as expertise) to the firm can be a source of power over the firm when there are few substitutes. Suppliers may refuse to work with the firm or charge excessively high prices for unique resources. Potential factors include:

- Supplier to buyer switching cost ratio
- Differentiation of inputs
- Impact of inputs on cost and differentiation
- Presence of substitute inputs
- supplier concentration to buyer concentration ratio

**Buyer bargaining power**

The bargaining power of customers is the ability of customers to put the firm under pressure. Buyers' power is high if buyers have many alternatives. It is low if they have few choices. Potential factors include:

- Buyer to supplier concentration ratio
- Bargaining leverage
- Buyer switching costs
- Buyer information availability
- Differential advantage of industry products
- Buyer price sensitivity
- Availability of substitutes

## 3.1 Project Development

**US supply landscape**

Project development services for US offshore wind projects have been undertaken to date by a combination of US and European based companies. The US capability to support offshore wind developers in the development phase of the project comes from a deep-rooted experience in supporting large civil infrastructure and energy infrastructure projects onshore, such as in onshore wind, solar and natural gas. In some areas of supply, such as support with permitting, legal or environmental assessment, there is an advantage to having experience of US-specific requirements that the European supply chain has not yet gained. This is where companies with presence in Maine in particular have already gained track record in supporting US offshore wind projects and are well placed to continue providing services.

While US companies with the capability to support project development typically have presence across the country, there are a high number based in the northeast due to the higher initial concentration of offshore wind projects in the region. A number of US companies, including those with presence in Maine, have supported projects development from assisting with Site Assessment Plans (SAPs) and Construction and Operations Plans (COPs) through to owners engineering and permitting advisory.

The industry has seen large multinational survey companies enter the US offshore wind market in the very early stages and dominate the large site investigation scopes with support for smaller nearshore and environmental focused scopes provided by US companies (including Maine companies). Once project demand increases in the longer term, the US based fleet is expected to develop track record and capability, either via their own internal investment or through European companies relocating and/or partnering in the US.

While many project development services have no logistical barriers to supply (i.e. can theoretically be performed just as capably from anywhere in the word), it is likely there will be increasing US based supply and less reliance on services from Europe to support future US projects. This will occur either through existing US companies that are working in adjacent industries transitioning into the offshore wind market or from experienced European suppliers relocating to better establish a presence in the US close to their customers.

**Industry rivalry**

Companies with a presence in Maine have already been successful in capturing market share of project development services, primarily in permitting and environmental assessment. Differentiation for Maine companies against competitors therefore can come from experience and track record in supporting the offshore wind industry. The opportunity for innovation in these services may come from streamlining processes and development of tools for efficiency that enable iterations and updates to project design to be undertaken faster.

Where Maine companies do have experience in supporting offshore surveying and project engineering and design services (particularly in the floating wind market) there is strong competition from both other US and European companies in these areas.

### Threat of new entrants

The barriers to entry are relatively low in terms of cost for most project development services, where permitting and project management services are similar in other infrastructure and energy sectors and the primary cost resource is people rather than equipment. However, project developers aren't tied to their suppliers for these services beyond supplying the scope of a single project, so there is little to no cost for customers to switch to new suppliers where they are available entering the market.

### Threat of substitutes

There are few substitute technologies available to threaten suppliers of project development services. Technical differences and innovations in seabed surveying may necessitate companies offering offshore surveying to reinvest in equipment and techniques.

### Supplier bargaining power

Suppliers to companies offering project development services are typically offering expertise where it is unlikely there will be a bottleneck in availability.

### Buyer bargaining power

The primary bargaining power for project developers is the number of alternative companies offering project development services, enabling cost competition amongst suppliers.

### Maine opportunity to attract

The early opportunity for Maine suppliers of project development and permitting services arises where these can be provided by non-local suppliers with negligible logistical barriers. Where states have inexperienced local supply chain to support project development, Maine companies with experience have a good opportunity to supply. As these services represent lower project spend and job creation relative to heavy manufacturing there is perhaps less onus on developers to have this spend be local on a project-by-project basis, and thus more opportunity for Maine-based companies to support non-Maine projects.

Supply areas where companies based in Maine could readily supply the wider US market (and in some cases already do) could include:

- Wind farm project and component FEED and detailed design where US suppliers lack offshore wind specific experience.
- Project and package management, including specialist software.
- Data interpretation and risk assessment, including specialist software.
- Environmental surveying and assessment of environmental data.
- Metocean surveying and study including subsea surveying and wind measurement campaigns and analysis.
- Project support services including legal and financial advisory and contracting, procurement and recruitment services.

## 3.2 Turbine Supply

### US supply landscape

While the US offshore wind supply chain currently lacks dedicated offshore wind turbine and blade manufacturing facilities; early commercial projects will be supplied from existing European plants. Two of the three major turbine OEMs appear committed to establishing nacelle assembly facilities in NJ with the third likely to select a state with a high-volume project pipeline should they commit to a US facility.

Although no large-scale offshore wind blade manufacturing facilities currently exist in the US, SGRE have announced a blade finishing facility in VA in partnership with Dominion Energy to open in 2024/25 ahead of supporting the commercial scale CVOW project. MA is also looking to leverage the presence of a blade testing facility in the Port of Boston to attract a blade manufacturing plant to locate nearby.

Towers for US projects are expected to come from European or Asia-Pacific (APAC) suppliers until US supply can be established to meet demand. A joint venture between Marmen and Welcon has agreed to set up a facility to fabricate towers and transition pieces in the Port of Albany on the basis of NYSERDA selecting Equinor and BP's solicitation bid. Ørsted has also committed to supporting the construction of a tower facility in MD (likely at Sparrow's Point) in support of the Skipjack project. The US also has established domestic onshore wind tower supply chain (Ventower, MI and Broadwind, WI and TX) although further investment will be required to upgrade capability to produce offshore towers. Future US demand may still be met by towers from lower cost APAC suppliers.

### Industry rivalry

Strong competition between the three major turbine OEMs means significant sums are spend on constant innovation in this space, particularly the drive to increase turbine ratings and thus power output per device. The exacting requirements for component supply means there are typically a low number of approved Tier 2 suppliers for each turbine OEM.

The limited opportunity for tower suppliers to develop competitive advantage though innovation has led to competitive strategies based on lowest cost supply. This has resulted in low margins in towers supply that has forced some manufacturing facilities in Europe to be mothballed when their order books reduced.

### Threat of new entrants

High capital requirements, including the need for continuous world-leading R&D, make entering the turbine supply market prohibitive. For a component supplier to disrupt an established turbine supply chain would require an innovation that presents significant cost savings to the OEM as turbine platforms are hugely complex and take several years to process design iterations.

While the barriers to entering the towers market are lower, suppliers are unlikely to be able to amortize the cost of investment in facilities over a low number of orders and so entrants will need to have confidence and visibility of an order pipeline.

### Threat of substitutes

Alternatives to conventional three-bladed horizontal axis wind turbines have failed to reach technological maturity. Some established turbine components may be challenged by future innovations such as ferrite magnet generators and textile-based blades, though these would necessitate some redesign of the wider turbine system or moving on from established suppliers who the turbine OEM has invested in.

Potential future substitutes to conventional offshore wind towers include those made from alternative materials (e.g. concrete) or different manufacturing processes (e.g. spiral extrusion eliminating need for steel plate).

### Supplier bargaining power

Turbine OEMs have a limited and tightly controlled supply chain with little propensity to substitute Tier 2 companies beyond tower supply which is typically turbine technology agnostic. Tower supply is sensitive to the cost of steel plate as an input material.

### Buyer bargaining power

The low number of alternative suppliers for turbine components mean turbine OEMs generally have lower power to influence costs. The need for strong order books amongst competing turbine OEMs to cover the cost of continuous R&D investment prevents high margins being passed to project developers.

### Maine opportunity to attract

There is limited opportunity for to attract turbine component suppliers to Maine to export to the wider US market. Turbine component supply chains have a very limited number of qualified suppliers. While these may need to eventually become established in the US there is not currently a demand while nacelle assembly facilities have yet to be constructed. There are several suppliers of main turbine components established in the US serving the onshore wind market who may be better positioned to transition to support offshore projects from their existing facilities rather than establishing new facilities.

While the US can't yet satisfy the total project demand for offshore wind blades and towers from domestic suppliers it is likely additional facilities will be developed in the years ahead in states with significant project pipelines and financially backed ambitions to secure manufacturing content. There is likely opportunity for three US offshore wind blade manufacturing facilities (one per major OEM) that may, but do not need to, be co-located with nacelle assembly facilities.

## 3.3 Balance of Plant

### US supply landscape

While some announcements have been made around establishment of US facilities to support monopile foundation, inter-array cables and export cables manufacturing, it is likely some project demand will also still be met through supply from Europe and APAC.

EEW have reached FID on plans for a monopile facility in Paulsboro, NJ. However, it remains unclear what level of manufacturing will be carried out at the plant while the US lacks capability to produce offshore grade steel plate at the required thickness for turbine monopile foundations. Although jacket foundations tend to create higher opportunities for local content due to the increased labour demand in manufacturing and assembly, these are not currently anticipated to be used with near-term US offshore wind projects due to monopiles being the preferred solution in the water depths where these projects will be installed. There are currently no quayside facilities established for the serial production of any form of floating foundation platform.

The supply of subsea cables on early US offshore wind projects will likely be entirely from European facilities, including: JDR Cable (UK), supplying both the Vineyard Wind and US Wind projects; Hellenic Cables (Greece), supplying inter-array cables for Mayflower Wind; and Prysmian (Italy), supplying export cables to Vineyard Wind and array cables to Empire Wind. However, most of these suppliers including Hellenic Cables, Nexans and Prysmian have now committed to US-based array and/or export cable facilities to support projects in the future.

Offshore substation electrical infrastructure supply is expected to come from established supply in Europe while there is no specialist supply chain capability established in the US. The first contracts for Vineyard Wind and Mayflower projects have been awarded to European suppliers Bladt and Semco Maritime with sub-supply of electrical components coming from their established European supply chain.

Offshore substation foundations are likely to be supplied from fabrication yards in Europe, the Middle East or the US Gulf of Mexico. US suppliers working in the oil and gas sector, such as Gulf Island Fabrication, Keppel AmFELS, Kiewit and Dynamic Industries, may be better suited to offshore substation foundation fabrication than turbine foundations due to the one-off nature of the supply analogous to structures required in oil and gas. The capability to supply in the US Gulf of Mexico should be sufficient to meet the needs of the US offshore wind industry without the requirement for further facilities on the east coast.

### Industry rivalry

Each of the major fixed foundation project balance of plant components has a healthy number of global suppliers and in most cases multiple suppliers also announced to be investing in US manufacturing facilities. Due to the large scale, complexity, time consumption and expense of orders in combination with industry requirement to meet demand from multiple projects concurrently there consistently a need for several suppliers to be fulfilling orders at the same time. This does not reduce competition between suppliers however, as large manufacturing facilities need to maintain a minimum level of operations to remain economically viable. This is particularly relevant in a consistently developing offshore wind sector that requires suppliers to be making inward investment to keep up with evolutions in scale and technology innovation.

Due to the nascency of the floating offshore wind sector that has not yet delivered commercial scale projects, market leaders in many floating wind specific components are still to emerge. While there are a range of floating foundation designs being tested for the market, few have been considered with the capabilities of a specific manufacturer to deliver in mind, and no fabrication yards have been established with a primary focus on serial manufacturing of floating foundations. Similarly, dedicated manufacturing facilities to meet the anticipated future demand for a range of anchor and mooring line types do not yet exist.

### Threat of new entrants

Barriers for entry for Tier 1 suppliers are high due to the capital investments needed in facilities. Typically these suppliers have transitioned from, or are still, supporting adjacent industries alongside offshore wind. The political pressure in US for local content has enabled US companies to enter offshore wind earlier via joint ventures or partnerships with experienced non-US suppliers.

In many cases the barriers for entry for lower tier suppliers are reduced, such as for those providing secondary steel, but companies may still need to invest to produce at the scale and volumes required in offshore wind.

### Threat of substitutes

Depending on project and site characteristics there may be substitute technology options available in foundation choice and material, cable voltage and type of transmission (high voltage alternating current (HVAC) or direct current (HVDC) export transmission) that would rule out some suppliers from projects.

While the floating foundation market has not coalesced around a single or small number of platform designs, technology choice will be made from a range of competing alternatives where the final decision may influenced by the capabilities of local supply chain or available quayside infrastructure.

### Supplier bargaining power

While many Tier 1 balance of plant contracts are supported by a range of Tier 2 and below suppliers there are typically substitute providers for most products and services. Prices are subject to fluctuations in the cost of commodities that may not affect all suppliers equally.

### Buyer bargaining power

The availability of multiple suppliers at all tiers of the supply chain for each balance of plant element keeps costs competitive. In the US, implicit or explicit pressure to use local supply where possible can enable some suppliers to retain reasonable margins against lower cost non-US supply.

### Maine opportunity to attract

There is a gap in the US market for facilities to provide floating wind balance of plant components where there may be logic in attracting those suppliers to Maine. While it is currently unlikely a specialist facility for the serial production of floating foundations will be established similar to those established for the production of fixed monopile foundations, there could be an opportunity to use existing Maine suppliers to provide project design, construction management, logistics and workforce to deliver floating foundations from Maine should suitable quayside area to enable fabrication or assembly be realized.

Commercial scale floating projects will uniquely require significant volumes of mooring lines that could be an opportunity to attract a supplier to Maine. While not a requirement until a US pipeline of commercial scale floating wind projects emerges, there could in future be demand for a supplier of synthetic mooring lines to establish a US-based manufacturing facility.

Other supply areas where companies that chose to base in Maine could readily supply the wider US market could include:

- Design and supply of anchors and mooring line connectors
- Buoyancy modules
- Design and manufacture of davit cranes.
- Cable protection
- Cable ancillaries
- Testing, jointing and termination
- Control and monitoring systems
- Support to US suppliers of onshore electrical equipment to marinize for the offshore environment

## 3.4 Installation

**US supply landscape**

The installation strategy for US offshore wind projects will be dependent on the availability of Jones Act-compliant vessels to meet market demand. Dominion Energy has commissioned the first Jones Act-compliant turbine installation vessel, currently under construction at Keppel AmFELS Texas shipyard and expected to be available to support US offshore wind turbine installations by the end of 2023. For early US projects a feeder barge strategy to transport components staged at a nearby construction port to a non-US vessel waiting at the project site is currently the preferred solution for turbine and foundation installation. Other components such as subsea cables and the offshore substation can be installed directly from the manufacturing sites without the requirement to be staged at a US port. For the installation of floating foundation platforms there is currently a lack of operational US-flagged anchor handling tugs.

As more US-built, owned and operated vessels become available to support US offshore wind project installation at the same time as US manufacturing ramps up there will be less reliance on the European supply chain. The majority of established Tier 1 installation vessel and EPCI contractors in Europe have made commitments to enter the US market and several US marine construction companies have stated ambitions to transition into the offshore wind sector.

Early offshore wind projects navigating the Jones Act requirement has restricted US port staging and marshalling opportunities, where the first projects are likely to receive some components from overseas without ever reaching US mainland. However, several US ports have seen significant investment commitments in anticipation of being used to support manufacturing and installation of offshore wind components. Expected project development between now and 2030 will likely require multiple ports per region to meet installation demand. Investment in US East Coast port facilities to support installation staging includes the New Bedford Marine Commerce Terminal and Salem Harbor (MA), Port of Bridgeport and Port of New London (CT), ProvPort (RI), South Brooklyn Marine Terminal (NY), Wind Port (NJ), Tradepoint Atlantic (MD) and the Portsmouth Marine Terminal (VA).

**Industry rivalry**

A range of suppliers operate in the offshore installation sector where a current lack of Jones Act compliant installation vessels has played a role in ensuring no single supplier currently dominates the US market. To provide a more cost competitive solution in the mature European offshore wind market many of the major Tier 1 installation suppliers took on EPCI roles, carrying the risk of component supply within the scope of their own installation contracts based on understanding of, and confidence in, the experience of OEMs. This approach has not yet been seen in the US market where US OEMs have not yet been tested on their ability to deliver to time and budget.

**Threat of new entrants**

The barriers to entry in offshore installation are high given the cost of commissioning and operating specialist vessels. Most aspects of the onshore construction scope however can be carried out by civil engineering contractors working in infrastructure.

**Threat of substitutes**

The primary substitute in offshore wind installation is in floating projects where there is an opportunity to integrate the turbine with the foundation at quayside that can eliminate the need for a heavy lift vessel.

**Supplier bargaining power**

The most common expenditure on suppliers are for generic marine and mobilization services common across industry.

**Buyer bargaining power**

There are a limited number of suitable heavy lift vessels available to the US market capable of installing the increasing scale of offshore wind turbines. While installation suppliers are motivated to keep their fleets operational, the increased rate of offshore wind project installation required over the next decade may put a strain on the availability of suitable vessels globally. Similarly, it is anticipated there will be a bottleneck in the number of suitable installation staging ports, particularly on the US East Coast, available to support the construction of the planned pipeline of project capacity.

**Maine opportunity to attract**

The predominant opportunity in Maine to support the installation of offshore wind projects appears to be in developing port facilities for staging and marshalling of components. Utilizing Maine ports in support of fixed offshore wind projects will depend on the development of the US East Coast market and actions taken in other states to develop overflow port laydown areas.

Supply areas where companies that chose to base in Maine could readily supply the wider US market could include:

- Design and supply of handling and installation equipment for turbine, foundation, anchor, moorings and cable installation

- Marine coordination, logistics, offshore operations and installation project management services and software
- Marine warranty and owners engineer services
- Subsea engineering and inspection equipment and services
- Specialized installation services (e.g. grouting, marinized equipment)
- Ports advisory for staging and marshalling, component and equipment handling, etc.

## 3.5 Operations and Maintenance

**US supply landscape**

With few operational offshore wind projects in US waters there has been limited opportunity for supply of operations and maintenance services to date. It is anticipated that supply of O&M will follow a similar approach to elsewhere in the world where the cost of mobilisation and need to respond quickly to maintenance and repair to reduce asset downtime means most O&M services will be sourced locally where possible. As close proximity to the project for O&M is a necessity, several hubs are expected to form along the US East Coast.

The RI marine industry has already produced two CTVs specifically for the offshore wind sector, both designed and manufactured in RI. The first US SOV is currently under construction for long-term charter to service Ørsted and Eversource’s planned Revolution Wind, South Fork Wind and Sunrise Wind offshore wind farms in the northeast region.

**Industry rivalry**

The breadth and depth of offshore wind project operations services combined with the 25+year lifetime opportunity for suppliers means there are a wealth of companies covering a range of specialisms with the capability to offer support. Innovations that increase turbine availability or operational efficiencies even to a small degree are highly valuable over the course of a 25+year project lifetime. Competitive advantages can also be found when products or services can be demonstrated to increase safety in O&M work.

**Threat of new entrants**

Once suppliers are established and providing O&M services to operating projects there tends to be an incumbency advantage that makes it challenging for new entrants to disrupt. In some cases project developers sign long-term inspection, repair and maintenance agreements where the opportunity for new suppliers would be as a subcontractor to the primary provider. However, the cost of entry for supplier providing services in an adjacent offshore industry or to transfer skills from the onshore to offshore environment is relatively low.

**Threat of substitutes**

There are a range of operations software providers available to the market, though project operators are unlikely to readily switch software solutions during project operations unless an alternative provides a tangible cost benefit. In inspection, repair and maintenance replacing the need for humans to work in the offshore environment, such as through autonomous and/or robotic inspection, is seen as advantageous.

#### Supplier bargaining power

Suppliers to companies offering O&M services are typically offering expertise where it is unlikely there will be a bottleneck in availability.

#### Buyer bargaining power

In a mature offshore wind market there are likely to be a number of capable suppliers of a range of O&M services.

#### Maine opportunity to attract

Supply areas where companies that chose to base in Maine could readily supply the wider US market could include:

- Training and certification services for offshore workers
- Operations support including control room and condition monitoring equipment and software
- Data and digitalisation services including data interpretation, machine learning and AI, digital twins
- Automated and unmanned inspection services including UAVs, AUVs, etc.
- Subsea inspection services and equipment including ROV surveying
- Inspection and equipment
- Turbine access systems
- CTV and SOV design, build, operation and equipment supply

## 3.6 Summary

The opportunity for Maine to attract offshore wind companies to the state is likely to be predominantly where future demand for floating components is not being met in supply from other states. Several offshore wind industry OEMs have announced plans to develop manufacturing facilities on the US East Coast to serve the initial fixed foundation market and it is likely additional investments will be made in further facilities than result in native US suppliers having capacity to meet most of the demand. The majority of these components will also be applicable to the future floating offshore wind market. However, there is a gap in known location of floating specific component supply, including sufficient volume of mooring lines, anchors and floating platforms for a pipeline of commercial scale projects.

Table 3.1 summarizes the level of risks and barriers to companies attracted to entering a new market. A high-medium-low scoring system has been used to describe the level of potential concern for entrants in each supply chain element in each of the five forces. The size of the global offshore wind sector has resulted in a healthy, competitive supply chain in the majority of required component products and services. The opportunity for Maine to attract these suppliers will depend on their product or service offering and whether these can be supplied from a state outside the location of the project with little or no additional cost.

In project development services there could be potential for suppliers to be interested in locating in Maine. In this area it will be vital to balance any support for new suppliers to locate in Maine with support to the existing suppliers already located in the state who are already successfully providing services to US offshore wind projects. The key challenge for suppliers in this market segment is the high level of competition, thus enabling project developers to expect competitive pricing. Competition is high partly due to the services required also being found in other industries, where cost barriers to entry being relatively low mean there is also threat of new entrants from adjacent sectors increasing competition further in the future. For companies located in Maine looking to provide project development support to offshore wind projects the ability to support other sectors with similar services will be necessary for sustained business, particularly as project developers can readily switch between suppliers for new projects. Consideration will need to be given to how much work can be won in adjacent sectors in addition to the opportunity presented by the growth of the US East Coast offshore wind market.

*Table 3.1 - Summary of supplier market attractiveness assessment*

| Supply Element | Industry rivalry | Threat of new entrants | Threat of substitutes | Supplier bargain power | Buyer bargain power |
|---|---|---|---|---|---|
| Development and permitting | High | High | Low | Low | High |
| Surveys | High | Low | Low | Low | High |
| Engineering & design | High | High | Low | Low | High |
| Project management | High | High | Low | Low | High |
| Nacelle | Low | Low | Low | High | Medium |
| Rotor | Low | Low | Low | Medium | Medium |
| Tower | Medium | Medium | Low | High | High |
| Foundations | Medium | Medium | Medium | High | Medium |
| Export and array cables | Medium | Low | Low | Medium | Medium |
| Anchors and moorings | Low | Medium | Medium | High | Low |
| Offshore substation | Medium | Low | Low | Medium | Medium |
| Turbine / Foundation installation | Medium | Low | Medium | Low | Low |
| Subsea cable installation | Medium | Low | Low | Low | Low |
| Anchors and mooring installation | Low | Medium | Low | Low | Low |
| Onshore construction | High | High | Low | Low | High |
| Ports and logistics | Medium | Medium | Low | Low | Medium |
| Operations | High | Medium | High | Low | High |
| Inspection, maintenance & repair | High | Medium | Medium | Low | High |

The turbine supply market is unlikely to attract suppliers to Maine. The offshore wind market supports a low number of highly specialized nacelle and rotor OEMs who are highly likely to establish manufacturing facilities in US East Coast states with significant project pipelines. The Tier 2 supply chains for these elements are also largely highly specialized with some components single-sourced. The cost of research and development is high and presents a risk to both suppliers and OEMs. Where there are opportunities for new entrants to become suppliers to turbine OEMs, should they be looking to set up in a new location they may be more likely to establish their presence close to their customer base. Similarly, the US offshore wind tower supply market is likely to be established ahead of Maine developing a project pipeline and the opportunity for Tier 2 supply of secondary steel and other components is likely to be contracted with local suppliers.

An attractive opportunity for new entrants may be in balance of plant components unique to the floating wind market where there is currently less established competition and more room for innovation and differentiation based on skills and experience, rather than lowest cost solution. For companies in the floating foundation, anchor and mooring supply chains a key challenge however, is the current diversity of the technology landscape. Dozens of floating foundation designs are in development each with differing strengths and weaknesses regarding characteristic including structural performance, ability to be manufactured at scale and volume, ability to be manufactured or assembled using localized workforces, and ultimately, cost. Variability in ground conditions and water depths across leasable seabed areas may necessitate a variety of anchor and mooring solutions in the industry. These can present similar risks to Tier 2 and below companies with uncertainty in supply requirements presenting a threat that substitute products are a preferable match to specific foundation, anchor or mooring technology choices.

A key opportunity has been identified for Maine ports to support installation staging of US East Coast projects as well as fabrication, assembly and turbine integration of floating foundation projects. The primary challenge for any US East Coast port facility building a business case for investment is understanding their competitive landscape against the industry demand. The logistical benefit of having staging take place at ports nearby to the offshore site combined with the opportunity for local content creation in the state purchasing the electricity means the current pipeline of US projects will likely look to consider other east coast ports as a preference. While bottlenecks in port availability caused by a projected large volume of capacity buildout will likely require consideration of the use of out-of-state port facilities several other US and Canadian locations will be competing to secure contracts.

In the operations and maintenance phase there are services that could be provided to the wider US East Coast and beyond offshore wind market from Maine, particularly in areas such as data and digitalization service provision for wind farm control and operation optimization where a supplier's competitive offering can be based more on innovation than price and there is little competitive disadvantage from being located far from the project site. This, however, also means that competition can be global. The opportunity to attract and/or develop supply chain capability in Maine in operations and maintenance may therefore also be greater in areas specific to floating offshore wind where there are fewer experienced competitors.

# 4 SUPPORT TO MAINE ORGANIZATIONS AND OFFSHORE WIND DIVERSIFICATION

## 4.1 Introduction

Interviews were conducted with industry leaders in Maine offshore wind, renewable energies, innovative technologies such as artificial intelligence and machine learning, and design and construction. These interviews exposed key opportunities and specific challenges to developing the offshore wind industry in Maine. From the information gathered in these interviews, recommendations were developed for Maine to mitigate these challenges. The sections below detail these opportunities and challenges, and lay out recommendations related to market development, policy, investment, and innovation that will support a nascent and growing offshore wind industry in Maine. A self-assessment capability audit for engaging Maine companies not active or aware of opportunities in offshore wind is given in Appendix A.

## 4.2 Output from Engagement

This section highlights critical insights gathered from engagement with industry leaders and highlights key challenges to implementing offshore wind in Maine.

### 4.2.1 Market Development

Maine has the potential to play a significant role in the offshore wind industry, although it faces challenges both in terms of its current industrial capacity and available workforce. The key overarching obstacle to a robust offshore wind economy in Maine is the lack of a pipeline of projects. Interviewees noted numerous times that without a project in development, it is difficult and costly for existing firms to pivot toward offshore wind needs, or for new firms to launch into this industry. It is similarly difficult to launch workforce training programs or draw students into related degrees without a more solid guarantee of employment.

Maine has a rich history and strong existing economy in ship-building and maritime logistics. Maine is also well-positioned proximate to the New England and Mid-Atlantic regions which are the current centers of offshore wind development in the US. Maine enjoys a low cost of living, and proximity to Boston and to Europe relative to the rest of the East Coast, making it attractive to some companies looking to site their businesses near existing offshore wind hubs.

High financial costs are a major barrier to businesses looking to enter a new industry. Uncertainty around future revenues; lack of clarity around supply requirements; and the related costs for infrastructure, operating and maintenance, electrical, and components all create obstacles for Maine-based businesses interested in entering the offshore wind industry. In addition, US-built industrial components are expensive compared to similar components built elsewhere. For example, steel fabrication in the United States can cost three times as much as in Europe and Asia.

Industry leaders we spoke with report that, if given the choice, a Tier 1 supplier or developer will often choose to bring components in from abroad rather than purchasing ones built in the US. In practice, this can be as much a preference for working with proven suppliers as it is about reduced costs.

Maine colleges, universities, and technical schools train students for work in existing engineering, maritime, and renewable energy industries. Other Maine industries (for example, farming, logging, and fishing) have given workers skills that can potentially be applied to landside and maritime aspects of the offshore wind industry. With these other industries shrinking in Maine, there is an opportunity to transition these workers into offshore wind.

Before offshore wind projects can move into the construction phase, they first must complete work around development and permitting. This phase will be the first opportunity for Maine businesses to support the offshore wind industry. Required services during development and permitting include fishery surveys, avian surveys, and geophysical analysis. Supporting businesses that offer these types of professional services will help them immediately take advantage of new offshore wind industry developments. One challenge to be aware of is the fact that Maine companies do not benefit from being considered local when they serve as suppliers to non-Maine projects – this means they must compete on cost and quality alone.

### 4.2.2 Policy

The opportunity for Maine to develop floating offshore wind projects as a source of renewable energy is bolstered by the support of the current Governor's administration. Despite this support, there remain challenges to the certainty of the opportunity including pushback from existing stakeholder users of the waterfront and ocean, longer-term uncertainty from the potential for government administrations to change or shift priorities, a lack of industry specific support to companies interested in entering the offshore wind economy, and misinformation around the socioeconomic and environmental impacts of renewable energy developments. Furthermore, existing and potential future firms in Maine cite a perception that federal and/or state regulations are confusing to follow and that they create a complex process for entering and thriving in the offshore wind industry.

### 4.2.3 Investment

Maine's current port infrastructure is not yet positioned to best support the implementation of offshore wind. It will be critical for Maine to develop appropriately sized quayside infrastructure in order to provide needed support and services to an emerging offshore wind industry. The port of Searsport is being considered as an option to serve as a hub for offshore wind activities and investments due to its abundant available space, connectivity to other population centers along the coast of Maine, and skilled laborers who formerly worked in now-shuttered industries in the area. Searsport has already been the launch site for the floating wind demonstration project led by the Advanced Structures & Composites Center at the University of Maine. For these reasons, Searsport has been identified as Maine's premier option for staging and marshaling offshore wind components. Other Maine ports may also benefit from investment to become better placed to support the offshore wind industry. Opportunities for other ports may include hosting manufacturing infrastructure, vessel construction, and as O&M bases for future projects in the Gulf of Maine.

One major obstacle cited in interviews is the low housing stock available near Searsport. As the State invests in bringing the port of Searsport in line with the needs of offshore wind developers, there must also be a plan for developing additional housing that will be necessary for staff.

### 4.2.4 Innovation

Maine is home to many academic institutions that focus on advanced technology, such as the Roux Institute and its affiliated Institute for Experiential AI, and world class universities like University of Maine. There are additional opportunities for collaboration and knowledge sharing regionally with the many academic institutions in New England and down the East Coast. Maine-based programs in innovative technologies such as artificial intelligence, data science, machine learning, and robotics are already training students to translate these technologies to the needs of existing and emerging renewable energy industries.

These institutions are already looking to solve some of the biggest problems facing the offshore wind industry in Maine. The University of Maine has developed a floating wind demonstration project that could allow for offshore wind projects to be sited in the Gulf of Maine. This innovation has potential applications on the West Coast as well, where the use of floating wind would allow states to site turbines locally. However, developers already working on projects along the East Coast currently see additional lease space still available where it is possible to utilize fixed bottom turbines. This significant volume of fixed offshore wind capacity will be developed ahead of the first commercial-scale floating projects.

## 4.3 Recommendations

The following recommendations were developed out of the insights gathered from conversations with industry experts. The recommendations below seek to position the state of Maine to foster and grow offshore wind projects, and the businesses and workforces that are needed to support them.

### 4.3.1 Market Development

- Identify a specific group to implement statewide economic development programs and to focus on attracting new and existing companies to Maine. This could be a workstream within the Maine Governor's Energy Office. This group should identify what Maine companies can offer and where they add value and bring that information to potential developers and Tier 1 suppliers. This agency should be tasked with connecting directly with local companies to help them understand what opportunities will be available in offshore wind, explain what certifications or permitting will be necessary, and offer them technical assistance. Tiered supply chain intervention programs have been successfully deployed in other regions to provide differing levels of support appropriate to the needs and current capabilities of a diverse group of suppliers with the potential to transition into the offshore wind sector.
- Promote the capability of Maine firms to provide the specific services needed during the development and permitting phase, as the first phase in offshore wind development. These businesses can become a showcase for Maine firms' ability to support the offshore wind industry.

- Work with developers to understand where they experience gaps in their supply chains and identify Maine-based firms that could diversify their offerings to fill those gaps.
- Develop and define an offshore wind power procurement strategy than provides visibility of the route to market for an upcoming project pipeline to developers, suppliers and industry stakeholders to enable and de-risk investment.
- Focus on engagement and partnerships with critical stakeholders in the offshore wind industry. Developing a stakeholder engagement strategy is essential to aligning all members of the industry behind the same objective to cohesively move offshore wind implementation forward, ensure sustainability of projects, and foster community stewardship.
  - Industry associations could offer courses to prepare companies for certifications required for work in the offshore wind industry.
  - Community-based workforce organizations could develop specific trainings for roles in the offshore wind industry, and run recruitment events in partnership with Maine companies entering the industry.
  - Academic institutions could develop additional offshore wind skill-based curricula and certification programs as well as host career fairs with Maine offshore wind companies.
  - Environmental justice organizations could promote project benefits to the communities they represent, and offshore wind developers could partner with these organizations to target new investment into such communities.

### 4.3.2 Workforce

- Invest in technical schools and training. These offer training for in-demand, well-paying jobs without the higher cost of four-year college tuition.
  - Create state-funded grants for technical schools that offer training in trades identified as necessary for the offshore wind industry (ex. welders, electricians). These skills can also be applicable more widely to other industries.
  - Develop scholarships for students pursuing trades identified as critical to the offshore wind industry.
  - Begin a public relations campaign to tout the benefits of technical trades, to draw more people to them and reduce any stigma associated with pursuing these careers.
- Work with academic institutions to understand how existing programs and training can be expanded to include the needs of the offshore wind industry. For example, identify the specific safety regulations associated with offshore wind operations and maintenance that can be added to existing training for safety around broader maritime logistics.

### 4.3.3 Policy

- Develop a long-term offshore wind implementation plan, connected to community needs, to navigate and mitigate offshore wind implementation challenges in Maine. It is essential to provide developers with a clear, long-term plan to promote trust in a future project pipeline. In addition, this will provide a framework so Maine can build a cost-competitive supply chain to compete with the market in Europe. Clear communication is needed to elucidate the process of getting from the current state to having projects in development. Closely related to this recommendation is the need to align offshore wind procurement policy with existing net-zero carbon reduction targets.

- Plan for simple and straightforward permitting processes for offshore wind development. This will require the coordination and cooperation of many government agencies.
- Connect with Maine based enablement organizations to expand their efforts to include the offshore wind industry. The opportunity to work in partnership with organizations such the Maine International Trade Center, Gulf of Maine Research Institute, Island Institute, and New England Ocean Cluster could enable them to expand their services and membership to include the offshore wind industry. This can be done to positively raise the profile of offshore wind in Maine, expand connection of Maine companies to regional offshore wind projects, and generate knowledge and understanding for those companies for a future Maine-based offshore wind industry.
- Work with the Business Network for Offshore Wind (BNOW) to understand what resources they offer for existing firms looking to diversify their offerings to include offshore wind, and for new firms looking to launch in the industry.
- Consider incentives that the state of Maine could offer developers in exchange for signing purchasing agreements with Maine companies. As the offshore wind industry is in its infancy the first US-made components will likely be more expensive to produce than those procured from more mature markets. Financial incentives that help offset the cost premium associated with early projects will enable future project cost reduction and enable longer term sustainability of the industry.

### 4.3.4 Investment

- Work with developers to understand their critical needs for port infrastructure and services. Invest in and position Searsport as a bespoke site that meets the most up-to-date criteria for offshore wind project construction and staging, and consider investment in other Maine ports in order to be well positioned to exploit future opportunities in supporting offshore wind manufacturing, installation, operations and vessel construction.
- Create a plan for increasing the available housing needed by the offshore wind industry workforce.

### 4.3.5 Innovation

- Support research and development of floating wind arrays.
  - Connect floating wind array researchers and project developers with potential Tier 1 suppliers to understand what products and services will need to be developed or translated for floating wind.
  - Support floating wind researchers in identifying and applying for federal grants that support innovation.
- Foster programs that focus on AI, data science, machine learning, and robotics. Support academic institutions like the Roux Institute that partner with firms looking to integrate these innovative technologies into their work. Focus on training students to translate these emerging technologies into the fields of renewable energy and maritime construction and logistics, giving them experience that will translate to the offshore wind industry. Work with these institutions to develop research areas specific to the offshore wind industry.
- Connect leaders in these innovative technologies with those developing floating wind arrays, to bring together innovation in both areas of study.

# APPENDIX A SELF-ASSESSMENT CAPABILITY AUDIT

**SECTION 1 - Introduction**

A. Is your business located in Maine?

1 Yes

2 No

B. For this survey, please answer the following questions based only on your current business location. What is the zip code of your current location?

1 Enter zip code ________ (accept all five-digit responses)

C. Is your company involved with work related to wind energy project development, construction, manufacturing, operations, maintenance, or other professional service?

1 Yes

2 No

3 Not sure

D. Thinking of your organization's wind energy work, on what type of project does your organization currently work?

1 Land-based

2 Offshore

3 Both

4 Don't Know/No Answer

E. How would you describe your organization's focus as it relates to wind work? (Select all categories in which your organization works directly)

1 Project development

[If needed: This consists of all services contracted prior to the developer reaching final investment decision. This includes surveys and studies required to inform wind farm project and component design, as well as to obtain necessary planning consents.]

2 Wind turbine supply

[If needed: This includes general components of the wind turbine generator supply contract.]

3 Balance of plant supply

[If needed: This includes all components of an offshore wind project beyond the supply of the wind turbine generator.]

4 Installation and commissioning

[If needed: This includes the services contracted to construct an offshore wind project.]

5 Operations and maintenance

[If needed: This includes the services contracted to support the continuing operation of an offshore wind project.]

6 Decommissioning

[If needed: This includes services contracted to remove, make safe or dispose of wind farm components at the end of project lifetime.]

7 Sector Support

[If needed: This includes all services that will benefit the development of the supply chain but that may not be contracted directly as the result of an offshore wind project.]

8 Other (Please describe________)

If E = 1, ask F

F. What role does your organization take in project development? (Select all that apply)

1 Development and consenting

2 Surveys

3 Engineering & design

4 Project management

5 Other (Please describe_______)

If E= 2, ask G

G. What part does your organization assemble or manufacture? (Select all that apply)

1 Rotor

2 Nacelle

3 Electrical and auxiliary systems

4 Tower

5 Other (Please describe_______)

If E = 3, ask H

H. What part does your organization assemble or manufacture? (Select all that apply)

1 Export cables

2 Array cables

3 Offshore substation

4 Onshore substation

5 Foundations

6 Other (Please describe_______)

If E = 4, ask I

I. What does your organization install? (Select all that apply)

1 Turbine installation

2 Foundation installation

3 Subsea cable installation

4 Offshore substation installation

5 Onshore construction

6 Ports and logistics

7 Other (Please describe: ________)

If E = 5, ask J

J. What role does your organization take in operations and maintenance? (Select all that apply)

1 Operations

2 Turbine inspection and maintenance

3 Balance of Plant inspection and maintenance

4 Other (Please describe________)

If E = 6, ask K

K. What sector support role does your organization take? (Select all that apply)

1 Educational Institution/ Training Provider

2 Government Agencies

3 Trades, Labor and Workforce Organizations

4 Other (Please describe________)

L. How would you describe your organization's industry sector? (Select all categories in which your organization works directly)

1 Construction, Installation, and Operations/Maintenance Services

2 Education/Training

3 Environmental, Engineering, Geological, & Testing Services

4 Equipment, Supplies, Materials, and Associated Services

5 Government

6 Manufacturing and Fabrication Services

7 Marine Facilities, Transport, Logistics, and Safety

8 Offshore Wind Development

9 Offshore Wind Original Equipment Manufacturing (OEM)

10 Professional and Consulting Services

11 Trades, Labor, and Workforce Organization

12 Other (Please describe: _______________)

M. In which industry sector does your organization primarily work?

1 Construction, Installation, and Operations/Maintenance Services

2 Education/Training

3 Environmental, Engineering, Geological, & Testing Services

4 Equipment, Supplies, Materials, and Associated Services

5 Government

6 Manufacturing and Fabrication Services

7 Marine Facilities, Transport, Logistics, and Safety

8 Wind Project Development

9 Wind Original Equipment Manufacturing (OEM)

10 Professional and Consulting Services

11 Trades, Labor, and Workforce Organization

12 Other (Please describe: _______________)

**SECTION 2 – Volumetric Capabilities**

1. Including all full-time and part-time permanent employees at your organization, how many Maine-based workers support your business? (Please note that your response should include administrative staff supporting of your business.)

a. Record # of employees __________

2. Do any of your employees have any of the following certifications or licenses? (Please select all that apply)

a. Occupational Safety and Health Administration / OSHA (If yes, please specify which:____________)

b. Global Wind Organization / GWO (If yes, please specify which:____________)

c. Lean Six Sigma

d. Certified Composties Technician (CCT)

e. Quality Control Inspector

f. Helicopter Underwater Escape Training (HUET)

g. US Coast Guard Standards of Training, Certification, and Watchkeeping / STCW (If yes, please specify which:____________)

h. US Coast Guard Captain's License

i. Other (Please specify:____)

j. None

k. DK/NA

2. Approximately how much of your organization's work at your current location, in terms of total gross revenue, is related to offshore wind?

Record $:___________________________

3. Does your organization currently have excess production capacity? (In other words, could your organization produce more with additional investments of capital?)

a. Yes

b. No

c. DK/NA

4. Roughly how much excess capacity does your organization currently have, as a percent of current production? (For example: if you can produce 20 percent more without additional capital investment, write 20.)

Please provide a whole number 1-100: _____________

5. Thinking about your organization's energy related suppliers and vendors, what percent are located (Use numbers to indicate percentages, for instance 20=20%):

a. In Maine (Enter %)_____

b. Outside Maine but in the United States (Enter %)_____

c. Outside of the United States (Enter %)_____

d. DK/NA

6. What components do you source from suppliers and vendors outside of the United States?

**SECTION 3 – Interest in participating in offshore wind supply chain**

7. For each of the following statements, please indicate if you agree, disagree or neither?

| | STRONGLY AGREE | SOMEWHAT AGREE | NEITHER AGREE NOR DISAGREE | SOMEWHAT DISAGREE | STRONGLY DISAGREE | DK/NA |
|---|---|---|---|---|---|---|
| We are interested in the opportunity offshore wind presents for our business | 1 | 2 | 3 | 4 | 5 | 6 |
| Our current offering of goods and/or services can be used by the offshore wind industry. | 1 | 2 | 3 | 4 | 5 | 6 |
| Our company would need to make significant capital investments to serve the offshore wind industry | 1 | 2 | 3 | 4 | 5 | 6 |
| Our staff would need additional training to serve the offshore wind industry. | 1 | 2 | 3 | 4 | 5 | 6 |
| There is sufficient local qualified talent to grow a profitable business in the offshore wind industry. | 1 | 2 | 3 | 4 | 5 | 6 |
| There is sufficient market demand to grow a profitable business in the offshore wind industry | 1 | 2 | 3 | 4 | 5 | 6 |
| There is sufficient availability of necessary equipment to grow a profitable business in the offshore wind industry | 1 | 2 | 3 | 4 | 5 | 6 |
| There is sufficient supply of affordable raw materials to grow a profitable business in the offshore wind industry | 1 | 2 | 3 | 4 | 5 | 6 |
| There are policy challenges inhibiting growth of a profitable business in the offshore wind industry | 1 | 2 | 3 | 4 | 5 | 6 |
| There are permitting delays inhibiting growth of a profitable business in the offshore wind industry. | 1 | 2 | 3 | 4 | 5 | 6 |

8. Has your organization estimated the approximate capital required to offer goods and services to the offshore wind industry?

a. Yes

b. No

c. DK/NA

9. How likely is your organization to invest in the required capital to participate in the offshore wind industry?

a. Very Likely

b. Somewhat Likely

c. Not likely

d. DK/NA

10. When do you think your organization will be prepared to provide goods or services to the offshore wind industry?

a. Less than 6 months from now

b. More than 6 months but less than a year

c. More than one year but less than 2 years

d. More than 2 years

e. DK/NA

11. Please provide any other factors that make it difficult for your company to profitably participate in the offshore wind industry not included above, including any specific policy challenges.

______________________________________________

**SECTION 4 – Organization Practices**

12. Is your organization or any of your employees affiliated with one or more unions?

a. Yes (Please specify unions:____________)

b. No

c. DK/NA

13. Is your organization certified in any of the following International Organization for Standardization (ISO) standards? (Select all that apply.)

a. ISO 9001: Quality management systems

b. ISO 14001: Environmental management systems

c. ISO 27001: Information security management

d. ISO 29400: Ships and marine technology — Offshore wind energy — Port and marine operations

e. Other (Please specify which certifications:___________)

f. Not currently certified by ISO

g. DK/NA

14.. Has your organization enacted any policies or programs to minimize environment, health, and safety (EHS) impacts?

a. Yes (Please describe:__________)

b. No

c. DK/NA

15. Has your organization enacted any policies or programs to foster more diversity and inclusion?

a. Yes (Please describe:__________)

b. No

c. DK/NA

**SECTION 5 – Permission and Other Questions**

16. Are you interested in receiving future information about the findings of this research?

1 Yes

2 No

18. Would you be willing to be contacted by the researcher team to participate in a follow up interview regarding this research?

1 Yes

2 No

19. Lastly, since it sometimes becomes necessary for the project manager to call back to certain questions, please verify your contact information.

First Name ___________

Last Name ___________

Company ____________

Title ____________

Phone ___________

Email ______________