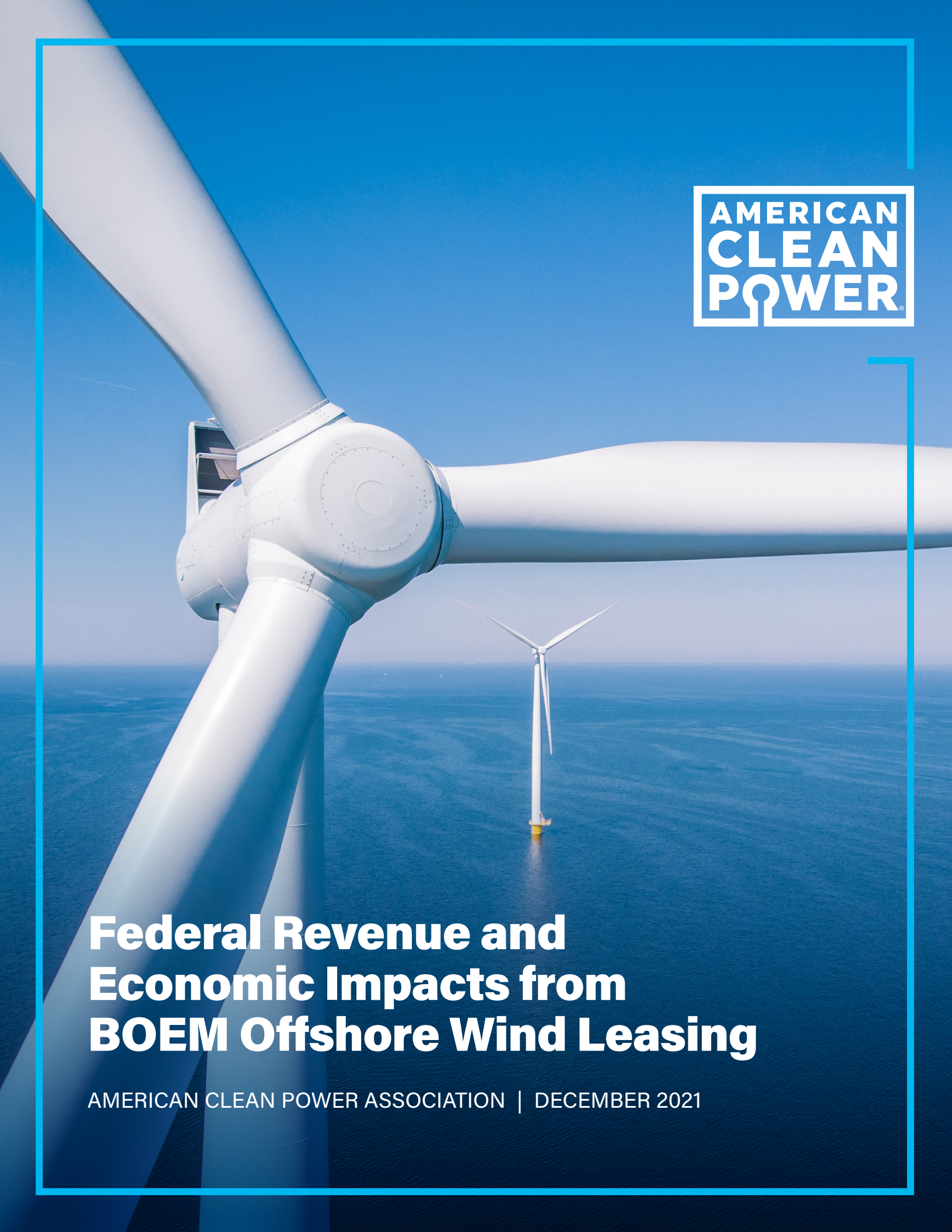


Federal Revenue and Economic Impacts from BOEM Offshore Wind Leasing

AMERICAN CLEAN POWER ASSOCIATION | DECEMBER 2021

Contents

Executive Summary

The offshore wind industry is rapidly expanding in the United States. There are currently 15 projects totaling 14.2 GW of offshore wind capacity in advanced development[1] or under construction. States along the Northeast coast, at the forefront of this growth, have established nearly 40 GW of offshore wind procurement targets through legislation, conditional targets, or executive orders. Others are expected to follow, with California, Oregon, and New Hampshire, among others, considering offshore wind targets.

The Bureau of Ocean Energy Management (BOEM) is the agency tasked with overseeing offshore renewable energy development in federal waters. The agency has worked to identify and lease areas in federal waters to offshore wind developers, but the pace is not consistent with state target timelines. To date, BOEM has conducted 8 competitive lease sales and there are currently 18 active leases with an estimated potential of 25.5 GW of total capacity. This is only 64% of the 40 GW states require, and further state action will only increase the need for additional leasing. It is therefore vital that BOEM hold new lease area auctions to open more areas for development to help meet not only the demand from individual states, but to meet the federal goal of 30 GW of offshore wind by 2030.

In October 2021, BOEM announced a proposed schedule for seven new lease area auctions across the United States by 2025. These include areas in the New York Bight, Northern & Central California, Carolina Long Bay, Oregon, the Gulf of Mexico, the Gulf of Maine, and the Central Atlantic. In the first three lease areas—New York Bight, California, and Carolina Long Bay—BOEM has already progressed to the Proposed Sale Notice (PSN) phase of the leasing process within previously identified Wind Energy Areas (WEAs). This study forecasts the revenue that BOEM could expect to accrue both from the sale of the area leases and the long-term rents and operating fees paid by projects developed in those areas, which necessarily involves estimating the size of the lease areas that will go to auction in the remaining four lease areas. Economic impacts from these future projects are also calculated.

We estimate that BOEM may lease between 6,600 and 11,400 square kilometers of area across the seven regions, generating between $1.6 and $2.7 billion in lease sale revenue over the next four years and an additional $1.1 to $1.8 billion in rents and operating fees for a total of $2.7 to $4.5 billion in new revenue over the coming decades. These leases are estimated to support between 23 GW and 40 GW of new offshore wind projects, representing over $120 billion of clean energy investment. The construction of these projects is expected to support between 73,000 and 128,000 jobs, while a further 28,000 to 48,000 jobs in operations and maintenance roles, in the supply chain, and in surrounding communities for the life of the projects could be permanently supported. Additional sales beyond those included in BOEM's "Path Forward" roadmap would increase these estimates.

Table: Summary of Annual Economic Impacts

	BASE CASE SCENARIO			HIGH AREA SCENARIO		
	Construction	Operations	Total	Construction	Operations	Total
Jobs	**73,147**	**27,511**	**100,658**	**127,751**	**48,297**	**176,048**
Wage ($ millions)	**$4,134**	**$1,532**	**$5,666**	**$7,222**	**$2,689**	**$9,911**
Output ($ millions)	**$16,647**	**$6,378**	**$23,026**	**$29,085**	**$11,198**	**$40,282**
GDP ($ millions)	**$7,975**	**$3,197**	**$11,171**	**$13,932**	**$5,612**	**$19,544**

Does not include rents and operating fees from current leases.

Introduction

The offshore wind industry is poised for significant growth in the United States. A necessary step in the evolution of the industry is the identification and leasing of areas in federal waters where offshore wind farms can be built. Past Bureau of Ocean Energy Management (BOEM) lease auctions helped enable the first wave of offshore wind development activity, but state policy requirements and the federal goal to deliver 30 GW of offshore wind by 2030 necessitate an expansion of lease areas and their timely auctioning.

This paper evaluates the economic impact of offshore wind activities as a result of potential BOEM lease auctions over the next four years. Two scenarios are presented representing a range of estimates for the ultimate size of lease areas to be auctioned and the amount of offshore wind power capacity built. Based on empirical data and reasonable estimates of future demand, these two scenarios highlight the strong economic impact future offshore wind farms will have on local and national economies and the influx of treasury revenues.

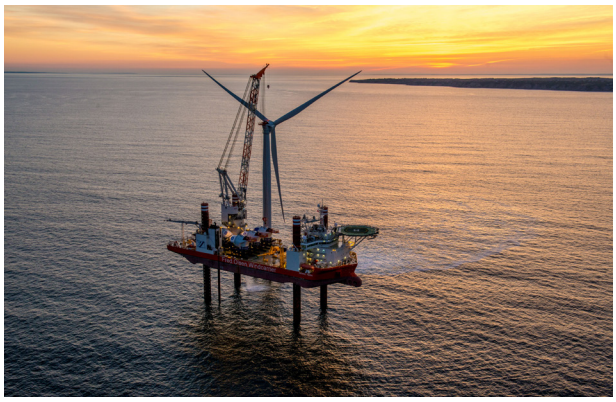
We first describe the lease areas BOEM has identified as part of its Offshore Wind Leasing Path Forward and the volume of offshore wind power capacity those areas can accommodate. Next, we forecast the revenue BOEM may generate from auctioning these lease areas as well as the rents and operating fees it will collect. Finally, we estimate the economic impacts of the offshore wind farms that are expected to be built in these lease areas.

Lease Areas

In October 2021, BOEM released its "Offshore Wind Leasing Path Forward 2021- 2025" schedule outlining target lease auction dates for offshore wind leases in 7 regions across the United States including the New York Bight, Carolina Long Bay, Northern & Central California, the Gulf of Mexico, the Central Atlantic, Oregon, and the Gulf of Maine.[1] In the New York Bight, Carolina Long Bay, and Northern & Central California regions, the specific lease areas that will be auctioned have been defined in Proposed Sale Notices (PSNs) or, in the case of California, been designated Wind Energy Areas (WEAs) and are currently undergoing environmental assessments in preparation for a PSN. In the remaining four areas, we have attempted to estimate the area that BOEM may make available for leasing.

New York Bight

The New York Bight is an area of shallow waters between Long Island and the New Jersey coast. In April 2018, BOEM published a Call for Information and Nominations (Call) to obtain nominations from companies interested in commercial wind energy development within the proposed area in the New York Bight. BOEM has identified nearly 800,000 acres as Wind Energy Areas (WEAs) in the New York Bight and initiated an environmental review on these areas for potential offshore wind leasing. In June 2021, BOEM issued a PSN that included up to eight lease areas comprising more than 625,000 acres in the New York Bight for commercial wind energy development. These areas could support over 9 GW of offshore wind capacity.[3]



Offshore wind development in the New York Bight will support demand from both the State of New Jersey and the State of New York. In July 2019, New York Governor Cuomo signed the Climate Leadership and Community Protection Act (CLCPA) into law which expanded the state's offshore wind target from 2,400 MW by 2030 to 9,000 MW by 2035. Currently, New York has secured offtake or issued awards in response to state solicitations to projects totaling just over 4.3 GW of capacity. In November 2019, New Jersey Governor Phil Murphy signed Executive Order #92, raising New Jersey's offshore wind goal from 3,500 MW by 2030 to 7,500 MW by 2035. To date, New Jersey has issued awards to projects totaling nearly 3.8 GW. In both states, there is sufficient demand to support new project development. The additional lease areas scheduled to be auctioned in Q1 of 2022 will be a vital step towards meeting both States' offshore wind targets.

Carolina Long Bay

BOEM released a PSN that includes the majority of the Wilmington East WEA in November 2021. The area included in the PSN is approximately 128,000 acres and has the potential for over 1.8 GW of offshore wind capacity. According to BOEM's roadmap, this lease sale is set to take place in Q2 of 2022. Previously, BOEM had identified three WEAs off the North Carolina coast: Kitty Hawk, Wilmington West, and Wilmington East, with one active lease within Kitty Hawk to date. Additionally, there are four call areas off the South Carolina coast: Grand Strand, Cape Romain, Charleston, and Winyah. However, BOEM has decided to move forward with a PSN for a single lease area within the Wilmington East WEA and we assume throughout the study that a final lease sale will include only the area defined in the PSN. In June 2021, Governor Roy Cooper of North Carolina issued an executive order calling for the development of 2.8 GW of offshore wind by 2030 with a total of 8 GW by 2040, creating sufficient demand for commercial development in this region that will necessitate additional lease sales in the future.

Northern & Central California

BOEM previously identified three call areas off the California coast: Morro Bay and Diablo Canyon off the central part of the state, and Humboldt off the North California coast. However, due to conflicts with the Department of Defense, BOEM announced in May 2021 an agreement to advance only the Humboldt Call Area and areas within and adjacent to the Morro Bay Call Area for offshore wind energy development. In July 2021, BOEM designated the Humboldt WEA and published the Morro Bay East and West Extensions Call, adding additional area to the existing Morro Bay Call Area. The Morro Bay WEA, containing approximately 241,000 acres, was designated in November 2021. According to BOEM's roadmap, lease areas within the Morro Bay and Humboldt WEAs could be auctioned as soon as Q3 2022. As currently defined, these areas are approximately 373,000 acres and could support over 5.4 GW of offshore wind development. Compared to areas currently under development on the east coast, the waters off California are significantly deeper, requiring the use of floating foundation offshore wind technology. In September 2021, California Governor Gavin Newsom signed AB 525 into law, which directs the state to establish specific goals for offshore wind production in 2030 and 2045 and puts the state on track to lead the U.S. on floating offshore wind. Meeting these eventual goals

will require significant action from BOEM to make lease areas available for commercial offshore wind development.

Gulf of Mexico

BOEM held its first Gulf of Mexico Renewable Energy Task Force meeting in June 2021 to facilitate coordination among federal, state, local, and tribal governments regarding the wind energy leasing process on the Outer Continental Shelf (OCS) in the Gulf of Mexico. In November, BOEM published a Call to further assess commercial interest in wind energy leasing. The Call Area consists of almost 30 million acres just west of the Mississippi River to the Texas/Mexican border. BOEM will consider comments received on the Call before conducting an environmental review and will then decide whether to publish a PSN to describe the areas chosen for leasing. According to its roadmap, BOEM is targeting a Q4 2022 PSN.

For areas where WEAs or Call Areas have not been defined, we consider two scenarios in this study. First, we assume roughly 82,000 acres supporting 1,200 MW of nameplate capacity will be auctioned in the Gulf of Mexico in the base case scenario. Recent project trends inform this factor. The last four offshore wind projects to win a state solicitation award – Ocean Wind 2 (1,148 MW), Atlantic Shores (1,510 MW), Empire Wind 2 (1,260 MW) and Beacon Wind (1,230 MW) – were all within this range. It is assumed that BOEM would seek to lease enough acreage in each region to support at least one project and will, at a minimum, make enough area available for auction to accomplish that. In the past, BOEM auctions have included multiple lease areas with multiple winning bidders. In our high area scenario, we therefore estimate that area sufficient for at least two projects (2,400 MW) will be auctioned in the Gulf of Mexico.

Central Atlantic

According to its roadmap, BOEM is targeting a Q2 2023 lease sale in the Central Atlantic region. However, a Call Area has yet to be defined. Like the methodology used in the Gulf of Mexico, we assume roughly 82,000 acres, enough to support 1,200 MW of offshore wind development, will be auctioned in the Central Atlantic in the base case scenario. In the high area scenario, given the large size of the region and expected demand from states such as Delaware, Maryland (with a state target of 1,200 MW by 2030), and Virginia (with a state target of 5,200 MW by 2034), we assume a much larger area to be auctioned on par with the upcoming NY Bight sale. In this scenario, nearly 659,000 acres could be made available for leasing, enough area to support 9,600 MW of commercial offshore wind development.

Oregon

BOEM is currently planning for offshore renewable energy leasing and development activities through the BOEM Oregon Intergovernmental Renewable Energy Task Force, a partnership of state, local, and tribal governments, and federal agencies. While BOEM has yet to define a Call Area, they have identified Q3 2023 as a target date for a lease sale off Oregon's coast. In the base case scenario, we assume that an area totaling roughly 206,000 acres will be auctioned off Oregon's coast, enough for 3,000 MW of offshore wind capacity to be installed. This value was adapted from a 2020 Pacific Northwest National

Laboratory (PNNL) study that found that up to 3 GW of electricity generated by offshore wind could be carried by current transmission lines in Oregon.[4] A bill has also been introduced in Oregon to require the state to identify the benefits and challenges of integrating up to 3 GW of offshore wind. Due to a lengthy sale process, it is assumed that BOEM would seek to maximize the proposed lease areas to take advantage of existing infrastructure and will thus make an area with a potential of at least 3,000 MW available for a lease auction. In the high area scenario, this area is doubled to roughly 412,000 acres with an offshore wind capacity potential of 6,000 MW.

Gulf of Maine

While there is not an active Call Area in the Gulf of Maine, the opportunities for development have been studied. In January 2019, BOEM established a Gulf of Maine Task Force with representatives from New Hampshire, Massachusetts, Maine, and federally recognized Tribes in the area. Currently, there are approximately 800,000 acres of federal waters being assessed for offshore wind development. Offshore wind installed in the Gulf of Maine would employ floating foundation technology due to the deep waters in the region. While Maine's previous goal of installing 5 GW of offshore wind by 2030 was converted to a general renewable portfolio standard (RPS), there is still significant demand for offshore wind in the region. Currently, a New Hampshire bill requiring 600 MW of offshore wind procurement is working its way through the state house. In Massachusetts, the state has set a target of 5,600 MW by 2035. To date, Massachusetts has secured just 1.6 GW through procurements. While a decision on another phase of offshore wind procurement is set to be announced in December 2021, the state will still require additional offshore wind development to meet its target. A lease sale in the Gulf of Maine would help reach these goals by opening new areas for commercial offshore wind development.
BOEM has proposed a lease sale in Q3 of 2024 but has not determined the total area. In this analysis, we assume that, in the base case scenario, BOEM would make enough area available for at least one project totaling 1,200 MW. In the high area scenario, we assume that enough area to develop five projects totaling 6,000 MW could be made available for auction.

Input Assumptions

As shown in Table 1, under the base case scenario, BOEM would auction nearly 6,600 square kilometers with a potential for nearly 24 GW of offshore wind energy generation between 2022 and 2024. In the high area scenario, BOEM would auction roughly 11,400 square kilometers of lease area with a total potential capacity of over 41 GW.

Table 1: Lease Auction Areas and Potential, by Scenario

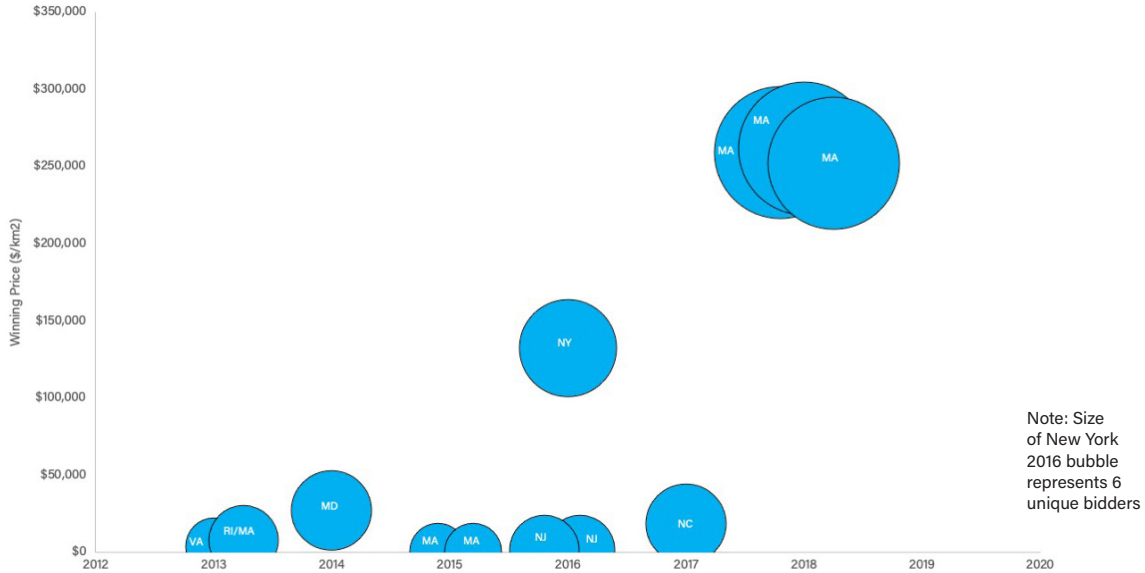
		BASE CASE			HIGH AREA SCENARIO		
Region	**Lease**	**Acres**	**KM²**	**Potential (MW)**	**Acres**	**KM²**	**Potential (MW)**
New York Bight	Central Bight	84,688	343	1,234	84,688	343	1,234
New York Bight	Hudson South - B	84,332	341	1,229	84,332	341	1,229
New York Bight	Hudson South - C	80,062	324	1,166	80,062	324	1,166
New York Bight	Hudson South - D	76,148	308	1,109	76,148	308	1,109
New York Bight	Hudson South - E	84,688	343	1,234	84,688	343	1,234
New York Bight	Hudson South - F	87,890	356	1,280	87,890	356	1,280
New York Bight	Hudson South - A	85,755	347	1,249	85,755	347	1,249
New York Bight	Hudson North	43,056	174	627	43,056	174	627
Northern & Central California	Morro Bay	240,898	975	3,510	240,898	975	3,510
Northern & Central California	Humboldt	132,369	536	1,928	132,369	536	1,928
Carolina Long Bay	Wilmington East	127,865	517	1,863	127,865	517	1,863
Oregon	N/A	205,921	833	3,000	411,842	1667	6,000
Gulf of Mexico	N/A	82,368	333	1,200	164,737	667	2,400
Gulf of Maine	N/A	82,368	333	1,200	411,842	1667	6,000
Central Atlantic	N/A	82,368	333	1,200	658,947	2667	9,600
TOTAL		**1,629,170**	**6,593**	**23,735**	**2,823,512**	**11,426**	**41,135**

Lease Revenue Forecast

In this study, the sale of OCS-A 0499, now known as Atlantic Shores Offshore Wind, will serve as the baseline price given it is the most recent data point and is located near the lease areas proposed in the New York Bight PSN, the region in which the first competitive lease auction will take place per BOEM's proposed schedule. The WEAs in the New York Bight are assumed to garner a winning bid of this baseline price converted to 2020 dollars, equal to $298,223/km2. Note, the use of this baseline price represents a conservative estimate and does not reflect increased competition for lease areas, the further growth of a secondary market for offshore leases, and demand for offshore wind since 2018. The price growth exemplified by the secondary market sale of the Atlantic Shores Offshore Wind lease and, for example, BP's $1.1 billion acquisition of a 50% interest in Equinor's Empire Wind and Beacon Wind projects, suggest that auction prices in an upcoming NY bight lease sale may be significantly higher than estimated here.

In 2018, BOEM held a competitive lease auction for three leases off the coast of Massachusetts. In the weeks following this lease sale, EDF Renewables purchased the OCS-A 0499 lease off the coast of New Jersey from US Wind for $215 million. The sale price, roughly $290,000/km2 (2018$) represents a significant increase from the 2016 auction price of just $1,356/km2, suggesting that the demand for offshore wind in this region is strong. Compared to the leases auctioned in the Massachusetts area in 2018, which had an area-weighted average price of $257,533/km2, this represents roughly a 12.5% increase in cost per square kilometer. As shown in Figure 1, OCS lease area auction prices have grown rapidly since the first competitive solicitations for offshore wind leases began in 2013.

Figure 1: Historical Auction Winning Prices and Number of Bidders



Auction prices are expected to be lower in California and Oregon due to the high cost of floating offshore wind technology compared to the fixed-bottom foundations that can be employed in the NY bight, despite the potential for higher project revenue from higher wholesale power prices in the region. Lower capacity factors and wholesale power prices depress auction prices in the Carolina Long Bay, Gulf of Mexico, and Central Atlantic regions compared to those in the New York Bight. In the Gulf

of Maine, where wholesale power prices are generally similar to those in New York and New Jersey, deep waters necessitate the use of more expensive floating technology, reducing the price bidders would likely offer. Table 2 details the auction price forecast for each region. A detailed methodology is described in the Appendix.

Table 2: Offshore Wind Lease Area Auction Price Forecast

REGION	LEASE	AUCTION PRICE ($/KM²)
New York Bight	Central Bight	$298,223
New York Bight	Hudson South - B	$298,223
New York Bight	Hudson South - C	$298,223
New York Bight	Hudson South - D	$298,223
New York Bight	Hudson South - E	$298,223
New York Bight	Hudson South - F	$298,223
New York Bight	Hudson South - A	$298,223
New York Bight	Hudson North	$298,223
Northern & Central California	Morro Bay	$218,049
Northern & Central California	Humboldt	$214,329
Carolina Long Bay	Wilmington East	$221,359
Oregon	N/A	$214,329
Gulf of Mexico	N/A	$171,997
Gulf of Maine	N/A	$169,670
Central Atlantic	N/A	$272,319

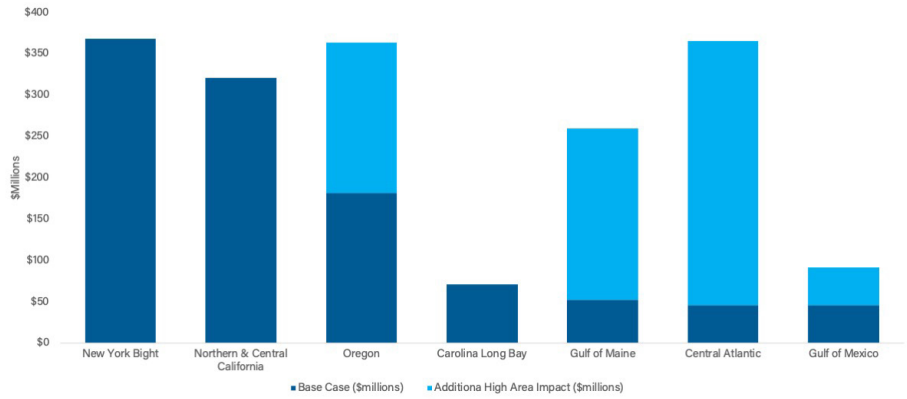
In the base case scenario, the seven lease auctions would result in a total estimated auction revenue of roughly $1.6 billion. In the high area scenario, the price per square kilometer remains the same but the increased area made available for leasing in Oregon, the Gulf of Mexico, the Gulf of Maine, and the Central Atlantic increase total BOEM auction revenue to roughly $2.7 billion. Table 3 details total BOEM revenue for each region under each scenario.

Table 3: Offshore Wind Lease Area Auction Revenue Forecast

REGION	BASE CASE ($MILLIONS)	HIGH CASE ($MILLIONS)
New York Bight	$756.2	$756.2
Central Atlantic	$90.7	$726.2
Oregon	$178.6	$357.2
Northern & Central California	$327.4	$327.4
Gulf of Maine	$56.6	$282.8
Gulf of Mexico	$57.3	$114.7
Carolina Long Bay	$114.5	$114.5
TOTAL	**$1,581.4**	**$2,679.0**

In addition to auction revenues, BOEM collects rent on leases prior to commercial operation and collects operating fees once a project enters commercial operation. Per the New York Bight PSN, rent costs are currently pegged at $3/acre and operating fees are equal to two percent of expected revenue, where expected revenue is calculated using a 40% capacity factor and the annual average price of electricity derived from a regional wholesale power price index.[5] To forecast expected rent and operating fees paid to BOEM, we assume that it will take six years to go from lease auction to start of construction and that construction will take three years, leading to a total of nine years of rent payments followed by 25 years of operating fees. Forecasted rents and operating revenues are presented below for both the base case and high area scenarios. Leasing additional areas in the Central Atlantic, Oregon, Gulf of Maine, and Gulf of Mexico regions would have a significant impact on BOEM rent and operating fee revenue.

Figure 2: Forecasted Rents and Operating Fees from BOEM Lease Auctions



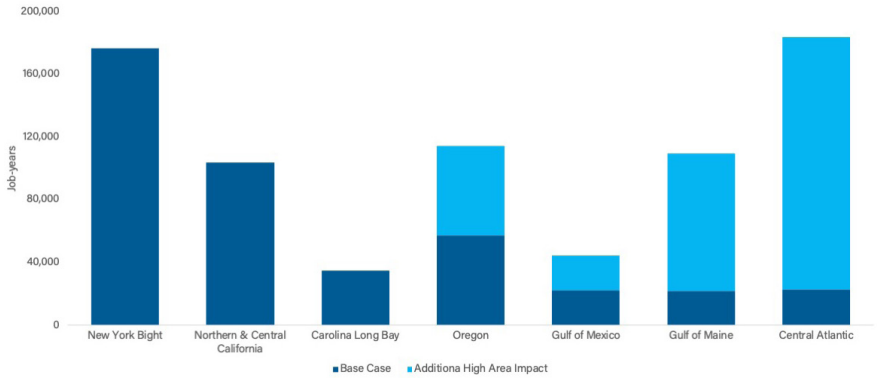
In the base case scenario, roughly $43 million dollars in rents is forecasted to be collected between the date of lease auction and the start of commercial operation, or nine years. More importantly, over $1 billion in operating fee revenue is forecasted to be collected by BOEM over 25 years of commercial operation across all seven lease areas. In the high area scenario, forecasted rents total $75 million while total lifetime operating fees total roughly $1.8 billion.

Economic Impacts

This analysis estimates the economic impacts of two phases of offshore wind: project development and construction, which is estimated for the six-year period of 2028 to 2033, and annual operations and maintenance (O&M) for the lifetime of the projects, assumed to be 25 years.

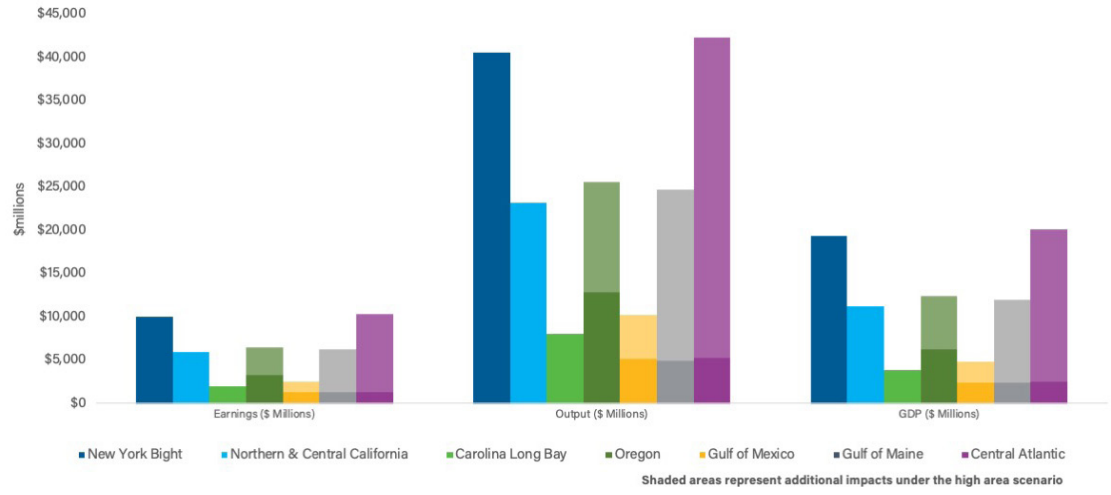
The offshore wind farms built in the lease areas identified above will deliver significant amounts of clean energy as well as hundreds of billions in capital investment, tens of thousands of jobs, and billions in GDP to the U.S. and local economies. The 23 GW to 40 GW of offshore wind development across the New York Bight, Carolina Long Bay, Northern & Central California, the Gulf of Mexico, the Central Atlantic, Oregon, and the Gulf of Maine, would support between 73,000 and 128,000 jobs during the six-year construction period.[6] The Central Atlantic lease area has the potential to support the most job-years (183,684) across the six-year construction period provided BOEM opens a wide area for leasing in that region, followed by the New York Bight (176,269 job-years), and California (103,615 job-years).

Figure 3: Total Construction Job-Year Impacts from BOEM Lease Auctions



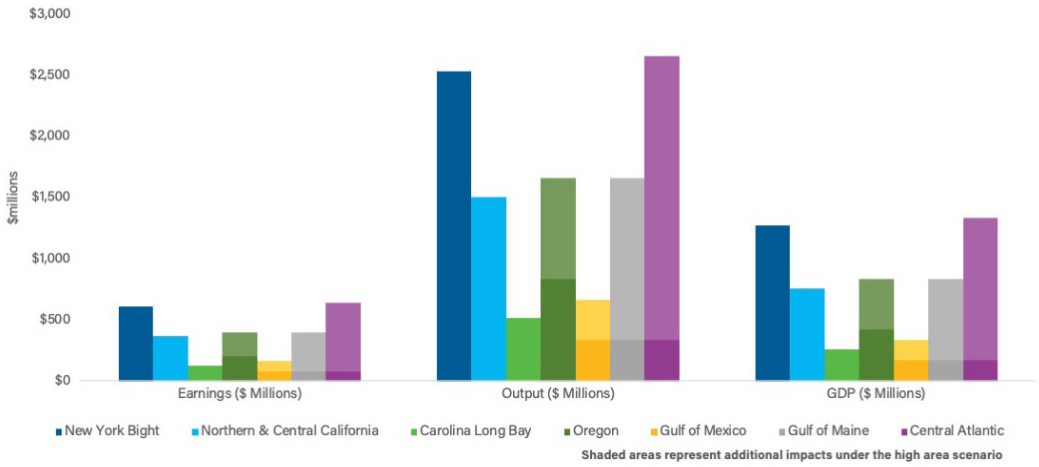
Annually, offshore wind construction in the lease areas would also support between $4.1 billion and $7.2 billion in wages, between $16.6 billion and $29.1 billion in output, and between $8.0 billion and $13.9 billion in GDP additions. Cumulatively across the six-year construction period, impacts would amount to between $24.8 billion and $43.3 billion in wages, between $99.9 billion and $174.5 billion in output, and between $47.8 billion and $83.6 billion in GDP.

Figure 4: Total Economic Impacts from BOEM Lease Auctions During Construction



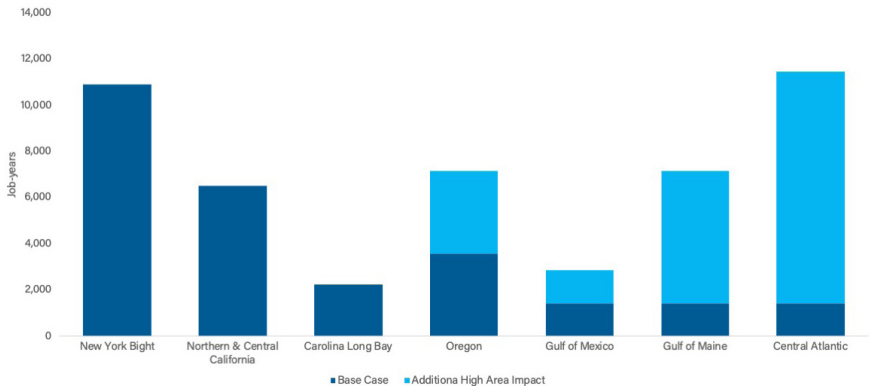
Once construction of the offshore wind projects is complete, O&M activity will continue to create positive economic impacts throughout the life of the projects. While annual impacts during the O&M phase are lower than construction impacts, operations of these facilities would create economic impacts that last for decades. Annually, O&M of the offshore wind projects in the new BOEM lease areas would support between roughly 28,000 and 48,000 jobs, in the base case and high area scenarios, respectively. A majority, 58%, of the jobs supported during O&M would be related to technical work, management, and supply chain goods and services, and the remaining 38% would stem from induced impacts.

Figure 5: Annual Operations Job Impacts from BOEM Lease Auctions



In addition to supporting permanent, full-time jobs, operations of the offshore wind facilities will also generate positive economic impacts in terms of wages, output, and GDP. Each year, O&M would support between $1.5 billion and $2.7 billion in wages, between $6.4 billion and $11.2 billion in output, and between $3.2 billion and $5.6 billion in GDP additions. Under the high area scenario, projects in the Central Atlantic lease area would support roughly a quarter of total earnings, output, and GDP.

Figure 6: Annual Economic Impacts from BOEM Lease Auctions During Operations



Conclusion

BOEM has committed to seven new lease auctions by 2025. These auctions, in the New York Bight, California, Carolina Long Bay, Oregon, the Gulf of Mexico, the Gulf of Maine, and the Central Atlantic, could generate auction revenues of between $1.6 billion and $2.7 billion, depending on how much area BOEM opens to leasing. In addition to revenues from lease auctions, BOEM is expected to receive between $1.1 and $1.8 billion in rents and operating fees in the coming decades. In sum, BOEM could generate between $2.7 and $4.5 billion in new short- and long-term revenue through new offshore lease auctions across these seven regions.

In doing so, BOEM will jumpstart economic development in these regions and across the country. New offshore wind projects in these lease areas could support between 73,000 and 128,000 jobs paying between $4.1 billion and $7.2 billion in wages to American workers annually during six years of construction activities. Once completed, these projects could generate between 28,000 and 48,000 permanent, full-time jobs related to operations and maintenance paying between $1.6 billion and $2.7 billion in wages during the operational lifetimes of the projects.

Table 4: Annual Economic Impacts of BOEM Lease Auction Development

	BASE CASE SCENARIO			HIGH AREA SCENARIO		
	Construction	Operations	Total	Construction	Operations	Total
Jobs	**73,147**	**27,511**	**100,658**	**127,751**	**48,297**	**176,048**
Wage ($ millions)	**$4,134**	**$1,532**	**$5,666**	**$7,222**	**$2,689**	**$9,911**
Output ($ millions)	**$16,647**	**$6,378**	**$23,026**	**$29,085**	**$11,198**	**$40,282**
GDP ($ millions)	**$7,975**	**$3,197**	**$11,171**	**$13,932**	**$5,612**	**$19,544**

Appendix

Lease Forecast Methodology

To estimate the winning bid price for leases in each region, two methods were used. First, estimated average monthly capacity factors from BloombergNEF[7] were combined with average monthly wholesale power prices[8] from 2020 to estimate annual revenue for a project in each region under study. This revenue was then compared to what the revenue would have been in the New York Bight (that is, under identical capacity factors and wholesale power prices) and used to scale up or down the winning bid price for that lease area. For example, if the future annual revenue earned in a particular lease area was estimated to be 10% lower than an equivalent project would produce in the New York Bight based on monthly capacity factors and power prices, the winning bid price would be adjusted down by 10% from the New York Bight baseline. Second, projects in three lease areas – California, Oregon, and the Gulf of Maine will employ floating foundations rather than the fixed-bottom foundations found in the New York Bight and other lease areas. As a newer, more expensive technology, bidders may be less likely to pay prices approaching the New York Bight given increased capital costs. Based on research by NREL, it is estimated that, in 2030, the cost of floating offshore wind will be roughly 47% higher than that of fixed-bottom offshore wind.[9] As such, the winning bid price in areas which necessitate floating technology are scaled down by 47%.

In California, for example, estimated capacity factors are roughly equivalent to those in the New York Bight. However, wholesale power prices are significantly higher leading to greater revenue per MW of installed capacity. In the absence of any other adjustment, this would lead to higher forecasted winning bid prices than those in the New York Bight. On the other hand, because floating offshore wind rather than fixed-bottom will be installed, the winning bid price was scaled down, leading to an estimate of roughly $\$218{,}000/km^2$ in Morro Bay lease area and $\$214{,}000/km^2$ in the Humboldt lease area, both lower than those in the New York Bight. The remaining difference in price comes down to small differences in estimated capacity factors and wholesale power prices between different geographies within California. This methodology was applied to each lease area to forecast auction prices and total BOEM revenues in both the base case and high area scenarios. Forecasted revenue was obtained by multiplying the forecasted winning bid price by the total area of each lease area. Auction prices are expected to be lower in California and Oregon due to the high cost of floating offshore wind technology compared to the fixed-bottom foundations that can be employed in the NY bight, despite the potential for higher project revenue due to high wholesale power prices in the area. Lower capacity factors and wholesale power prices depress auction prices in the Carolina Long Bay, Gulf of Mexico, and Central Atlantic regions compared to those in the New York Bight. In the Gulf of Maine, where wholesale power prices are generally similar to those that projects in the NY Bight would face, deep waters necessitate the use of more expensive floating technology, reducing the price bidders would offer.

Economic Impact Methodology

In each lease region, a 1,200 MW wind farm using 80 turbines, each with a nameplate capacity of 15 MW, was used as a standard project and modeled using NREL's Offshore Wind Jobs and Economic Development Impact (JEDI) Model.[10] As a result, capital costs, O&M costs, and estimated impacts vary by region and foundation type. As detailed later in the study, projects eventually developed in the California, Oregon, and Gulf of Maine lease areas will rely upon floating offshore wind technology rather than the fixed-bottom foundation technology used elsewhere. Local content assumptions are detailed

in the appendix. In short, in the fixed-bottom case, we assumed that foundations and turbine towers will be sourced domestically due to recent announcements by current lease holders who intend to source these components locally for projects currently under development. It is expected that once the supply chain for this initial tranche of projects is built out, it is likely to remain the same, or grow further going forward. In the floating foundation case, these values are significantly lower due to uncertainty about where these components will be manufactured. To calculate the total impacts in each scenario, the economic impact results from this standard project were scaled to the total capacity estimated in each region and subsequently summed across regions for each scenario.

NREL's Offshore Wind JEDI model relies on turbine component cost estimates and additional cost estimates from their ORBIT tool (Offshore Renewables Balance-of-System and Installation Tool). NREL pairs these cost estimates with input-output (I-O) multipliers from the IMPLAN model, a standard I-O model used to determine the following impacts:

- Job-years – full time equivalent (FTE) job-years, meaning one job for one year
- Wages – employee compensation and proprietor income
- Output – the total value of all goods produced
- Value added – gross domestic product (GDP), a subset of output representing the total value of all final goods and services

Economic activity is assessed across three impact categories:

- Installation activities impacts – impacts from spending on on-site labor engaged in development and construction
- Supply chain impacts – impacts due to activity in supporting industries (i.e., construction material and component suppliers, equipment manufacturers, etc.)
- Induced impacts – impacts driven by reinvestment and spending of wages by individuals impacted in the first two impact categories

NREL JEDI Model Domestic Content Assumptions

	DOMESTIC CONTENT SHARE	
CATEGORY	**FIXED-BOTTOM**	**FLOATING**
TURBINE COMPONENT COSTS		
Nacelle/Drivetrain		
Materials	10%	10%
Labor	10%	10%
Blades		
Materials	75%	75%
Labor	75%	75%
Towers		
Materials	100%	100%
Labor	100%	100%
Other/Miscellaneous	0%	0%
BALANCE OF SYSTEM COSTS		
Substructure and Foundation		
Monopile	100%	0%
Scour Protection	80%	80%
Spar	0%	0%
Semisubmersible	0%	25%
Mooring System	0%	25%
Array Cable System	50%	50%
Export Cable System	50%	50%
Offshore Substation	50%	50%
ASSEMBLY AND INSTALLATION		
Foundation		
Vessel	50%	50%
Labor	90%	90%
Mooring System		
Vessel	50%	50%
Labor	90%	90%
Turbine		
Vessel	50%	50%
Labor	90%	90%
Array Cable		
Vessel	50%	50%
Labor	90%	90%
Export Cable		
Vessel	50%	50%
Labor	90%	90%

Offshore Substation		
Vessel	50%	50%
Labor	90%	90%
Scour Protection		
Vessel	50%	50%
Labor	90%	90%
Ports and Staging		
Foundation	100%	100%
Mooring System	100%	100%
Turbine	100%	100%
Array Cable	100%	100%
Export Cable	100%	100%
Offshore Substation	100%	100%
Scour Protection	100%	100%
Development and Other Project Costs		
Site Auction Price	100%	100%
BOEM Review	100%	100%
Construction Operations Plan	100%	100%
Design Install Plan	100%	100%
Site Assessment Plan	100%	100%
Site Assessment Activities	100%	100%
Onshore Transmission	100%	100%
ENGINEERING AND MANAGEMENT		
Construction Operations	100%	100%
SOFT COSTS		
Commissioning	100%	100%
Construction Finance	50%	50%
Construction Insurance	50%	50%
Contingency	50%	50%
Decommissioning	50%	50%
Other/Miscellaneous	50%	50%

LOCAL CONTENT FOR ANNUAL OPEX	DOMESTIC CONTENT SHARE	
CATEGORY	**FIXED-BOTTOM**	**FLOATING**
OFFSHORE MAINTENANCE		
Technicians (Labor)	100%	100%
Spare Parts	50%	50%
Vessels	100%	100%
Onshore Electric Maintenance	100%	100%
OPERATIONS		
Operation, Management and General Administration	100%	100%
Operating Facilities	100%	100%
Environmental, Health, and Safety Monitoring	100%	100%
Insurance	100%	100%
Annual Leases and Fees	100%	100%

[1] We define a project that has secured offtake or won a state solicitation award as in advanced development.

[2] Available at https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/OSW-Proposed-Leasing-Schedule.pdf.

[3] Capacity estimates are based on 3.6 MW/km2 or 15 kW/acre

[4] Exploring the Grid Value Potential of Offshore Wind Energy in Oregon. Pacific Northwest National Laboratory. May 2020. Available at https://www.pnnl.gov/news-media/wind-power-oregon-coast-could-provide-more-electricity.

[5] Atlantic Wind Lease Sale 8 (ATLW-8) for Commercial Leasing for Wind Power on the Outer Continental Shelf in the New York Bight – Proposed Sale Notice. BOEM. June 2021. Available at https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/86-FR-31524.pdf

[6] Note, total jobs are calculated by dividing the total number of job-years by six years of development and construction.

[7] Offshore Wind: The U.S.'s Emerging Markets. BloombergNEF. June 2021.

[8] S&P Global Market Intelligence. Accessed November 2021.

[9] Offshore Wind Market Report: 2021 Edition. U.S. Department of Energy Office of Energy Efficiency & Renewable Energy. August 2021. Available at https://www.energy.gov/sites/default/files/2021-08/Offshore%20Wind%20Market%20Report%202021%20Edition_Final.pdf

[10] JEDI Offshore Wind Model Release 2021-2 available at https://www.nrel.gov/analysis/jedi/wind.html.

Prepared By: American Clean Power

About American Clean Power

American Clean Power is the voice of the clean power industry that is powering America's future, providing cost-effective solutions to the climate crisis while creating jobs, spurring massive investment in the U.S. economy and driving high-tech innovation across the nation. We are uniting the power of America's renewable energy industry to advance our shared goals and to transform the U.S. power grid to a low-cost, reliable and renewable power system.

Learn more about the benefits clean power brings to America at cleanpower.org and follow us on Twitter @USCleanPower, Facebook and LinkedIn.

Co-sponsored by:

About American Clean Power California

ACP-California is a state project of American Clean Power.

About the National Ocean Industries Association

The National Ocean Industries Association (NOIA) represents and advances a dynamic and growing offshore energy industry, providing solutions that support communities and protect our workers, the public and our environment.
Learn more about NOIA at noia.org or follow @oceanindustries on LinkedIn, Twitter, or Facebook.

About the New York Offshore Wind Alliance

The New York Offshore Wind Alliance (NYOWA) is a diverse coalition of organizations with a shared interest in promoting the responsible development of offshore wind power for New York. NYOWA is a project of the Alliance for Clean Energy New York (ACE NY).
The mission of the Alliance is to promote policies that will lead to the development of offshore wind in the Atlantic Ocean off the coast of New York State. NYOWA's specific goal is to secure policies and programs that will achieve Governor Cuomo's goal for New York of 9,000 MW of offshore wind power by 2035. The Alliance will undertake both public education and advocacy to build support for New York's long-term large-scale offshore wind program.

About RENEW Northeast, Inc.

RENEW Northeast, Inc. ("RENEW") is a non-profit association uniting environmental advocates and the renewable energy industry whose mission involves coordinating the ideas and resources of its members with the goal of increasing environmentally sustainable energy generation in the Northeast from the region's abundant, indigenous renewable resources. RENEW members own and/or are developing large-scale renewable energy projects, energy storage resources and high-voltage transmission facilities across the Northeast. They are supported by members providing engineering, procurement and construction services in the development of these projects and members that supply them with multi-megawatt class wind turbines. RENEW seeks to promote policies that will increase energy diversity, promote economic development, and achieve state policy goals including those found in Renewable Portfolio Standards and Global Warming Solutions Acts.

About The Southeastern Wind Coalition

The Southeastern Wind Coalition is a 501(c)3 that works to advance the land-based and offshore wind industry in the Southeast. We focus on providing fact-based information on the economic and environmental opportunities of wind energy, and encourage solutions that result in net economic benefits to residents and ratepayers. For more information about the Southeastern Wind Coalition visit sewind.org.

About The Special Initiative on Offshore Wind

The Special Initiative on Offshore Wind (SIOW) is an independent project at the University of Delaware's College of Earth, Ocean and Environment that supports the advancement of offshore wind power as part of a comprehensive solution to the most pressing energy problems facing the United States. SIOW provides expertise, analysis, information sharing and strategic partnership with industry, advocacy, and government stakeholders to build understanding and drive the deployment of offshore wind.