ASSESSMENT OF COORDINATED PORT FACILITY DEPLOYMENT FOR OFFSHORE WIND PROJECT STAGING IN BALTIMORE, MD

A White Paper
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INTRODUCTION AND PURPOSE

The business of Offshore Wind in Maryland has recently taken a major step forward with the successful completion of an offshore lease auction for Maryland’s first offshore wind power generating facility. With the identification of a developer for the project (US Wind) - the Maryland Energy Administration (MEA), the Bureau of Ocean and Energy Management (BOEM), and the Maryland business community (with the assistance of the group Business Network for Maryland Off Shore Wind - BizMDOSW) are now poised to work with US Wind to identify a strategy for the advancement of the project that meets the goals of all stakeholders. To that end, BizMDOSW has commissioned this White Paper to provide background information relative to the deployment of the Maryland Wind Farm using Maryland assets in keeping with the spirit of the Maryland Ocean Renewable Energy Credit (OREC) provisions.

The purpose of this paper is to suggest a framework for developing a strategy for offshore wind project staging that involves a “Coordinated Network” of port facilities distributed throughout Baltimore Harbor for the staging, construction, and deployment of offshore wind projects in the Mid-Atlantic region. The concept of a distributed port facility approach to offshore wind project deployment is not a new one, with many of the European ports involved in offshore wind having developed in this manner. Groundwork for the concept has been developed through a study commissioned by the MEA and conducted by Moffat Nichol, Inc.\(^1\) which describes a number of port facilities in Baltimore, MD and their potential involvement in offshore wind.

This White Paper aims to build on that research by presenting a high level assessment of the benefits and challenges associated with a “Coordinated Distributed Port Facility” approach to deployment versus a “Centralized Single Facility” approach. The assessment includes examples of “Distributed” and “Centralized” approaches that have been taken in the United States and Europe. Advantages and disadvantages are discussed and recommendations are provided at the end of this White Paper for additional assessment.

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A BRIEF REVIEW OF MARYLAND ASSETS

Maryland has a number of coastal assets that lend themselves to incorporation into the strategy for deployment for offshore wind facilities. The Port of Baltimore, with its numerous marine industrial, manufacturing, and heavy shipping facilities, represents a key opportunity for the State of Maryland to engage in both the initial US Wind project, and the offshore wind marketplace in general. The focus of this paper will be the potential for the Port of Baltimore to play the key role of Fabrication and Deployment Center (FDC) for the offshore wind projects scheduled for the Mid-Atlantic region. Ocean City, MD is ideally located adjacent to the awarded lease blocks for the first Maryland offshore wind project, and can serve as a management and operations center for the MD offshore wind farm for the study phase and the operation and management (O&M) portion of the project.

Ocean City

Located immediately adjacent to the Maryland Offshore Wind lease areas, Ocean City represents the closest Maryland maritime business center to the proposed wind farm. Ocean City lacks the deep water heavy industrial facilities and shipping assets that are found in major Port cities, however with numerous marinas, an active recreational maritime community, and marine maintenance facilities, Ocean City can support aspects of offshore wind projects that do not involve heavy industrial or heavy shipping activities. Marine research and survey activities to support the design and permitting actions that the offshore wind projects must undertake, and project Operations and Maintenance (O&M) activities to support the ongoing operation of the offshore wind power production facility once it is in production are activities that Ocean City marine businesses can support. As the up-front studies and surveys are near term activities that will begin well prior to the installation phase of the wind farm, and the O&M activities will occur over the life span of the operating offshore wind power production once the wind farm is complete, Ocean City represents a Maryland asset that could engage in offshore wind project deployment over the long term.

Port of Baltimore

While the Port of Baltimore is farther from the proposed Maryland wind farm lease blocks than Ocean City, it has exactly the kinds of heavy shipping and heavy industrial capacity that is needed to support the construction phase of offshore wind projects. The Port of Baltimore has numerous marine facilities that are either currently engaged in, or have historically been engaged in, heavy marine construction, major manufacturing, and/or shipping. Actions currently supported within the Port include: containerized, auto, bulk, and break-bulk shipping from major shipping terminals; manufacturing; heavy lift shipping, marine
construction; and maritime equipment and vessel maintenance. An initial analysis of the Port of Baltimore assets that could be employed to support offshore wind is being completed for the MEA by the consulting firm of Moffat Nichol (M&N). The M&N report identifies six terminal facilities in Baltimore that have heavy construction and/or significant marine shipping assets that could be adapted to support offshore wind project construction. A summary of the basic characteristics of the Baltimore terminal assets identified in the M&N study is presented below in Table 1, and the location of the facilities can be found in Figure 1 below.

Figure 1: Shows a few of the many Marine Terminal assets resident within the Port of Baltimore.
(Marine Terminals presented in the M&N presentation to BizMDOSW, 2014)
TABLE 1

Summary of basic characteristics of a few of the Baltimore terminal assets identified in the M&N study.

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Size (acres)</th>
<th>Water Depths (feet)</th>
<th>Number of Berths</th>
<th>Cranes</th>
<th>Features / Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MPA Dundalk Terminal</strong></td>
<td>570</td>
<td>34-50</td>
<td>13</td>
<td>9 Container</td>
<td>Rail access, containers, break-bulk, wood pulp, Ro-Ro, autos, project cargo, farm and construction equipment</td>
</tr>
<tr>
<td><strong>Sparrows Point Shipyard</strong></td>
<td>50 acres at North Yard</td>
<td>24-40</td>
<td>3 piers and 1 graving dock</td>
<td>Multiple 200 and 50 ton Clyde cranes</td>
<td>Rail access, 1200 x 200 x 28 foot deep graving dock</td>
</tr>
<tr>
<td><strong>Sparrows Point Kinder Morgan</strong></td>
<td>100</td>
<td>35-40</td>
<td>1</td>
<td>40 ton gantry crane</td>
<td>Rail access</td>
</tr>
<tr>
<td><strong>Cianbro</strong></td>
<td>2</td>
<td>16</td>
<td>1</td>
<td>Tenant lease</td>
<td>Construction yard, railroad bridge and draw bridge passage</td>
</tr>
<tr>
<td><strong>AmPorts Atlantic Terminal/MAPC</strong></td>
<td>55</td>
<td>31</td>
<td>2</td>
<td>Tenant lease</td>
<td>Rail access and car handling</td>
</tr>
<tr>
<td><strong>Rukert Terminals</strong></td>
<td>56 acres paved storage</td>
<td>15 (barge berth) – 50 feet</td>
<td>3 berths and 2 piers</td>
<td>1 Gantry and 1 Liebherr 500 mobile crane</td>
<td>Rail access, bulk, break bulk, containers and Ro-Ro</td>
</tr>
<tr>
<td><strong>FMC Site</strong></td>
<td>90</td>
<td>5-20</td>
<td>****</td>
<td>Tenant lease</td>
<td>Road access, industrial site adjacent to Harbor.</td>
</tr>
</tbody>
</table>

These facilities represent but a few of the significant assets in Baltimore which could be adapted for use in the deployment of offshore wind projects. The following sections describe a potential strategy for cooperative port facility engagement in offshore wind that draws on the strengths of the multiple terminal assets within the port.

OVERVIEW OF DEPLOYMENT SCHEMES – CENTRALIZED TO DISTRIBUTED

The concept of Offshore Wind project deployment is definitely a 21st century phenomenon. Europe was the earliest adopter, with the first projects coming on line a little over a decade ago. As one might expect with the development of a significant new industry, European offshore wind project developers were making it up as they went along. This includes the methods in which port facilities were incorporated into the new industry. Existing port infrastructure assets were repurposed to support offshore wind. As there was little time and no centralized European actor to define port deployment strategy before ports were pressed in to service in support of the new industry, a distributed approach to fabrication and
deployment developed where multiple facilities within a port (and sometimes multiple ports) were employed to piece together the supply chain for the first offshore wind projects. Because of the size and massive bulk of offshore wind components, manufacturing of components and fabrication of the wind towers needed to be conducted along the waterfront. Shipping of these types of components along traditional overland routes is extremely problematic due to their size and weights. This meant that, by necessity, much of the manufacturing capacity to build offshore wind components was centered in the ports.

Because of the speed in which the industry developed, and the number of states and countries that were involved in the effort, there was little time for central planning, and the industry began to develop through organic growth in an opportunistic manner. Manufacturers that saw the future potential of offshore wind and either had, or could acquire, manufacturing capacity on the waterfront began operations to support the new industry. Because no one manufacturer had the capacity to fabricate all components needed for wind farm build-out, multiple nodes for manufacturing sprang up. This necessitated the development of shipping assets to sew together the various supply chain facilities, and then the development of a set of logistical operations to support both the manufacturing and the port facilities. Over time as the industry grew, and component manufacturers and developers began to seek control of larger segments of the industry, the concept of a centralized staging facility developed whereby components manufactured at various locations could be trans-shipped to a central location where the majority of components needed for a project could be put together and shipped to the wind farm site. While affording an aspect of control, centralized facilities require a large amount of specialized infrastructure to support a broad variety of component trans-shipment and fabrication. Because such a broad array of specialized infrastructure is needed for a centralized facility that has not previously been required for other industries, new purpose-built facilities had to be constructed. Examples of various facility types are described in the sections below.

Centralized Facility

As noted above, centralized facilities are relatively new concepts in the industry and only a few partial centralized facilities have been developed thus far. In the centralized facility scenario, one site aims to be the center for all of the fabrication (the putting together of the various components) for the full wind farm project. The advantages to this approach are that the wind developer and component manufacturers can control the site more readily as such sites lend themselves to a single user (or single primary user) because of the amount of land and quayside needed and the intensity of the operations once the wind farm project is underway. The concept follows a kind of modified “Just-in-Time” (JIT) approach to the fabrication of wind towers whereby the various components needed for the wind farm are shipped from their point of manufacture to a centralized port facility where a certain quantity of the components needed are placed in storage on the site until needed. In such a concept for instance, wind farm foundations pieces, which are the first components to be constructed as part of a wind farm, would be shipped to the centralized
fabrication port in advance of their placement at the wind farm site. As many as a third of all of the components needed for the foundations would be staged at the centralized fabrication port prior to deployment to the wind farm site (for a 100 turbine deployment, this would mean that as many as 30 foundation assemblies could be located on site at a time). The advantage of this approach for the developer and the wind farm installation contractor is that a sufficient supply of components is on hand to buffer the timing of the in-water construction of the wind farm, mitigating some of the challenges related to scheduling and weather issues that can effect delivery schedules for individual components. The dis-advantage to this approach is that significant lay-down area that must be reserved exclusively for components is required in the port adjacent to or within close proximity to the quay-side (as the components are generally too large to ship overland by road/rail without significant impact to the local traffic). In order to accommodate this approach, the deployment port facility must have sufficiently robust infrastructure characteristics to handle all of the wind farm components, including large quantities of the heaviest and bulkiest components. Because of the size and number of the components handled in this strategy, the robust infrastructure requirements need to be distributed throughout the facility, necessitating in nearly all cases significant infrastructure upgrades (if a retro-fitted facility), or the construction of a new purpose-built facility. Additionally, because of the number of individual components that are received, the frequency of deliveries, the amount of activity related to assembly, and rate at which the assembled components need to be shipped out to the erection site, there is little opportunity for the portion of the port facility associated with the offshore wind project deployment to service other business lines during the deployment phase of wind farm development.

**Correlative Examples**

As noted above, there are relatively few examples of the Centralized Port facility strategy, as it is a relatively new concept and requires a significant commitment to specialized infrastructure development. One example in Europe is the Port of Granaa in Denmark, which is the deployment port for the Anholt Offshore Wind Farm (the third largest wind farm in the world with 400 MW of capacity). The turbine supplier, the project developer, and the construction entities worked together in the Port to facilitate the consolidated deployment of the Anholt Offshore Wind Farm. The site was selected both because of its proximity to the installation site, and also because of the availability of land for the development of the port and the ability to build on the Port’s significant infrastructure, allowing berthing of both deep-draft vessels and installation vessels, as well as the ability to “walk” extremely large heavy-lift cranes across the site while loaded. The developer, component supplier,
and construction contractor benefitted from centralized control of project components and near exclusive use of the portion of the terminal facility that was utilized for wind project deployment.

In the United States, in the City of New Bedford, Massachusetts, a similar facility is under construction that is aimed at servicing wind projects along the northeast US Atlantic coast. This project, the first of its kind in the US, is patterned after the deployment facilities in Europe where full project deployment from a centralized fabrication facility is possible. The facility in New Bedford represents new construction in which the significant infrastructure attributes required for full project deployment are being built into the facility from the outset. Designed for super-lift capacity, the facility will allow giant heavy-lift cranes to pick wind components from ocean going delivery ships (“Coasters”) and “walk” the components across the site to locations where the components can be staged and fabricated for shipment to the wind farm site. A hardened quayside is being constructed as part of the facility that will allow for a large “Coaster” delivery vessel to be berthed at the site at the same time as two “Installation Barges”, and heavy-lift cranes and other specialized large component transport vehicles will have the ability to work immediately adjacent to the quayside. The facility is scheduled for completion by the end of 2014, and it is expected that the facility will be utilized for deployment of the Cape Wind Offshore Wind Project, which at over 100 turbines planned is anticipated to be the first large scale installation for offshore wind in the US.

**Distributed Approach**

The distributed approach (as it is being referred to in this paper) represents a strategy for wind project deployment that involves more than on centralized facility. As previously mentioned, it is the approach that arose “from the grass-roots” in the European experience as offshore wind began to develop as an industry. In a sense, it is the natural outcome of overprinting a new industry on an existing set of marine industrial uses. It allows existing facilities to re-purpose portions of their activities to support offshore wind deployment while continuing to support other uses. Properly coordinated, it also allows for the development of wind industry staging that leverages existing infrastructure, reducing the initial cost of build-out investment while distributing those costs that are necessary to a broader set of assets. The challenge of this approach is maintaining an efficiency for the overall installation process that meets the overall wind farm project timeline. This challenge however, can be met through efficient logistics handling of components both on and between the individual sites handling the various project components. In fact, the application of this distributed strategy in Europe precipitated the development of
what has become a very active offshore wind logistics subsector of the industry, which is constantly innovating and identifying ways to improve connections and increase efficiencies to the benefit of the overall wind industry.

**Correlative Examples**

While many examples of this strategy exist throughout Europe, two of the most dynamic examples exist in northern Germany in the centers of Cuxhaven and Bremerhaven. These two port cities have become major players in the European offshore wind space, and are often referenced by the industry as examples of how offshore wind development translates to economic vitality for ports that take the steps to diversify into the offshore wind industry.

The Port of Bremerhaven is located on the River Weser in the state of Lower Saxony along the northern coast of Germany. Once a major shipping port experiencing economic stagnation, today Bremerhaven boasts that it is the home port of the offshore wind power industry and has experienced a tremendous resurgence because of that association. Businesses within the Port of Bremerhaven continue active trade in autos (Bremerhaven is one of the largest auto shipping ports in Europe), containerized cargo, bulk and break-bulk cargo, fishing, frozen foods, cruise industry, and vessel and marine equipment fabrication and repair. However now the Port has overprinted on those activities a significant offshore wind component - a business sector that has grown exponentially over the last decade. By all accounts, the offshore wind sector has transformed the Port into a major player and has revitalized the City. While the Port is currently in the process of developing a special offshore wind area, the success of the Port to date has been related to its ability to take existing Port assets and apply them to the wind industry. Multiple terminal areas have expanded into the offshore wind marketplace, including Bremenports, the auto and container terminal facilities in the Port. Through innovation in logistics transport, the Port has shown that multiple facilities within a Port geography can be incorporated into an effective strategy to serve the offshore wind industry while maintaining existing business lines. Specifically, Bremerhaven has succeeded in capturing both the fabrication/deployment and supply chain manufacturing aspects of the offshore wind business. Certain components are manufactured and/or fabricated within the Port and are either moved to the quayside facilities that will ship the components to the wind farms or are shipped to the wind farms directly. The Port also receives wind farm components that were manufactured in other locations and prepares them for installation and then ships them to installation sites. There are five separate facilities within the Port that have been or are being brought into service for the offshore wind industry:

- Container Terminal 1 was utilized by RWE Innogy as a base port for the construction of its offshore wind park North Sea East 1, and continues to be used to support various projects.
- The public trans-shipment terminal for heavy cargo at Labrador Harbor offers offshore wind companies infrastructure tailored to the wind industry’s needs.
- The former shipyard site of Schichau Seebeck is now the Seebeck Offshore Industrial Park, and offers centrally located offices, component storage areas, and moorings for service ships.
• The area within the greater Port known as Blexer Bogen is being repurposed as a new terminal where turbines can be loaded from the factory straight onto ships.
• The ABC-Halbinsel facility is an offshore terminal operated by BLG/WindEnergy Logistics. It operates as a logistics hub and storage area for heavy load structures and large components.

One of the more significant byproducts of the growth of the offshore wind industry in Bremerhaven is the development of BLG Logistics and its logistics facility. Seeing the opportunity in logistics that arises from the need to move components, technology, and personnel around a Port with distributed wind facilities, BLG has developed capabilities and equipment for the specialized transport of wind components that now serves the greater European offshore wind industry. From the innovative use of self-propelled modular transporters (SPMTs) to move wind components around the port, to the development of factory to barge direct rail systems for the intra-port transport of heavy lift components (such as giant tripod foundation systems), effective and efficient logistics support helped shape the Port into a offshore wind hub that it is today.

The Port of Cuxhaven is located in Northern Germany where the River Elbe meets the North Sea. Cuxhaven was historically a large vibrant fishing port with a fishing fleet and industries related to fishing and fish processing. With the decline in fishing, the Port decided it needed to attract new industry to its shores and was watching the development of the offshore wind industry in neighboring Bremerhaven with great interest. Like Bremerhaven, Cuxhaven saw the potential of offshore wind and set its sights on being a major hub on the North Sea. Since 2007, a steady and increasing business sector has developed related to the production, assembly and logistics services for offshore wind turbines. Over the last several years a unique cluster of offshore wind power and maritime industries has developed and moved in to the Port. Using multiple facilities, the wind cluster operates out of repurposed and new facilities developed to allow for heavy lift and specialty roll-on/roll-off operations. The Port conducts trans-shipment of offshore wind components and shipping of manufactured components. Similar to Bremerhaven, one of the keys to the success of the Port of Cuxhaven is the coordination between the various facilities in the Port and the logistics capabilities that have developed to connect the Port facilities.
APPLICATION TO BALTIMORE

In applying the concept of wind port deployment strategy to Maryland, one must consider the fact that the largest and most comprehensive set of industrial Port assets in the State resides in Baltimore. A diverse and extensive set of maritime industrial and commercial assets exists in the Port related to a myriad of business and public sector interests. Any number of the existing assets within the Port could be repurposed or augmented to support the development of offshore wind in the Mid-Atlantic. Corollary examples from other wind projects around the world suggest that a key to the implementation of successful offshore wind deployment scenarios rests with the ability to determine an effective strategy for wind port development. In cases where the primary purpose of the wind port is to provide trans-shipment of components manufactured elsewhere, the importance of having a centralized location for the acceptance, storage, fabrication and trans-shipment to the erection site appears to be more important. In cases where manufacturing of at least a portion of the wind farm components is intended to be conducted in the port, the use of multiple staging areas within a port appears to be more common. The practical impact of this supposition is on where and when the infrastructure costs for the supporting port facility are realized.

Centralized Approach

Because a centralized offshore wind project port facility must receive and store all components for wind farm deployment, the site must have a significant amount of storage space (industry norms developed to date indicate that at least 28-acres of open space is required for the turn-key deployment of an approximately 100-turbine wind farm facility. Because the full complement of wind components are handled on a centralized site, the site must have the load bearing and quayside attributes that the largest and heaviest components require. The quayside berth should be able to accommodate one ocean-going "coaster" delivery vessel and up to two installation barges simultaneously; the substrate at the quayside should be capable of allowing the installation vessels to “jack-up” at the quayside. Because of the intensity of operations during deployment from a centralized facility, a wind developer (or component supplier) may request exclusive access to a centralized terminal site to avoid conflicts at the quayside and in moving components around the facility. Additionally, it is likely that on this type of facility, component suppliers and/or installation contractors will desire to have large crawler cranes “crawl” across the entire site carrying loads to facilitate direct transport of components from one part of the site to
another. In the Port of Baltimore, the selection of a port strategy that focuses on centralized deployment would necessitate the selection of a primary site for offshore wind deployment.

**Benefits and Challenges**

The benefits to the Port of Baltimore in the selection of a strategy that involves a centralized approach to wind project deployment include:

- Less inter-facility traffic resulting in lower impact to connecting transportation routes;
- A consolidated operation requiring a lower level of coordination from a security, management, and governance standpoint; and
- A principal focal point within the port that allows for direct focused marketing.

The benefits to a developer of a centralized approach to project deployment include:

- A consolidated operation requiring a single set of security and management protocols;
- Ease of onsite transport of components, particularly if the site has been prepared such that heavy lift cranes can “crawl” across the site; and
- Allows the developer to have a focused set of contract relationships.

The challenges inherent in the centralized facility deployment scheme include:

- The very high initial cost for infrastructure development;
- The long lead time needed for the infrastructure improvements. When permitting, design, and construction timelines are considered, the timeframe associated with the development of a centralized port facility for offshore wind deployment may exceed the allowable timeframe; and
- The fact that a smaller cross-section of port maritime assets would become involved in offshore wind.

**Distributed Approach**

An approach to offshore wind project deployment that involves multiple facilities has distinct advantages in Maryland. The Port of Baltimore has a variety of existing assets that can be repurposed to support the offshore wind industry. Proper alignment of existing facility assets with the infrastructure needs for the various components that make up an offshore wind project is key. One possible multiple facility scenario could involve as many as five separate facilities, each set up to provide specialized components for a wind farm project: foundation pieces, transition pieces, tower sections, nacelles and hubs, and blades. The potential facilities that have large land area available and can be adapted for heavy lift and transport would be best suited for the large component pieces: foundations and nacelles. Those facilities with less land area that have lift capability (but not necessarily super-lift capacity) could be employed for transition pieces and tower sections. Blades and components associated with power transfer stations could be accommodated at some of the smaller facilities.
Another scenario that may be more realistic involves a hybrid central-distributed approach whereby certain groups of like components are handled at one facility (such as foundation and transition pieces), while the other component parts (nacelles, blades, hubs, and tower sections) are handled at another location.

A byproduct of the distributed facility approach is the fact that logistical considerations are heightened. As in the Port of Bremerhaven, Germany, any scenario that requires components to be moved around within the Port will necessitate the development of a logistics industry to support those functions. Distributed component deployment will require connections and coordination between Port facilities. The facilities will need to be accessed by both ocean going vessels as well as installation barges. A set of logistics solutions are likely to develop that facilitate the movement of components around the Port. Land-based technologies such as tele-handlers and SPMTs may be applied for short hauls. Barges and ferries may be employed to move components around the Port by water. Another byproduct of the distributed approach to offshore wind farm development is that it will encourage the manufacturing of components within the Port.

**Benefits and Challenges**

One of the main benefits to the distributed deployment approach in Baltimore is the fact that the Port already has a number of assets that could be incorporated into the new industry (reference M&N study). Under this strategy, multiple assets could move quickly to prepare themselves for deployment, thereby shortening the overall project timeline. In the case of Baltimore, a distributed approach would allow for:

- Specialization for component handling (by the pier operator and staff), which will increase efficiency;
- Efficiency in staging. It’s far easier to plan out the layout of a location if all of the components are the same, than if they are all different;
- The lack of need to deal with the full range of components at one site reduces individual site infrastructure development costs;
- Components to be shipped directly from the manufacturing location, vs. needing a staging location in Europe to mix and match components on the delivery vessel;
- Mitigation of the potential that a problem with one manufacturing process will hold up a whole shipment;
- Mitigation of the huge investment that would need to be made for each location. Only a few of the locations would need significant investments, and those investments could be targeted to the specific component.
- Finally, it also allows for multiple developers to work at the same time in the port on multiple installations. This approach allows for the
specialization of facilities in the production of individual components. As such, this strategy encourages the development of multiple projects concurrently, whereas the centralized approach does not allow that level of diversity as the deployment site is by its nature under the control of a single developer.

**Potential Opportunities Related to Logistics**

As noted above, Ports that choose to utilize a distributed approach to offshore wind project deployment will need a significant amount of logistical capacity to tie together the distributed assets of the Port into a cohesive operation. This fact provides significant opportunities for existing businesses in the Port to participate in offshore wind deployment. Operations that are currently servicing other industries will have the opportunity to assist with wind component movement within the Port. For example, a marine repair facility that hauls and transports large vessels has the skills to move large valuable assets around a Port. Conversion to blade transport using specialized blade transport trucks would be a relatively easy task. Crane and lift operations will have ample opportunity to provide services related to wind component loading, off-loading, and transport. Barge and tug-boat companies will be called in to service to transport components over water between facilities. Specialty marine construction operations such as jack-up barge operators will have the opportunity to become involved in trans-shipment within the Port. Water transportation companies will be needed to transport workers around the Port. For example, a large national garment manufacturer is starting a ferry service to move its employees around the Port to its various operations – expansion of this service to assist in the movement of offshore wind project workers between the various facilities in the Port would be an easy extension. In Europe, logistics companies such as BLG Logistics branched out from their traditional market sector to support offshore wind, and thrived due to the demand for transport, lift, and carry services; and this model could well be replicated in Baltimore.

**SUMMARY AND RECOMMENDATIONS FOR FUTURE ASSESSMENT**

The Port of Baltimore contains numerous assets that already have a many of the attributes that are needed to support offshore wind project deployment. These potential facilities could be brought into service in less time and at a lower initial cost under a distributed deployment scheme than if a centralized deployment strategy were employed. Incorporation of multiple resources throughout the Port also has the benefit of encouraging involvement, as a lower individual facility entry cost would be required because facilities could take advantage of the already existing attributes they possess, and lower individual facility infrastructure upgrade costs would be required as no one facility
would be building out for full component deployment. Leverage existing capacity within the Port would allow for a more rapid development timeline and lead to efficiencies through leveraging of existing operations.

Employment of a strategy involving multiple facilities within the Port would also encourage the development of a robust logistics support industry, breeding innovation and involving a larger cross section of existing Port businesses in the movement of personnel, equipment, and components within the Port. It is expected that this strategy would also encourage the establishment of manufacturing capacity and the supply chain within the Port as individual facilities would be motivated to accommodate component manufacturing in order to justify infrastructure improvements. Development of supply chain manufacturing within the Port will benefit not only the first offshore wind project planned for Maryland waters, but will also benefit the long term development of the offshore wind industry in the US.

Besides benefitting the Port, it is expected that a strategy that involves a distributed deployment approach would also benefit a developer. It is anticipated that this strategy would require less large infrastructure improvement, leading to a shorter ramp-up period and result in lower up front development costs being passed on to the developer. Involvement of a broad range of Maryland assets would also assist in compliance with ORC standards.

The research and assessment presented in this paper represents a beginning point in a larger and more elaborate discussion that will need to be undertaken as offshore wind projects advance in the Mid-Atlantic. A partial list of recommended additional evaluations and studies that could be conducted in support of the decision making process includes:

- A more detailed analysis of individual Port facility characteristics, matching facility attributes to the requirements for various individual component manufacturing and/or handling;
- An evaluation of required and potential infrastructure modifications and improvements;
- An evaluation of the environmental benefits and challenges associated with planned or potential infrastructure improvements;
- An evaluation of logistics opportunities and challenges – including the need for connections between facilities (and the infrastructure needed to support those connections), and the logistics innovations that are likely to develop;
- An assessment of supply chain development, including an evaluation of how existing Port assets could be incorporated into future supply chain development;
- An economic study to determine the primary, secondary, and induced economic benefits to the Port and the region from infrastructure improvements; and
- A study of the management schemes and governance options that can be applied in the administration of wind project deployment scenarios in the State of Maryland.
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