Offshore Wind Development and Supply Chain Overview

LABOR ENERGY PARTNERSHIP

Prepared by
Dave Effross
June 2022

FOREWORD

This paper was prepared by Dave Effross for the Labor Energy Partnership Offshore Wind Workshop and is not intended to reflect the views, opinions or research of the Labor Energy Partnership.

About the Labor Energy Partnership

The Labor Energy Partnership (LEP) is based on a shared commitment of the AFL-CIO and the Energy Futures Initiative (EFI) to promote federal, regional and state energy policies that address the climate crisis while recognizing the imperatives of economic, racial and gender justice through quality jobs and the preservation of workers' rights.

Suggested Citation: Effross, D. (2022, June). *Offshore Wind Development and Supply Chain Overview*.

EXECUTIVE SUMMARY

How do we make offshore wind (OSW) power competitive? Systems need to be created and put into place. This means we need not only energy infrastructure but also specialized construction and supply infrastructure. The University of Delaware's Special Initiative in Offshore Wind (SIOW) has calculated estimates of what such a system would result in for the United States, based upon 32,352 megawatts (MW) of installed capacity in the Northeast from 2021 through 2030. The National Renewable Energy Laboratory (NREL) has performed similar research and modeling, for the years 2023–3030. SIOW and NREL's respective efforts predict that the supply chain components and commodities in **Table 1** will be required.[1,2]

TABLE 1. **Components and commodities required for 30 GW of ODW**

	SIOW	NREL
	32,352 MW	**30,000 MW**
	2021–2030	**2023–2030**
Wind turbines	2,057	2,110
Blades	–	6,330
Towers	–	2,110
Nacelles	–	2,110
Array cables (miles)	3,344	–
Export cables (miles)	5,463	–
Total cabling (miles)	8,807	9,240
Offshore substations	53	–
Steel (1,000 tons)	–	7,090
Permanent magnet (1,000 tons)	–	81

All of these, including development expenditures (DEVEX) and operational expenditures (OPEX), will require expenditures of roughly $109 billion, of which $100 billion will be capital expenditures (CAPEX) between 2021 and 2030.[3] The NREL projects capital expenditure numbers at $97.4 billion between 2023 and 2030.[4] This includes steel, cable and concrete, among other materials, but not the cost of shipbuilding for specialized wind turbine installation vessels (WTIV) and feeder vessels, barges and other vessels that transport supplies to the WTIVs. It also does not include the costs of modification or construction of specialized pier facilities, which have several projects already underway.

As with many new technology rollouts, there is a chicken-and-egg problem. All of the above are networked and interdependent, and their successes depend upon each other. Moving first or early, enduring uncertainty with regard to others' entry, without supportive policy, means taking on risk. It is easier and less uncertain for companies to establish operations in a new market once the industry is somewhat established. This is a business, then, in need of a jump-start. We need to effect policy in such a way as to help incubate an egg or risk otherwise creating a chicken.

1 SIOW. (October 2021). *Supply Chain Contracting Forecast for U.S. Offshore Wind Power—The Updated and Expanded 2021 Edition.* Retrieved from https://nationaloffshorewind.org/wp-content/uploads/SIOW-supply-chain-report-2021-update-FINAL.pdf. p. 20.

2 Lantz, E., Barter, G., Gilman, P., et al. (August 2021). *Power Sector, Supply Chain, Jobs and Emissions Implications of 30 Gigawatts of Offshore Wind Power by 2030*. NREL/TP-5000-80031. National Renewable Energy Laboratory. Retrieved from https://www.nrel.gov/docs/fy21osti/80031.pdf. p. 13.

3 Ibid., pp. 6, 24.

4 Ibid., p. vii.

Effectively, this means crafting federal and state industrial and energy policies, temporarily, into a demand-driven marketplace. Although such actions may draw objections from free market purists, it would be wise to remember that the problems these policies are meant to address, including global climate change, local air quality degradation and the creation of domestic jobs as well as their location, exist largely outside of market mechanisms as undervalued-to-unvalued externalities. The hidden hand does not grasp that which has no explicit price or cost.

TWO SEMINAL OSW SUPPLY CHAIN PAPERS

In August and October 2021, the NREL and SIOW respectively released two comprehensive reports addressing OSW supply chain issues.

The NREL released *Power Sector, Supply Chain, Jobs and Emissions Implications of 30 Gigawatts of Offshore Wind Power by 2030* in August 2021[5] as part of a continuing series investigating and analyzing this new industry, the challenges it presents and the trials presented to it. The NREL's paper is the product of 10 authors, who utilized several mathematical models, including the Regional Energy Deployment System (ReEDS) to simulate the bulk power system scenarios, the NREL's proprietary Wind-Plant Integrated System Design and Engineering Model (WISDEM®) for wind turbine costs and materials, the Offshore Renewables Balance of system Installation Tool (ORBIT) for balance-of-system costs and the NREL's Jobs and Economic Development Impact model to estimate jobs and economic impacts. More specifically, the NREL used WISDEM to process the ReEDS regional deployment values to build hypothetical plant capacity and number of wind turbines and then ORBIT to compute balance-of-system costs and the electrical system design for the desired plant size at an average distance from shore for each region.

The NREL states the ReEDS model's limitations as that it:

- Does not consider high-voltage direct current (HVDC) transmission and backbone systems for OSW
- Does not capture all local decision-making considerations, including for OSW interconnection, siting and transmission expansion
- Does not account for technology learning associated with deployment
- Does not include foresight of future system conditions, carbon dioxide emissions constraints or OSW targets
- Does not include scenarios with full energy system decarbonization, so it does not reflect a ceiling for OSW energy development in the long run
- Models only limited cross-sectoral linkages

Some selected conclusions of the NREL's report include[6]:

- The target of 30 gigawatts (GW) by 2030: The primary scenario has significant supply chain implications in the next decade and out to 2050. Between 2023 and 2030, OSW buildout requires annual averages of $12.2 billion in CAPEX, manufacturing and installation of more than 263 12- to 15-MW wind turbines, 886,000 tons of steel, 10,100 tons of permanent magnets, 979 miles of electrical cable; four to six Jones Act–compliant turbine installation vessels depending on installation strategies and a minimum of $375 million to $500 million in port upgrades beyond current plans.
- Achieving 30 GW by 2030 could support five to 10 new manufacturing plants to produce various OSW components, including one to two manufacturing plants each for wind turbine nacelles, blades, towers, foundations and subsea cables. The OSW sector would consume 0.9% of current annual U.S. steel production, or about four years of production from a typical U.S. steel mill.

5 Ibid.
6 Lantz et al., 2021, p. vi.

- From 2041 to 2050, the target of 30 GW by 2030: Primary scenario CAPEX will be $14.9 billion per year, driving a 50% increase in wind turbine demand relative to the 2020s, a doubling or more in annual demand for steel and electrical cabling and a 90% increase for permanent magnets. As many as nine Jones Act–compliant turbine installation vessels could be required during this period, and minimum port upgrades could be as high as $3.1 billion.

The target of 30 GW by 2030: The primary scenario results in 77,300 workers employed in OSW or in jobs induced by OSW activity by 2030 and more than 135,000 by 2050.

For the period of 2023-2030, construction period installation and supply chain jobs will employ approximately 31,300 workers per year on average; by 2030, operation and maintenance (O&M) activities will employ 13,400. Construction period–induced jobs during this period in retail, food service and childcare sectors will average 22,800; by 2030, O&M period–induced jobs will total 9,800.

From 2041 to 2050, construction-period installation and supply chain jobs will employ 40,800 workers per year on average; by 2050, O&M activities will employ 36,700. Construction period–induced jobs during this period will average nearly 30,800; by 2050, O&M period–induced jobs will total 26,800.

Wages for OSW jobs conservatively average $66,000 for construction and $55,000 for O&M, with a range of $53,000 to $132,000 across all job categories (current-year dollars). Wages for construction period– and O&M period–induced jobs will average $43,000 and $39,000, respectively.

The NREL summarizes these findings as follows (see **Table 2**).[7]

TABLE 2. **Summary of estimated impacts of the 30-GW-by-2030 target**

Impact	2023–2030	2031–2040	2041–2050
Cumulative Deployment (GW at end year [yr])	30	51	110
Deployment Average (GW/yr)	3.7	2.1	5.9
Offshore Wind Energy Generation (terawatt-hour/yr at end year)	117	194	429
Cumulative Capital Expenditures ($billion at end year)	97.4	156	305
Average Capital Expenditures ($billion/yr)	12.2	5.85	14.9
Cumulative Wind Turbine Demand (units)	2,110	3,490	7,440
Average Wind Turbine Demand (units/yr)	263	138	395
Cumulative Steel Demand (thousand tons)	7,090	18,100	38,800
Average Steel Demand (thousand tons/yr)	886	1,100	2,070
Cumulative Permanent Magnets (thousand tons)	80.7	147	337
Average Permanent-Magnet Demand (thousand tons/yr)	10.1	6.65	19
Cumulative Electric Cabling (miles)	9,240	21,000	46,200
Average Electric Cabling (miles/yr)	979	1,180	2,510
Wind Turbine Installation Vessels (minimum working vessels required each year)	4–6	4–6	5–9
Cumulative Port Infrastructure Upgrades Beyond Current Existing or Planned Capabilities ($million)	375–500	375–500	2,330–3,100
[Construction Period] Installation, Manufacturing, and Supply Chain Jobs (thousand full-time equivalents (FTEs)/yr, period average)	31.3	16	40.8
[Construction Period] Induced Jobs (thousand FTEs/yr, period average)	22.8	12.1	30.8
[Operating Period] O&M Technicians, Management, and Supply Chain Jobs (thousand FTEs, at end year)	13.4	19.4	36.7
[Operating Period] Induced Jobs (thousand FTEs, at end year)	9.8	14.2	26.8

7 Ibid., p. vii.

The SIOW in October 2020 released *Supply Chain Contracting Forecast for U.S. Offshore Wind Power—The Updated and Expanded 2021 Edition*.[8] The initiative has taken a different tack: Instead of focusing on job creation and wind farm numbers, for example, the SIOW's report analyzes OSW commitments by state to forecast years when states are likely to solicit and procure OSW power, focusing on how that activity influences the private-sector supply chain expenditures. The SIOW then applies this to supply chain analysis, in terms of timing, quantity, volume and geographic contribution. The SIOW's analysis also stresses CAPEX, OPEX and DEVEX contract forecasting for OSW projects.

The SIOW presents the following near-to-midterm forecast of OSW power contracts (in MW; see **Table 3**).[9]

TABLE 3. **Near-to-midterm forecast of OSW power contracts (in MW)**

Year	RI	CT	MA	NY	NJ	MD	VA
2018		304	800	128		368	
2019	400	804	804	1,696	1,100		
2020				2,490			
2021	600		1,600		2,658	400	
2022				1,200		400	2,600
2023		1,000	1,600	1,000	1,200	400	
2024				1,200			1,000
2025			800		1,200		
2026				800			1,600
2027				800	1,400		
2028							
2029							
2030							

The SIOW's and the NREL's respective efforts predict that the supply chain components and commodities in **Table 4** will be required.[10,11]

8 SIOW, 2021.
9 Ibid., p. 18.
10 SIOW, 2021, p. 20.
11 Lantz et al., 2021, p. 13.

TABLE 4. **Components and commodities required for 30 GW of OSW**

	SIOW	NREL
	32,352 MW	30,000 MW
	2021-2030	2023-2030
wind turbines	2,057	2,110
blades	-	6,330
towers	-	2,110
nacelles	-	2,110
array cables (miles)	3,344	-
export cables (miles)	5,463	-
total cabling (miles)	8,807	9,240
offshore substations	53	-
steel (1000 tons)	-	7,090
permanent magnet (1000 tons)	-	81

The NREL's is the more comprehensive of the two studies in terms of infrastructure and service needs, including thorough analysis of WTIVs and feeder vessels, the implications of the Jones Act upon their supply and new port development to support a domestic OSW industry.

Both are thorough efforts, although they can both be expanded upon. The NREL, for example, is continuing its ongoing efforts and plans to release further studies in the near future. Several issues that require elucidation and further investigation, as follows:

- Tier 2–3 suppliers: Most of the supply chain analysis so far has been concentrated on Tier 1. There is a need to understand the makeup of tiers 2 and 3. Jobs in these lower tiers are not necessarily union positions or even domestic ones. Many of the less high-tech, high-profile parts, such as ring bearings, are often sourced from China, which undercuts American production with cheap labor and government subsidies. Effective public policy cannot be made without an accurate industry assessment, and a closer understanding of the potential supply sources for these components is needed.
- The issue of the uncertainty inherent in a nascent market should now be largely resolved. The United States has an established pipeline of more than 30 GW of OSW projects, and investments are starting to flow to domestic sites for certain components such as cables. Still, these items could be imported, as seems to be the case for the first generation of projects, and the cost of establishing domestic production must be competitive with established locations. This is a chicken-and-egg question that raises policy questions regarding methods of jump-starting supply. Financial tools such as loan guarantees, grants and tax breaks come into play in the consideration of ensuring domestic supply, as do domestic content laws.
- Costs of labor as component: These studies discuss labor in terms of full-time equivalent jobs and labor costs, to a certain extent. They do not consider foreign content and competitiveness with foreign suppliers (in all three tiers). Moreover, the NREL's modeling does not assume a fully domestic supply chain for any component. Nor does either paper discuss workforce training and the necessity of state and federal support for these programs.

- Industry concentration and anticompetitiveness: Some of the major developers are tied to European manufacturers through longstanding supply relationships. Under these circumstances, supply chains are kept within corporate families dealing preferentially with their own affiliates or long-term partners. New entrants at the Tier 1 or Tier 2 level are unlikely.

In OSW, the United States does not hold the advantages of primacy; we were not early entrants. The good news, however, is that a new generation of OSW equipment (e.g., turbines with blades longer than 100 meters) has made much of the existing capacity in need of retooling or unsuitable for producing the new models. Factories need to be modified, and a new generation of WTIVs and feeder vessels must be built. Given the forecast installations of OSW globally, the world needs additional capacity to produce OSW components. Europe and China therefore do not have such a big head start on us as they once did, because America is leapfrogging the older generation of wind equipment as the market expands considerably.

This also means, however, that much of our demand cannot be filled overseas. Some components are more difficult to produce than others, of course. Bearings are less likely to be in short supply than turbine blades. Nevertheless, Europe and China are likely to prioritize domestic demand. If America wants to develop OSW and reap the economic benefits, we will need to develop a domestic supply chain for many critical components.

This also has implications with respect to the Jones Act. The Jones Act is no longer a limiting constraint, because the next-generation equipment that needs to be rapidly built also includes ships. America must build its own WTIVS, superfeeders and other vessels because we will not be able to source them elsewhere.

STEEL

Steel is one of the most critical and intensively used raw materials in OSW development. The towers, transition pieces, offshore substations and foundations (monopiles) are all built from steel plate—most importantly, reversing mill steel plate.[12] The U.S. steel industry is already gearing up to fill the demands of the new OSW market. New production facilities are being constructed, and OSW is creating union jobs in the steel industry. The following are a few illustrative examples:

- Ørsted is investing $70 million in steel fabrication facility with Crystal Steel Fabricators in Federalsburg, Maryland, on the state's Eastern Shore. The expanded plant will construct monopiles, and Crystal Steel will increase its workforce by about 50 new employees.[13]
- U.S. Wind will construct a new monopile manufacturing facility, Sparrow's Point Steel, to occupy the defunct Bethlehem Steel plant in Sparrow's Point, Baltimore. Production is planned to start in about two years, and preconstruction work will start this year. At full capacity, Sparrow's Point Steel could provide well-paying union jobs for 375 to 550 workers in three shifts at full capacity.[14]
- Nucor has added a blast and prime line at its steel plate mill in Brandenburg, Kentucky. Blasting and priming is used to remove mill scale from steel products and add corrosion protection. Nucor Chief Executive Officer Leon Topalian stated in 2021, "Nucor Steel Brandenburg will be one of only a very few mills in the world capable of reliably supplying steel plate suited to OSW market applications and expectations."[15]

12 Unlike coil steel, which is cast in continuous rolls, reversing mill plates are cast into slabs, which are then reheated and rerolled to required thickness, size and tolerance. This allows a greater variety of specifications to be met with respect to size, thickness and heat treatment. While plate steel is defined as a flat-rolled steel of more than 4.75 millimeters (mm) thickness, OSW typically requires thicker plates than other applications, up to 150 mm.

13 Milligan, C. (Oct. 14, 2021). "Ørsted's Latest Investment Brings Offshore Wind Steel Fabrication to Md.'s Eastern Shore." Maryland Inno. Retrieved from https://www.bizjournals.com/baltimore/inno/stories/news/2021/10/14/orsted-invest-offshore-wind-steel-fabrication-md.html.

14 Mirabella, L. (Feb. 11, 2022). "U.S. Wind Moves Ahead With Sparrows Point Manufacturing Hub for Offshore Wind Farms in Ocean City and East Coast." Baltimore Sun. Retrieved from https://www.baltimoresun.com/business/bs-bz-us-wind-progress-offshore-wind-sparrows-point-manufacturing-20220211-kugi3orm5zfs3m7nfce7ngqqxm-story.html.

15 Association for Iron and Steel Technology. (April 29, 2021). "Nucor Nears Completion of Two Major Capital Projects." Retrieved from https://www.aist.org/news/steel-news/2021/april/26-30-april-2021/nucor-nears-completion-of-two-major-capital-projec/

- The U.S. steel industry produced 86 million tons of steel in 2021, while the DOE estimated that 30 GW of OSW would require 886,000 tons of steel, meaning that the entire pipeline of East Coast OSW projects up to 2030 will require an amount of steel equivalent to approximately 1% of the industry's annual output.
- As noted above, the only grade of steel that may not be available is the large plate used in monopole designs, which Nucor will be able to supply by late 2022.[16] Annual investment by U.S. steel firms in 2022–2023 is planned to be greater than $16 billion, giving firms a chance to meet the rising market for all wind turbines.[17]

OSW RESEARCH AND DEVELOPMENT PROGRAMS

There already exist several public OSW research and development programs at both the federal and state (northeastern U.S., the scope of this paper) levels.

Federal

- The U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE). The EERE maintains a Wind Energy Technologies Office (WETO), which "funds research nationwide to enable the development and deployment of offshore wind technologies that can capture wind resources off the coasts of the United States and convert that wind into electricity."[18] Working in conjunction with the U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM), the WETO has "allocated over $200 million for competitively selected OSW research, development and demonstration projects."[19] (See footnote for a listing of those projects.)
- BOEM. The BOEM maintains an Office of Renewable Energy Programs, which "facilitates the responsible development of renewable energy resources on the Outer Continental Shelf [OCS] through conscientious planning, stakeholder engagement, comprehensive environmental analysis and sound technical review."[20] Under OCS Renewable Energy Program regulations, the BOEM issues leases, easements and rights-of-way for OCS activities that support production and transmission of energy from sources other than oil and natural gas.
  - MarineCadastre (https://marinecadastre.gov) is a joint BOEM/NOAA initiative that provides "authoritative data to meet the needs of the offshore energy and marine planning communities." MarineCadastre's website makes publicly available datasets, maps and tools that aid in OSW planning processes.
- The U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). NOAA's National Ocean Service performs biogeographic assessments for siting process purposes. An explicative podcast can be found on NOAA's website.[21]

16 Danieli. (Nov. 6, 2020). "Complete Plate Mill and Meltshop for the New, 1.2 Million Shtpy Nucor Steel Brandenburg Complex." Retrieved from https://www.danieli.com/en/news-media/news/complete-plate-mill-and-meltshop-new-1-2-million-shtpy-nucor-steel-brandenburg-complex_37_586.htm.

17 SteelOrbis. (Dec. 30, 2021). "U.S. Steel Industry: A Look Back at 2021 and a Look Ahead to 2022." Retrieved from https://www.steelorbis.com/steel-news/latest-news/us-steel-industry-a-look-back-at-2021-and-a-look-ahead-to-2022-1228244.htm.

18 EERE, WETO. (n.d.). *DOE Releases Report Detailing Strategies to Expand Offshore Wind Deployment*. Retrieved from https://www.energy.gov/eere/wind/wind-energy-technologies-office.

19 EERE, WETO. (n.d.). *Wind Energy Technologies Office Projects Map*. Retrieved from https://www.energy.gov/eere/wind/wind-energy-technologies-office-projects-map.

20 BOEM. (n.d.). *Renewable Energy: Facilitating the Responsible Development of Renewable Energy Resources on the OCS*. Retrieved from https://www.boem.gov/renewable-energy.

21 National Ocean Service. (n.d.). *Picking the Right Spot: Offshore Wind Energy*. Retrieved from https://oceanservice.noaa.gov/podcast/mar17/nop02-wind-energy.html.

State

- Massachusetts: The Massachusetts Clean Energy Center (MassCEC) is a state economic development agency devoted to the clean energy sector. MassCEC funds in-state academic and research institutions to advance research and innovation in OSW development, technology and operations.[22]
- Rhode Island: The University of Rhode Island is a National Sea Grant College and performs OSW research.[23]
- New York:
  - In 2018, the DOE created the National Offshore Wind Research and Development Consortium (NYSERDA; https://nationaloffshorewind.org) and competitively selected the NYSERDA to administer it.

    The consortium is a "nationally focused, independent, not-for-profit organization dedicated to managing industry-focused research and development of OSW to maximize economic benefits for the United States." Using matching New York state and federal grants, the consortium has $41 million to support efforts that "address barriers to OSW development in the U.S. and seek to reduce the levelized cost of electricity." Membership includes federal and state agencies, developers, industry, academia and researchers. There is an independent board of advisors, and the consortium is designed to be financially self-sustaining.

    The consortium issues competitive solicitations for OSW technology projects, divided among three core categories: (1) OSW plant technology advancement, (2) OSW power resource and physical site characterization and (3) installation, O&M and supply chain solutions.
  - In January 2022, Gov. Kathy Hochul (New York) in her State of the State address announced a plan to strengthen New York's renewable energy leadership and make a nation-leading $500 million investment in OSW. This plan would directly invest in OSW manufacturing and supply chain infrastructure and create more than 6,800 green jobs, with a combined economic impact of $12.1 billion statewide.
- New Jersey:
  - Rutgers University (the state's leading public university) performs OSW research under the auspices of the Rutgers University Center for Ocean Observing Leadership, or RUCOOL.[24]
  - In January 2022, New Jersey also joined the National Offshore Wind Research and Development Consortium (NOWRDC). The New Jersey Board of Public Utilities (NJBPU) is the state agency involved, and it will contribute $1 million over four years to support research initiatives in OSW and coordinate NOWRDC activities with the Wind Institute and the New Jersey Economic Development Authority (NJEDA).
  - NOWRDC funds OSW R&D projects on a competitive basis. Its objectives are articulated in its October 2019 roadmap.[25] It was initially funded with $41 million in matching grants from the DOE and NYSERDA. Additional contributions have been made by state members Maryland, Virginia, Massachusetts, and now New Jersey.

22 MassCEC. (n.d.). *Offshore Wind*. Retrieved from https://www.masscec.com/offshore-wind.
23 University of Rhode Island. (n.d.). *Offshore Renewable Energy: Research*. Retrieved from https://web.uri.edu/offshore-renewable-energy/research/.
24 RUCOOL. (n.d.). *Offshore Wind*. Retrieved from https://rucool.marine.rutgers.edu/research/offshore-wind/.
25 NOWRDC. (October 2019). *Research and Development Roadmap Version 2.0*. Retrieved from https://nationaloffshorewind.org/wp-content/uploads/2019/12/National-Offshore-Wind-Research-and-Development-Consortium-Roadmap-2.0.pdf.

- Delaware:
  - The University of Delaware's Center for Research in Wind (CReW): The CReW (https://crew.udel.edu/) is part of the Delaware Energy Institute (https://dei.udel.edu), also at the University of Delaware. It conducts research and publishes in peer-reviewed publications and law journals on offshore and coastal wind power, transmission planning and storage to support large-scale carbon-free power systems. Despite the name, CReW also works on vehicle-to-grid electric storage issues. Among other projects, the CReW has established the Atlantic Wind Consortium, a project funded by the DOE.[26] The consortium is an industry-university association that has conducted several research projects to advance wind turbine technologies and created a program of graduate study in OSW power.
- Maryland:
  - Maryland Energy Administration (MEA)'s Fiscal Year (FY) 2022 Maryland Offshore Wind Capital Expenditure Program[27]: The program is issuing competitive grants of up to $400,000 to support new or existing emerging businesses entering the OSW supply chain in Maryland by offsetting their CAPEX investments. Applicants must contribute at least 50% of the total project costs as matching funds or in-kind services. The total program budget is $1.6 million for the year.
  - FY 2022 Maryland Offshore Wind Workforce Training Program: This program is issuing competitive grants of up to $400,000 to support new or existing workforce training centers entering the OSW industry by offsetting their CAPEX investments and/or OPEX. Applicants must contribute at least 25% of the total project costs as matching funds or in-kind services. The total program budget is $1.2 million for the year. The MEA may increase or decrease the program budget at its sole discretion and without notice.
- Virginia:
  - Virginia Coastal Energy Research Consortium (VCERC): The VCERC was created in 2006 to include Old Dominion University, the Virginia Institute of Marine Science of the College of William & Mary, the Advanced Research Institute of Virginia Polytechnic Institute and State University, James Madison University, Norfolk State University, Virginia Commonwealth University, Hampton University, George Mason University and the University of Virginia and was located at Old Dominion University. According to statutory language, "the Consortium shall serve as an interdisciplinary study, research and information resource for the Commonwealth on coastal energy issues."[28] The consortium appears to be defunct at this time. The statute was repealed, effective October 1, 2021,[29] and the VCERC currently has no online presence.

26 CReW. (n.d.). *Atlantic Wind Consortium*. DOE project number: DE-EE0003535. Retrieved from https://crew.udel.edu/wind-power/projects/atlantic-wind-consortium/.

27 MEA. (n.d.). *Wind Energy in Maryland*. Retrieved from https://energy.maryland.gov/Pages/Info/renewable/windprograms.aspx.

28 Virginia Legislative Information System (LIS). (2006). S. 262, [105th Cong. §2(a)] (2006). Retrieved from https://lis.virginia.gov/cgi-bin/legp604.exe?061+ful+CHAP0939&061+ful+CHAP0939.

29 Virginia Code § 67-600 (Repealed effective Oct. 1, 2021). Virginia Coastal Energy Research Consortium established. Retrieved from https://law.lis.virginia.gov/vacodefull/title67/chapter6/.

- Virginia Offshore Wind Development Authority (VOWDA)[30]: The VOWDA is an authority created through 2010 legislation.[31] Its mission is to facilitate, coordinate and support development of the OSW energy industry, OSW energy projects and supply chain vendors by:
  - Collecting ocean and environmental data
  - Identifying regulatory and administrative barriers
  - Working with local, state and federal government agencies to upgrade port and logistic facilities and sites
  - Ensuring development is compatible with other ocean uses and avian/marine wildlife
  - Recommending ways to encourage and expedite OSW industry development

STATE OSW WORKFORCE DEVELOPMENT PROGRAMS

- Massachusetts:
  - MassCEC: According to the MassCEC website,[32] its goal is to support the development of a skilled and capable workforce and address identified gaps and needs for the new OSW industry. MassCEC, in partnership with Vineyard Wind and Mayflower Wind, has awarded more than $2 million in grants to Massachusetts institutions, labor unions, nonprofit organizations and businesses to support new OSW workforce training and development programs and projects in the Commonwealth.

    MassCEC is piloting a Community of Practice (CoP) for Massachusetts Offshore Wind Workforce Training and Development, which aims to help the OSW workforce grantees and other interested partners and stakeholders' network, share information and resources, coordinate and collectively develop training and educational pathways into and through the OSW industry. Through this CoP, MassCEC aims to build a cohesive and comprehensive ecosystem of training providers, educational institutions, community development organizations and support services organizations throughout the Commonwealth that can work collaboratively to build a world-class OSW workforce in Massachusetts.

    In August 2021, MassCEC awarded $1.6 million in grants to OSW workforce training programs aimed at reducing specific obstacles for people of color and low-income people. Eight grants were made, each targeting a specific obstacle that might prevent people of color and low-income people from pursuing OSW jobs.[33]

    Furthermore, in 2018 MassCEC released its *2018 Massachusetts Offshore Wind Workforce Assessment.*[34] This report is a comprehensive analysis of labor needs and economic impacts associated with the planning, construction and maintenance of OSW energy in the Massachusetts and Rhode Island/Massachusetts Wind Energy Areas.

30 VOWDA. (n.d.). *About the Virginia Offshore Wind Development Authority*. Retrieved from https://www.vaoffshorewind.org/authority/about.
31 Virginia Code. Chapter 12. Virginia Offshore Wind Development Authority. Retrieved from https://law.lis.virginia.gov/vacode/title67/chapter12/.
32 MassCEC. (n.d.). *Offshore Wind Workforce Community of Practice*. Retrieved from https://www.masscec.com/offshore-wind-workforce-community-practice.
33 Shemkus, S. (Aug. 3, 2021). "Massachusetts Grants Focus on Equity in Offshore Wind Workforce Development." Retrieved from https://energynews.us/2021/08/03/massachusetts-grants-focus-on-equity-in-offshore-wind-workforce-development/.
34 Vigeant, P., Donovan, A., Menard, J., et al. (2018). *2018 Massachusetts Offshore Wind Workforce Assessment*. MassCEC. Retrieved from http://files.masscec.com/2018%20MassCEC%20Workforce%20Study.pdf.

- Rhode Island:
  - WindWinRI (https://windwinri.com) was created by the North Kingstown Chamber of Commerce (CoC). The CoC is the leader of a consortium of economic development, education and business partners dedicated to designing and implementing a strategic, demand-driven career pathway system that meets the employment needs of Rhode Island businesses. Additionally, the innovative system for capacity building makes available professional credentials for local students and incumbent workers for long-lasting placements within the wind energy technology industry. The chamber has received a multiyear Real Jobs Planning Grant to initiate the career pathway system design and implementation.
- New York: The Empire State has established several institutions:
  - New York Offshore Wind Training Institute (OWTI): In 2020 the $20 million OWTI was launched through the State University of New York's (SUNY) Farmingdale State College and Stony Brook University campuses. These academic centers on Long Island are developing a plan for deploying the public funds and have issued the first solicitation for $3 million to support organizations focusing on early training and skills development for disadvantaged communities.[35] The first two winning proposals will receive a combined $569,618 to support early training and skills development for disadvantaged communities and priority populations—including veterans, individuals with disabilities, low-income individuals, homeless individuals and single parents—in both the Capital Region and New York City. Awardees include:
    - Hudson Valley Community College (HVCC) in Troy, New York: In support of the Capital Region's OSW initiative, HVCC recently began offering a two-year associate degree in welding and fabrication and will focus student recruitment efforts on priority populations in urban and rural disadvantaged communities, providing full or partial scholarships to participants. Foundational welding skills training will be provided by the Capital Region Educational Opportunity Center, a division of HVCC, with additional noncredit training and certifications will be provided at the college's main campus. The college will also partner with regional manufacturers building turbine components to provide a skilled workforce pipeline of welders and fabricators, aiming to train 75 individuals, including 65 from priority populations and disadvantaged communities.
    - LaGuardia Community College (LAGCC) in Queens, New York: LAGCC is collaborating with Siemens Gamesa for workforce training in the construction, repair and maintenance of OSW facilities in the New York City metro area. The college will convene employers to detail the skill gaps for both new entrants to the workforce and incumbent workers in the construction trades to help inform and develop a best-in-class custom curriculum. A total of 50 low-income individuals from the Brooklyn-Queens waterfront will be trained to work as OSW technicians.
  - National Offshore Wind Training Center (NOWTC) at Suffolk County Community College: The developers of New York's Sunrise Wind project have invested $10 million in the NOWTC at Suffolk County Community College on Long Island.[36] The NOWTC will train and certify workers through the nation's first Global Wind Organization (GWO) Training Center for OSW, also located on Long Island.[37] The Center of Excellence for Offshore Energy at SUNY Maritime College was launched with a grant from the New York State Clean Energy Career Initiative. The center is working to develop classroom and online training programs for wind operations, dynamic positioning and offshore vessel operations.[38] The center's stated objectives are to: (a) develop in-class/online courses and programs for offshore renewable energy to include credit/noncredit courses leading to certificates and degrees, (b) foster Maritime College curriculum change and innovation in the area of offshore

35 NYSERDA. (n.d.). *Offshore Wind: Workforce Development*. Retrieved from https://www.nyserda.ny.gov/All%20Programs/Programs/Offshore%20Wind/Focus%20Areas/Supply%20Chain%20Economic%20Development/Workforce%20Development.

36 Ørsted. (March 29, 2019). "Sunrise Wind Announces Plan to Launch Long Island-Based National Workforce Training Center for Offshore Wind." Retrieved from https://us.orsted.com/news-archive/2019/04/sunrise-wind-announces-plan.

37 NYSERDA, n.d.

38 SUNY Maritime College. (n.d.). *About the Center of Excellence for Offshore Energy at SUNY Maritime College*. Retrieved from https://www.sunymaritime.edu/aboutcenters-excellence/center-excellence-offshore-energy.

renewable energy (production, installation and maintenance) and (c) provide collaborative research opportunities for faculty and students.

- New Jersey:
  - The NJEDA[39] runs several OSW workforce development programs:
    - Wind Innovation and New Development (WIND) Institute: Still nascent, it was called for by Gov. Phil Murphy (New Jersey) in Executive Order 79 (2019). According to the Wind Council Report's April 2020 recommendations,[40] the WIND Institute will:
      - Be established as an independent authority with a corollary nonprofit
      - Have an advisory board that enables all stakeholder groups, including industry, organized labor, academia and other interested parties to guide its activities
      - Coordinate and galvanize cross-organizational efforts by acting as a centralized hub for OSW workforce development
      - Champion research, innovation and thought leadership that unlocks market potential
      - Leverage a combination of state funding, federal funding and, where appropriate and feasible, philanthropic funding to ensure sustained and adequate support
      - Have a dedicated physical presence to support in-person collaboration and act as a hub of activity for the region's industry
    - With respect to OSW occupational training, the WIND Institute will:
      - Establish a wind turbine technician occupation in New Jersey by creating training programs in consultation with industry and postsecondary educational institutions
      - Expand the pipeline of trade workers with the skills and qualifications required for OSW, by working with local trade organizations (unions), secondary education institutions and community colleges to help workers gain these specialized skills and qualifications
      - Introduce a GWO Safety Certification, establishing a certification program and ensuring that New Jersey has the required training facilities
  - The NJEDA also announced in December 2021 that it plans to enter into a memorandum of understanding (MOU) with the Gloucester County Institute of Technology (GCIT) to support the expansion of the GCIT's welding and painting programs with an eye to the OSW industry. GCIT is a four-year vocational-technical public high school located in Deptford Township, in Gloucester County, New Jersey, about 8 miles from Paulsboro, home of the New Jersey Wind Port (NJWP). Through the MOU, the NJEDA will provide up to $75,000 for programs that prepare students and workers for jobs in heavy steel OSW component manufacturing, funded by the NJBPU. This program will be run in collaboration with EEW American Offshore Structures (EEW AOS), a leading manufacturer of OSW monopile foundations, to expand and tailor its welding and painting programs.

    EEW AOS and GCIT have already made commitments to support the expansion of these programs, including securing donated welding equipment from welding manufacturer Lincoln Electric that will be used in production. Welding for these OSW tower foundations occurs onshore in fabrication facilities using specialized machines and welding consumables. Lincoln Electric will also be conducting a train-the-trainer program for GCIT and other regional vocational school welding instructors focused on the primary welding processes and materials used in production.

39 NJEDA. (2022). *Offshore Wind*. Retrieved from https://www.njeda.com/offshorewind/.
40 Wind Council. (April 22, 2020). *Wind Council Report: Recommendations Issued Pursuant to Executive Order No. 79*. Retrieved from https://1e7pr71cey5c3ol2neoaoz31-wpengine.netdna-ssl.com/wp-content/uploads/2020/12/Wind-Council-Final-Report_2020-04-21-2.pdf.

In December 2020, EEW AOS announced a $250 million investment in a state-of-the-art manufacturing facility to build steel monopiles. The facility is located at the Paulsboro Marine Terminal, proximate to the NJWP site. Construction on the facility broke ground in 2021, and the hiring of specialized welders and painters is projected to begin by the end of 2022.[41]

- New Jersey Wind Turbine Tech Training Challenge: The challenge is a competitive grant program awarding up to $1 million to a New Jersey community college to establish an OSW turbine technician training program that includes an industry-recognized credit-bearing certificate program and pathway to an associate degree or higher.
- New Jersey Offshore Wind Safety Training Challenge: The challenge is a grant program administered by the Office of the Secretary of Higher Education (OSHE), with the support of the NJEDA. The challenge helps to establish an industry-recognized training program and facility that is foundational for preparing New Jersey workers to participate in and support the growth of the OSW energy sector in the state. The training program and supporting facility is the first of its kind in the state and enables New Jersey to strengthen its leadership position in OSW energy. The competition was structured as a challenge in which New Jersey–based community colleges and training providers, including labor unions, nonprofit or community organizations and private training providers, were given an opportunity to submit proposals for establishing a GWO-accredited Basic Safety and Sea Survival Training program in New Jersey. An evaluation committee evaluated, scored and ranked submissions and recommended one proposal for the OSHE's consideration for a potential grant award. In July 2021, Atlantic Cape Community College, in Hamilton, New Jersey, won the challenge and was awarded $3 million to establish an industry-recognized GWO safety training program and facility.

- Maryland:
  - The MEA's FY 2022 Maryland Offshore Wind Workforce Training Program[42]: This program has a budget of $1.2 million to distribute in competitive grant awards to support new or existing workforce training centers entering the OSW industry by offsetting their CAPEX investments and/or OPEX. Each grant may be no more than $400,000 and may cover no more than 75% of project costs. Applicants must contribute at least 25% of total project costs as matching funds or in-kind services. The MEA may increase or decrease the program budget at its sole discretion and without notice.

OSW UNION TRAINING

Unions have been active in organizing OSW, with some success. In November 2020, Ørsted announced an agreement with North America's Building Trades Unions (NABTU). The partnership created a national agreement designed to transition U.S. union construction workers into the OSW industry in collaboration with the leadership of the 14 U.S. NABTU affiliates and the AFL-CIO. The agreement is based on a model developed by the Rhode Island Building Trades for the Block Island Wind Farm project.

Ørsted, along with its partners, will work together with the building trades' unions to identify the skills necessary to accelerate an OSW construction workforce. The groups will match those needs against the available workforce, timelines, scopes of work and certification requirements to fulfill Ørsted's pipeline of projects down the East Coast. Ørsted and NABTU, along with their affiliates and state and local councils, have agreed to work together on long-term strategic plans for the balanced and sustainable development of Ørsted's OSW projects. Nevertheless, this agreement remains an MOU. Negotiation is still ongoing in terms of project labor agreements (PLA).

41 "Agreement Will Expand Job Training for Offshore Wind Component Manufacturing." (Dec. 21, 2021). New Jersey Business Magazine. Retrieved from https://njbmagazine.com/njb-news-now/njeda-gcit-agreement-will-expand-job-training-program-for-careers-in-offshore-wind-component-manufacturing/.

42 MEA. (n.d.). *Maryland Offshore Wind Workforce Training Program—FY 2022*. Retrieved from https://energy.maryland.gov/Pages/Info/renewable/offshorewindworkforce.aspx.

In January 2021, Dominion Energy announced that it would collaborate with the Virginia State Building and Construction Trades Council, the Electrical Workers and the Laborers' Mid-Atlantic Region to negotiate a PLA for the onshore power interconnection work as part of the first stage of its Coastal Virginia Offshore Wind project.[43]

Vineyard Wind, a joint venture of Copenhagen Infrastructure Partners P/S and Avangrid, Inc., has negotiated a PLA with the Massachusetts Building Trades Council to ensure opportunities for local skilled labor. The agreement allocates $500,000 to a special fund for preapprenticeship and recruitment programs such as Building Pathways South, which will create opportunities for low-income residents, particularly in underserved communities, to both work on the Vineyard Wind project and achieve family-sustaining careers in the union construction industry. Moreover, the terms of the agreement will ensure that a majority of the workforce is from local communities, specifically from Bristol, Plymouth, Barnstable and Dukes counties, in addition to setting concrete hiring targets for women and people of color. This agreement includes a high-voltage and fiber-optic training program for local union workers at the Electrical Workers' training site in Taunton, Massachusetts. Workforce development is a critical part of the success of the burgeoning OSW industry because the required skills and safety standards are different from traditional job requirements onshore.[44]

MANUFACTURING AND PORT DEVELOPMENT

Port development is a critically to be a weak link in the United States' OSW supply chain. Current port marshalling areas can only meet half of our potential OSW demand, according to an assessment of OSW port infrastructure and deployment methods conducted by energy policy analyst Sara Parkison, a PhD candidate at the University of Delaware. Her conclusions include the necessity of developing "forward-looking port and vessel designs that will allow for more efficient and cost-effective deployment," as well as architectural and engineering advancements, in design in order to meet the Biden administration goal of 30 GW of OSW energy by 2030.

Marshalling ports are large waterside sites with the acreage and weight-carrying capacity needed to assemble, store and deploy OSW wind turbines. They are difficult to site because:

- The optimal East Coast sites are either already developed or set aside for conservation
- Space requirements are great (up to 54 acres over two years for a 1-GW project)
- Lack of overhead access from port to sea (bridges and power lines that can snag vertically transported turbine sets)
- Lack of deep enough shipping channels

Europe has designed and built megaports for the mass deployment of OSW turbines. The total area of the top three European marshalling ports are three times the size of all U.S. ports.[45] Furthermore, according to Jay Borkland, board chair of the Business Network for Offshore Wind, U.S. ports will also need to develop more space-saving ways of storing the components in marshalling ports.[46] Specifically, tower sections will have to be stored closer together, and blades will have to be stacked tighter in the U.S. ports than those in the European ports, Borkland said.

43 Jackson, M., and Castillo, M. (March 30, 2021). "Offshore Wind and Labor Union Partnerships: A Boon for an Equitable Green Recovery." Atlantic Council. Retrieved from https://www.atlanticcouncil.org/blogs/energysource/offshore-wind-and-labor-union-partnerships-a-boon-for-an-equitable-green-recovery/#:~:text=Dominion%20Energy%20announced%20on%20January,Atlantic%20Region—to%20negotiate%20a.

44 Vineyard Wind. (n.d.). "Building Trades Union and Vineyard Wind Sign Historic Project Labor Agreement" [Press release]. Retrieved from https://www.vineyardwind.com/press-releases/2021/7/16/building-trades-union-and-vineyard-wind-sign-historic-project-labor-agreement.

45 Hayes, E. (Oct. 18, 2021). "Report: Planned OSW Assembly Ports Will Only Meet Half of Demand." NetZero Insider. Retrieved from https://www.rtoinsider.com/articles/28888-planned-osw-assembly-ports-meet-half-demand.

46 Ibid.

New Jersey currently holds America's lead in OSW port development. The NJWP, which will be the first purpose-built wind port on the East Coast, is designed to host OSW blade, tower and nacelle manufacturers on more than 100 acres of co-located space. Developers broke ground in September 2021 and construction began in earnest in December 2021 with the goal of opening the port in winter 2023–2024. As of October 28, 2021, the NJEDA has already received 16 nonbinding offers to become tenants at the NJWP, including from six of the largest turbine manufacturers and OSW developers in the world. GE Renewables U.S. LLC, Siemens Gamesa Renewable Energy, Inc., and Vestas-American Wind Technology, Inc., are the three largest OSW turbine manufacturers in Europe and the United States, and all three have submitted bids for parcels C and G, the two manufacturing parcels available at the NJWP.

The NJWP will get around some of the siting problems listed above by locating on a new artificial island on the eastern shores of the Delaware River, in Lower Alloways Creek Township in Salem County. The site was selected in June 2020 after a 22-month assessment process, including engagement with industry, government and environmental stakeholders, and the NJEDA has been preparing the site and finalizing design since summer 2020. The port will have unimpeded access to the Atlantic Ocean. This is particularly important because the newer, larger wind turbines (often 400 feet tall) are transported to wind farm sites vertically. Therefore, they cannot pass under many bridges or power lines. Although some monopiles will be manufactured upstream at the Port of Paulsboro, they will be floated downriver horizontally for assembly at the new wind port.

In January 2021, the NYSERDA selected a proposal by Equinor to build what it calls the first U.S. OSW towers and transition piece manufacturing site at the Port of Albany, up the Hudson River in Rensselaer. Marmen, an onshore wind turbine manufacturer, and Welcon, a Denmark-based manufacturer of OSW towers, will participate in the project. Transition pieces are components constructed from steel pipe and connect monopoles to the wind turbine generators that rest on them.

New York Empire State Development Corporation is also seeking federal funding through the U.S. Department of Transportation's port infrastructure development grant program to develop the 32-acre Arthur Kill terminal on Staten Island as an OSW staging and assembly terminal. Apollo Global Management, a global alternative investment management firm based in New York City, has signed an exclusive agreement to invest in the project.

In March 2020, Maine commissioned a study by Moffat and Nichol to evaluate the Port of Searsport, Maine's second largest seaport, as a venue to support the transportation, assembly and fabrication of OSW turbines. This Port Infrastructure and Market Potential Assessment is part of the Maine Offshore Wind Initiative, which aims to identify development opportunities for OSW in the Gulf of Maine, which has the greatest number of natural wind resources of any area off the East Coast.

In 2017 MassCEC released its *Massachusetts Offshore Wind Ports and Infrastructure Assessment*. Three OSW developers with leases in waters south of Martha's Vineyard have committed to using the New Bedford Marine Commerce Terminal as the primary area for the staging, assembly and deployment of turbine components. Nevertheless, the OSW industry has identified additional activities, including the construction and staging of foundations, manufacturing of components and long-term operations and maintenance facilities, that may require secondary locations. MassCEC has identified a number of waterfront properties in Massachusetts that could be acquired and potentially improved through private investment to become suitable facilities for a number of OSW activities.[47]

47 MassCEC. (May 2017). *Massachusetts Offshore Wind Ports and Infrastructure Assessment*. Retrieved from https://www.masscec.com/massachusetts-offshore-wind-ports-infrastructure-assessment.

OSW VESSELS

It should be noted that at this time the vessels required for the construction of OSW farms are linked inextricably to port availability and characteristics. They are also subject to the Jones Act to some degree.

The Merchant Marine Act of 1920 is a federal law that provides for the promotion and maintenance of the U.S. merchant marine. Section 27 is known as the Jones Act, after Sen. Wesley Livsey Jones of Washington state, who introduced it. This section mandates that all shipping between U.S. ports be conducted on domestically constructed vessels under U.S. flags and crewed by U.S. citizens and permanent residents. (It also enumerates certain seafarer's rights.)

In 2021, an amendment to the OCS Lands Act clarified that devices affixed to the seabed for the purposes of oil and gas exploration as well as developing "non-mineral energy resources" fall within exclusive federal jurisdiction and constitute "coastwise" points under the Jones Act. Furthermore, two U.S. Customs and Border Protection (CBP) rulings (particularly Headquarters H316313, issued Feb. 4, 2021) later affirmed to the market that although certain portions of the project construction and turbine erection process could fall outside the purview of the Jones Act and be completed using noncompliant vessels, the act would ultimately apply to OSW construction and operations and, therefore, require the market to carefully adapt to the Jones Act's requirements.[48]

The Jones Act can cause certain production problems, in that there are currently no U.S.-flagged WTIVs in existence. In fact, there are only 12 vessels in the world capable of installing the new generation of larger OSW turbines, and none of them is Jones Act–compliant.[49] Dominion is currently having one built in Brownsville, Texas, by Keppel AmFELS, the *Charybdis*, to be ready for service by the end of 2023, and this is the only American WTIV under construction.

A lack of Jones Act–compliant WTIVs means that any such foreign-flagged vessels will not be able to dock and take on cargo in American ports. This is one reason that OSW developers will likely rely upon feeder vessels to ferry subassemblies and supplies to the WTIVs. The Coastal Virginia Offshore Wind project, under development by Dominion, ran into precisely this problem when it installed its first two pilot turbines in 2020. It was forced by scarcity to employ a foreign-flagged WTIV, fed by Jones Act–compliant vessels shuttling between it and port.

Moreover, a February 2021 CBP decision determined that Vineyard Wind's WTIV did not require Jones Act compliance because it remains stationary during the installation of a given turbine and therefore is not engaged in coastwise transportation, while the movement of its crane to unload components from the feeder vessels and installation on the seabed does not constitute transportation. Similarly, the CBP's decision also held that Vineyard's transportation of tools, equipment and personnel to and from the WTIV—and, critically, on board the WTIV as it moved from location to location—fall outside the Jones Act's requirements because the tools and equipment do not constitute "merchandise" and the crew on board the WTIV "are directly and substantially related to the operation of the vessel." Other construction activities, such as grading, turbine foundation preparation and cable laying, also have been held to fall outside the scope of the Jones Act.[50]

Another reason to rely upon feeder vessels is cost: It is more efficient to reserve these huge and massively expensive vessels for installation duty than to use them for transportation. A third reason is that most available wind ports and their related channels are not deep enough to service WTIVs, which are massive jack-up vessels with deep drafts. Dredging operations are time-consuming, expensive and environmentally problematic.

48 Wilcon, J., and Valenstein, C.A. (Dec. 14, 2021). "Jones Act Compliance Strategies for U.S. Offshore Wind Construction." Retrieved from https://www.morganlewis.com/pubs/2021/12/jones-act-compliance-strategies-for-us-offshore-wind-construction.
49 Calma, J. (Feb. 23, 2021). "The U.S. Offshore Wind Boom Will Depend on These Ships." The Verge. Retrieved from https://www.theverge.com/22296979/us-offshore-ships-wind-boom-installation-vessels.
50 Ibid.

FIGURE 1. **A WTIV at Work**[51]

PROPOSED ACTIONS

Tax policy can be a powerful tool to help the U.S. OSW industry get off the ground. The Biden administration has proposed for its 2022 budget and Treasury Green Book to authorize an additional $10 billion for new Internal Revenue Code (IRC) Section 48C tax credits for advanced energy manufacturing projects, over and above the $2.3 billion already allocated. The Green Book further proposes expanding the types of projects eligible for the credits and revising the evaluation process for selecting the projects.

The Green Book also proposes a direct-pay option, through which taxpayers could elect cash payments instead of their IRC Section 48C credits. These cash payments would be made even if they exceed total taxes due.

The current definition of eligibility in IRC includes property designed to be used to produce energy solar, wind, geothermal and “other” renewable resources, among other qualifying criteria. OSW was neither specifically mentioned nor excluded.

The Department of the Treasury applies the following criteria in evaluating projects that apply for 48C credits:

- Expectation to have commercial viability
- Maximum domestic job creation
- Maximum net impact in avoiding or reducing air pollutants or anthropogenic emissions of greenhouse gases
- Maximum potential for technological innovation and commercial deployment

51 CT Examiner. 2020. Retrieved from https://ctexaminer.com/wp-content/uploads/2021/06/2020-11-02-GustoMSC-NG-16000X-SJ-Dominion-Energy_0006-scaled.jpg.

- Minimum levelized cost of generated or stored energy or of measured reduction in energy consumption or greenhouse gas emission
- Minimum project time from certification to completion

Additional factors, such as diversity of geography, technology, project size and regional economic development, are also considered. An IRC Section 48C credit allocation, if awarded, equals 30% of the eligible investment in a project.

The new proposal would reserve $5 billion of the $10 billion in Section 48C credits for allocation to projects in coal communities. It would also revise the definition of qualifying advanced energy projects to include "industrial facilities; recycling in addition to production; and expanded eligible technologies, including but not limited to energy storage and components, electric grid modernization equipment, carbon oxide sequestration and "energy conservation technologies." The selection criteria would also be revised to include "evaluating wages for laborers."[52]

On August 11, 2021, Sen. Ed Markey (Massachusetts) announced proposed legislation entitled the Offshore Wind American Manufacturing Act. It is cosponsored by Sens. Robert Menendez (New Jersey), Cory Booker (New Jersey) and Elizabeth Warren (Massachusetts). The Offshore Wind American Manufacturing Act would boost domestic OSW manufacturing through an investment tax credit and a production tax credit for qualified OSW components and dedicated OSW vessels (e.g., WTIVS and superfeeders).

This legislation would:

- Create a 30% investment tax credit for qualified facilities that manufacture OSW components and subcomponents
- Create a new production tax credit that ranges from $0.02 to $0.05 per watt multiplied by the total rated capacity of the turbine. The production tax credit would vary by components, including blades, towers, nacelles, generators, gearboxes, foundations *and* related vessels
- Prioritize American workers and require prevailing wages for laborers involved in the construction and expansion of qualified manufacturing facilities or in the manufacture of qualified OSW products

The full investment tax credit would be available until Dec. 31, 2028, and phase out annually afterward. The production tax credit would be available until Dec. 31, 2030.

The provision covering "related vessels" is particularly important. American OSW developers have thus far been wary of investing in WTIVs and the new, larger feeder vessels, and the Markey bill actually covers this critical sector of OSW turbine construction infrastructure. So far, there are only 12 vessels in the world capable of installing the new generation of larger OSW turbines, and none of them is Jones Act–compliant. Only one is under construction, the *Charybdis*, for Dominion Energy, scheduled to sail in 2023.

The 472-foot, $500 million ship is being built in Brownsville, Texas, by Keppel AmFELS, out of 14,000 tons of U.S.-sourced steel. A total of 1,000 U.S. workers will be employed at peak construction. It will first be deployed out of New London, Connecticut, to support the construction of Revolution Wind and Sunrise Wind. *Charybdis* will be homeported in Hampton Roads, Virginia, and manned with an American crew. Ørsted and Eversource will charter the *Charybdis* for Revolution Wind (Connecticut and Rhode Island) and Sunrise Wind (New York).

All of the above notwithstanding, both the Biden Section 48C extension and the Markey bill target only manufacturing and would be helpful in reducing risk and attracting entrants for a nascent industry. Nevertheless, they are limited in that they do not address electric grid infrastructure issues or worker training.

52 U.S. Department of the Treasury. (May 2021). *General Explanations of the Administration's Fiscal Year 2022 Revenue Proposals*. Retrieved from https://home.treasury.gov/system/files/131/General-Explanations-FY2022.pdf. p. 44.

Furthermore, the DOE's Loan Programs Office currently has up to $4.5 billion in loan guarantee authority for Renewable Energy and Efficient Energy Projects under the Title 17 Innovative Energy Loan Guarantee Program (Title 17), authorized by the Energy Policy Act of 2005. Title 17 helps eliminate gaps in commercial financing for energy projects in the United States that utilize innovative technology to reduce, avoid or sequester greenhouse gas emissions.[53] These funds should be directed toward jump-starting the OSW industry, to help provide investment certainty where too little now exists.

TIME IS ON OUR SIDE, FOR NOW

It is important to bear in mind that, when making OSW policy, the rest of the world does not have such a big head start on America as one might think. The new generation of larger turbines requires building new ports and manufacturing facilities or retooling them, so the United States can tool up and catch up.

The other side of this coin, however, is that America cannot look to foreign supply sources for certain critical OSW components. There will be a shortage of supplies, equipment and finished goods as Europe and China all move quickly to deploy the newer, larger OSW power turbines.

The Jones Act is not necessarily a limiting constraint now, because it has been superseded by basic supply constraints. America now must build its own WTIVs and superfeeders, for example, because we will not be able to source them elsewhere. Europe and China are fulfilling their own demands.

Likewise, if America wants to maximize the economic potential of OSW, manufacturing jobs have to be created and maintained in the United States. For many of the critical components and infrastructure pieces, the demand is present, some public policy in support of demand growth is present and, therefore, the emphasis must be on a fuller set of fiscal incentives for manufacturing and the development of local job creation requirements by state agencies soliciting OSW electricity. To this end, strong long-term demand signals can be achieved through proper public policy. This would include support for domestic manufacturing and registered apprenticeships, for example, and it would have the added benefit of positively impacting deindustrialized communities. Manufacturing and labor cooperation is achievable, particularly when manufacturers invest in training for skilled labor in a nascent and growing industry. With judicious policy incentives and stakeholder buy-in, OSW can become an accepted part of America's energy resources portfolio.

53 Loan Programs Office. (n.d.). *Innovative Clean Energy Loan Guarantees*. Retrieved from https://www.energy.gov/lpo/innovative-clean-energy-loan-guarantees.