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Offshore Wind Energy: Federal Leasing, Permitting, Deployment, and Revenues

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SUMMARY

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Offshore Wind Energy: Federal Leasing, Permitting, Deployment, and Revenues

Offshore wind continues to be of interest as a potentially significant renewable energy resource for the United States. Offshore wind power relies on turbines constructed in bodies of water, which use wind to generate electricity. According to some estimates, offshore regions of the contiguous United States and Hawaii have the net technical potential to generate more than 7,000 terawatt hours per year of wind-based electricity—nearly twice the amount of electricity used annually in the United States in recent years—although these estimates do not take into account considerations of economic feasibility. The Biden Administration has announced a government-wide effort to deploy 30 gigawatts of offshore wind energy by 2030, which would be equivalent to more than 2% of the U.S. utility-scale electricity generating capacity and approximately 25% of total U.S. wind electricity generating capacity.

Several U.S. offshore wind projects have been developed, or are under development, in state-owned or federally owned waters. In state waters, the five-turbine Block Island Wind Farm off Rhode Island began commercial operations in 2016. To date, no projects in federal waters have progressed to the point of electricity generation, except a two-turbine pilot project off the Virginia coast. In May 2021, the Department of the Interior (DOI) approved the construction and operations plan (COP) for a larger project, Vineyard Wind, on a federal lease off the coast of Massachusetts; in November 2021, DOI approved the COP for a second project, South Fork Wind, off the coasts of Rhode Island and Massachusetts. DOI's Bureau of Ocean Energy Management (BOEM), which oversees leasing and permitting of federal offshore wind projects on the U.S. outer continental shelf, has awarded multiple additional leases for wind energy development, all in the Atlantic region. BOEM also has undertaken pre-leasing evaluations in the Pacific region and has solicited interest in potential offshore wind development in the Gulf of Mexico region.

Congress has debated whether—and, if so, how and to what extent—to promote the development of U.S. offshore wind energy. Some stakeholders have advocated for expediting federal offshore wind leasing to enable states to meet renewable power commitments, facilitate a transition away from fossil fuel energy, and promote employment in the offshore wind sector. Others have expressed concerns that wind leasing may be proceeding too quickly, especially given potential conflicts with other ocean uses, such as fishing, as well as potential impacts of offshore wind development on birds and marine mammals, concerns about the visibility of some turbines from shore, and issues related to the variability of wind as an energy source. Congress also may consider multiple issues pertaining to the deployment of offshore wind energy projects, including considerations related to domestic capacity for offshore wind infrastructure installation in the coming years, physical connections to deliver offshore wind power to the onshore power grid, and domestic electricity markets to sell into competitively. Additional issues concern the optimal disposition of federal revenues from offshore wind development, including the extent to which future revenues should be shared with coastal states.

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Offshore wind is a growing contributor to the energy mix for some nations and has been of interest as a potentially significant renewable energy resource for the United States.[1] The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) estimated that offshore regions of the contiguous United States and Hawaii have the net technical potential to generate more than 7,000 terawatt hours per year of wind-based electricity—nearly twice the electricity used annually in the United States in recent years.[2] (This estimate takes into account potential technological, environmental, and land-use conflicts but not considerations of economic feasibility.) In March 2021, the Biden Administration announced a government-wide effort to deploy 30 gigawatts (GW) of offshore wind energy by 2030.[3] For comparison, in 2020, the total U.S. utility-scale electricity nameplate generating capacity was approximately 1,212 GW, with nearly 119 GW of that capacity produced from wind energy resources (virtually all onshore).[4]

The 117th Congress has conducted oversight and introduced legislation concerning offshore wind energy.[5] Congress has debated whether—and, if so, how and to what extent—to promote the development of U.S. offshore wind. Congress plays a direct role in decisions about wind

[1] For general information on global offshore wind development, see International Energy Administration, *Offshore Wind Outlook 2019*, November 2019, at https://www.iea.org/reports/offshore-wind-outlook-2019; *Offshore Wind: Tracking Report*, June 2020, at https://www.iea.org/reports/tracking-offshore-wind-2020; and *Renewables 2020: Analysis and Forecast to 2025*, November 2020, at https://www.iea.org/reports/renewables-2020/wind#abstract.

[2] U.S. Department of Energy (DOE), National Renewable Energy Laboratory (NREL), *2016 Offshore Wind Energy Resource Assessment for the United States*, Technical Report NREL/TP-5000-66599, September 2016, p. 39, at https://www.nrel.gov/docs/fy16osti/66599.pdf (hereinafter cited as NREL, *2016 Assessment*). NREL estimated that the Alaska offshore region could technically contribute a further 12,000 terawatt hours per year; NREL, *Offshore Wind Energy Resource Assessment for Alaska*, Technical Report NREL/TP-5000-70553, December 2017, p. v, at https://www.nrel.gov/docs/fy18osti/70553.pdf (hereinafter cited as NREL, *2017 Alaska Assessment*). U.S. wind energy resource estimates are highly dependent upon certain assumptions, such as turbine height and capacity power density (electricity generation per land or ocean surface area).

[3] White House, "Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs," fact sheet, March 29, 2021, at https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/. The initiative includes steps to expedite offshore wind leasing and permitting, invest in port infrastructure, provide access to loan guarantees, and provide research and development funding, among other actions. In January 2021, President Biden had set a goal of "doubling offshore wind by 2030" (Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," Section 207, January 27, 2021, 86 *Federal Register* 7619). The Administration also proposed floating offshore wind demonstration projects as part of the American Jobs Plan (White House, "The American Jobs Plan," fact sheet, March 31, 2021, at https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan).

[4] U.S. Energy Information Administration (EIA), *Electric Power Annual*, "Table 4.3 Existing Capacity by Energy Source," October 29, 2021, at https://www.eia.gov/electricity/annual/html/epa_04_03.html. *Nameplate generating capacity* refers to the maximum rated output of electricity generated under specific conditions.

[5] Recent hearings exploring offshore wind in the 117th Congress include U.S. Congress, House Committee on Natural Resources, Subcommittee on Energy and Mineral Resources, *Building Back Better: Reducing Pollution and Creating Jobs Through Offshore Wind*, hearing, 117th Cong., 1st sess., April 20, 2021, at https://naturalresources.house.gov/hearings/building-back-better-reducing-pollution-and-creating-jobs-through-offshore-wind; U.S. Congress, Senate Committee on Energy and Natural Resources, *Full Committee Hearing on Offshore Energy Development in Federal Waters and Leasing Under the Outer Continental Shelf Lands Act*, hearing, 117th Cong., 1st sess., May 13, 2021, at https://www.energy.senate.gov/hearings/2021/5/full-committee-hearing-to-examine-offshore-energy-development; U.S. Congress, House Committee on Foreign Affairs, Subcommittee on Europe, Energy, the Environment and Cyber, *Renewable Energy Transition: A Case Study of How International Collaboration on Offshore Wind Technology Benefits American Workers*, hearing, 117th Cong., 1st sess., July 29, 2021, at https://foreignaffairs.house.gov/2021/7/renewable-energy-transition-a-case-study-of-how-international-collaboration-on-offshore-wind-technology-benefits-american-workers; and U.S. Congress, House Committee on Energy and Commerce, Subcommittee on Energy, *Offshore Wind, Onshore Benefits: Growing the Domestic Wind Energy Industry*, hearing, 117th Cong., 1st sess., October 21, 2021, at https://energycommerce.house.gov/committee-activity/hearings/hearing-on-offshore-wind-onshore-benefits-growing-the-domestic-wind.

development offshore by virtue of the federal government's jurisdiction over most of the ocean territory surrounding the United States. The U.S. outer continental shelf (OCS), extending from the outer boundaries of state waters (in most cases, 3 nautical miles from shore) to at least 200 nautical miles from shore, is federally managed, primarily under the Submerged Lands Act and the Outer Continental Shelf Lands Act (OCSLA).[6]

A 2005 amendment to the OCSLA authorized the Secretary of the Interior to offer leases, easements, and rights-of-way on the OCS for offshore renewable energy activities.[7] Since then, the Department of the Interior's (DOI's) Bureau of Ocean Energy Management (BOEM) has awarded multiple leases for wind energy development in U.S. waters.[8] To date, no renewable energy projects in federal waters have progressed to the point of electricity generation, except a two-turbine pilot project off the Virginia coast.[9] In state waters, the five-turbine Block Island Wind Farm off Rhode Island began commercial operations in 2016.

This report begins with a brief overview of offshore wind technology. It then discusses background and selected considerations related to leasing, project permitting, deployment, and federal revenues from offshore wind. In addition to the issues discussed in this report, Congress has considered other issues relevant to the development of U.S. offshore wind, such as federal research activities, job programs, and tax incentives to promote offshore wind development, as well as broader questions related to the balance of conventional and renewable energy resources and to the physical and cyber security of the electric power system in the United States. These issues are outside the scope of this report.

Overview of Offshore Wind Technology

Offshore wind power relies on *wind farms* (collections of wind turbines) constructed in bodies of water that use wind to generate electricity in much the same manner as onshore wind farms. Generally, offshore wind turbines are larger than onshore wind turbines. Other distinguishing features of offshore wind turbines include the supporting structure or foundation for the wind turbine and the support vessels required for offshore wind development.

The wind flowing over a body of water turns an offshore wind turbine's blades; the blades attach to a rotor, which spins a generator to create electricity. The generated electricity then can be delivered to an onshore electrical grid through undersea cables to grid interconnection equipment.[10] Key factors that affect the amount of electricity generated from a wind turbine

[6] Submerged Lands Act, 43 U.S.C. §§1301 et seq.; and Outer Continental Shelf Lands Act (OCSLA), 43 U.S.C. §§1331-1356. For Texas and a portion of Florida, state waters extend to 9 nautical miles from shore. For more information, see CRS Report R40175, *Wind Energy: Offshore Permitting*, by Adam Vann; and CRS Report RL33404, *Offshore Oil and Gas Development: Legal Framework*, by Adam Vann.

[7] P.L. 109-58, Section 388 (43 U.S.C. §1337(p)), authorized the Secretary of the Interior to issue leases, easements, and rights-of-way for energy development "from sources other than oil and gas."

[8] As of the date of this report, the Bureau of Ocean Energy Management (BOEM) had issued 19 offshore wind leases for projects that remain active (**Table 1**). In addition to these, BOEM awarded several other leases that expired or were relinquished (for more information, see BOEM, "Lease and Grant Information," at https://www.boem.gov/renewable-energy/lease-and-grant-information). Some offshore wind projects span multiple leases, and some leases contain multiple projects.

[9] BOEM, "Coastal Virginia Offshore Wind Project," at https://www.boem.gov/renewable-energy/state-activities/coastal-virginia-offshore-wind-project-cvow.

[10] The size and number of undersea electrical cables and the type of additional equipment needed to ensure compatibility with the electrical grid depend on numerous factors, including whether the electrical cables deliver direct current (DC) electricity, where the electric charge flows in one direction, or alternating current (AC) electricity, where

include wind speed, air density, and the *swept area* of the turbine (the area through which the rotor blades spin). Generally, the faster the wind speed, the denser the air, and the larger the swept area, the more electricity can be generated from the wind turbine.

Variability of Offshore Wind Energy

In 2020, the global operating capacity of offshore wind energy totaled nearly 33 gigawatts (GW), with approximately 76% of the offshore wind capacity located in Europe. The United Kingdom—with more than 10 GW of offshore wind capacity—generated 24% of its total electricity from wind resources in 2020. Wind energy is a variable energy source, in that it can produce electricity only when the wind is blowing. In the late summer and early fall of 2021, weather conditions resulted in lower-than-expected wind energy generation in the North Sea, increasing demand for electricity from fossil fuel-fired generators in the United Kingdom. According to the International Energy Agency (IEA), European natural gas demand has increased due to wind availability, cold weather in the first quarter of 2021, and an overall increase in demand compared with pandemic-related declines in 2020. These increases in demand have combined with decreases in supply to increase natural gas prices and electricity prices overall.

In the United States, current levels of generation from variable renewable energy sources have not created widespread reliability issues. Sufficient backup capacity usually is available, and system operators and participants are developing new practices to address the variability of wind and solar sources. Options to address potential reliability issues include transmission system expansion, smart grid upgrades, increased generation from fossil sources, and energy storage additions. For more information on variable renewable energy, see CRS In Focus IF11257, *Variable Renewable Energy: An Introduction*, by Ashley J. Lawson.

Sources: Department of Energy, *Offshore Wind Market Report: 2021 Edition*, DOE/GO-102021-5614, August 2021, p. 37; UK Department for Business, Energy & Industrial Strategy, *Digest of UK Energy Statistics (DUKES)*, "Chapter 5: Electricity," updated July 29, 2021, p. 6; Carlos Fernández Alvarez and Gergely Molnar, "What Is Behind Soaring Energy Prices and What Happens Next?," IEA, October 12, 2021, at https://www.iea.org/commentaries/what-is-behind-soaring-energy-prices-and-what-happens-next; IEA, "Statement on Recent Developments in Natural Gas and Electricity Markets," September 21, 2021, at https://www.iea.org/news/statement-on-recent-developments-in-natural-gas-and-electricity-markets.

Different turbine configurations and characteristics can affect turbine performance. As mentioned, offshore wind turbines are typically taller and larger than onshore wind turbine systems. **Figure 1** depicts a typical offshore wind turbine configuration.[11]

Fixed-bottom turbine support structures are the predominantly deployed offshore wind technology.[12] These structures, also referred to as *foundations*, secure the tower with the turbine components to the sea floor. There are several types of foundation technologies, including monopiles, jackets, and gravity-based foundations. Monopiles, which accounted for approximately 75% of the global operating offshore wind capacity in 2020, are cylindrical structures driven or drilled into the seafloor and attached to the bottom of the turbine tower.[13] Jacket structures, which accounted for nearly 11% of the global operating offshore wind capacity

the electric charge reverses direction periodically. Most electricity in the United States is generated and distributed in AC at a frequency of 60 Hertz (i.e., cycles per second). Wind turbine generators produce AC electricity, although the frequency can differ from the electrical grid's 60 Hertz frequency. Most offshore projects use AC systems, although there is interest in DC technologies. Both technologies have advantages and disadvantages. See Padmavathi Lakshmanan, Ruijuan Sun, and Jun Liang, "Electrical Collection Systems for Offshore Wind Farms—A Review," *CSEE Journal of Power and Energy Systems*, (July 2021), pp. 10-11.

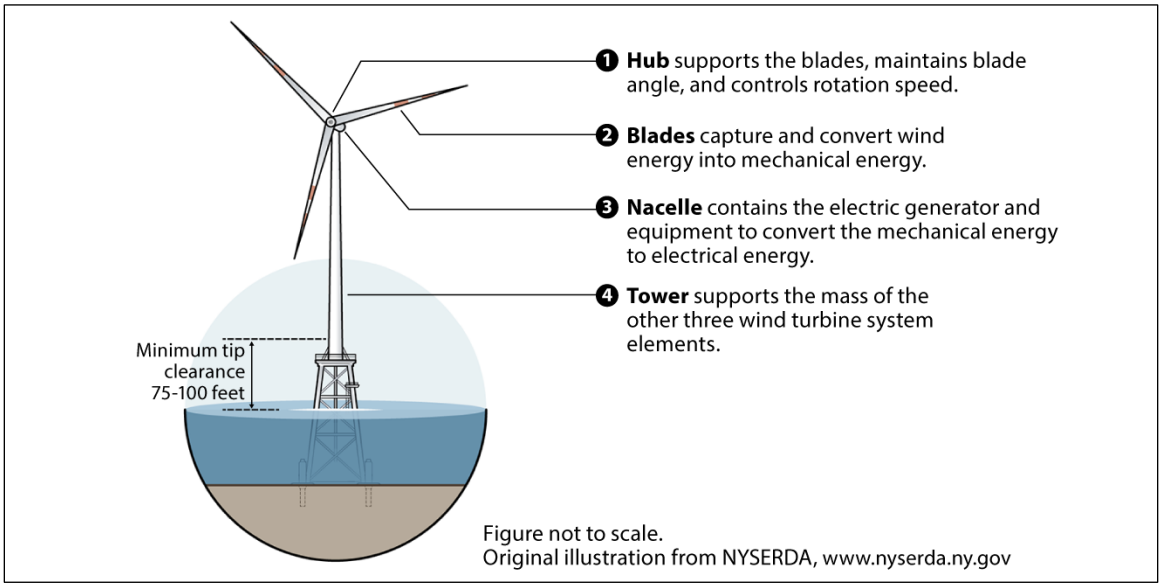
[11] Generally, there are two basic types of wind turbines: horizontal-axis turbines and vertical-axis turbines.

[12] National Offshore Wind Research and Development Consortium, *Research and Development Roadmap Version 2.0*, October 2019, p. 6.

[13] DOE, *Offshore Wind Market Report: 2021 Edition*, DOE/GO-102021-5614, August 2021, p. 57 (hereinafter cited as DOE, *2021 Market Report*).

in 2020, typically consist of four legs that are connected by braces and attached via anchors or drilled piles into the seafloor.[14] Gravity-based foundations are placed on the seafloor and rely on the structure's weight to resist overturning. Fixed-bottom structures were designed for European offshore sites and may not be appropriate for all U.S. offshore sites, due to differences such as water depth, seabed characteristics, and extreme weather conditions.

Figure 1. Offshore Wind Turbine Components



Source: CRS adaptation of illustration from New York State Energy Research and Development Authority (NYSERDA), "Offshore Wind 101," at https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/About-Offshore-Wind/Offshore-Wind-101.

In addition to fixed-bottom structures, the offshore wind industry is exploring the use of floating structures, which are not set into the ocean floor.[15] Floating foundations are a potential support structure for projects in deep water (approximately 60 meters or 200 feet in depth, or deeper), such as occurs in the Gulf of Maine and off the Pacific coast and Hawaii.[16] Most planned floating projects use semisubmersible structures; other floating structure designs can include barge, tension leg platform, and spar technology.[17] Tension leg platforms are buoyant structures that have arms connected through tension to a foundation or anchor system.[18] Spar technology relies on spar buoys, ballasted cylindrical buoys that keep the center of gravity below the center of buoyancy.[19] **Figure 2** depicts several types of fixed-bottom and floating structures.

[14] Ibid., p. 57.

[15] U.S. Government Accountability Office (GAO), *Offshore Wind Energy: Planned Projects May Lead to Construction of New Vessels in the U.S., But Industry Has Made Few Decisions amid Uncertainties*, GAO-21-153, December 2020, p. 9.

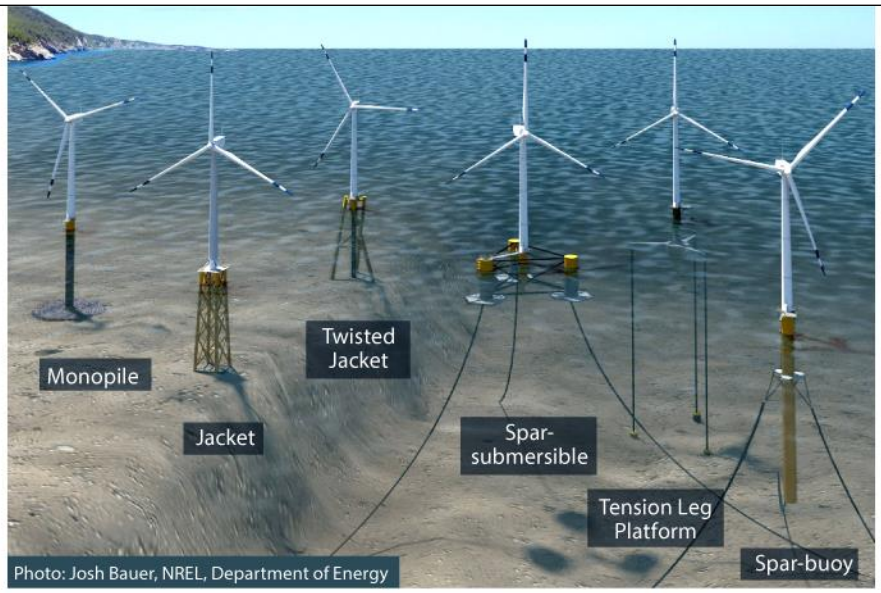
[16] DOE, *2021 Market Report*, pp. xii and 48.

[17] Ibid., p. 59.

[18] International Renewable Energy Agency (IRENA), *Floating Foundations: A Game Changer for Offshore Wind Power*, 2016, p. 5.

[19] Ibid., p. 5.

Figure 2. Offshore Wind Structural Support



Source: CRS adapted illustration from Josh Bauer, National Renewable Energy Laboratory (NREL), at https://www.energy.gov/eere/articles/us-conditions-drive-innovation-offshore-wind-foundations.

Federal Offshore Wind Leasing Process[20]

BOEM oversees leasing for offshore wind energy on the U.S. outer continental shelf, as well as permitting of wind projects on developed leases. This regulatory structure generally differs from that for offshore oil and gas, where BOEM has responsibility for leasing but its sister agency, the Bureau of Safety and Environmental Enforcement (BSEE), is primarily responsible for permits to develop projects on existing leases and for inspections and environmental enforcement.[21]

The OCSLA and agency regulations allow BOEM to offer commercial wind leases and "limited leases" (e.g., leases for pilot or research projects that do not result in commercial production beyond a specified limit).[22] The agency must afford a competitive process for offshore wind leasing unless it determines after public notice that there is no competitive interest.[23] BOEM has awarded most wind leases as competitive commercial leases, especially in recent years.

[20] This section provides background on BOEM's leasing process and activities, including relevant regulations and policies. For a discussion of the statutory framework underlying the BOEM process, see CRS Report R40175, *Wind Energy: Offshore Permitting*, by Adam Vann.

[21] Under DOI Secretarial Order 3299 (August 29, 2011), BOEM has authority over all aspects of DOI's offshore renewable energy program until the Assistant Secretary for Land and Minerals Management "determines that an increase in activity justifies transferring the inspection and enforcement functions to the Bureau of Safety and Environmental Enforcement." For more information, see BOEM and BSEE, "Memorandum of Agreement Between the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement," December 22, 2020, at https://www.boem.gov/sites/default/files/documents/renewable-energy/BOEM-BSEE-Renewable-Energy-MOA_0.pdf. Under this memorandum of agreement, BSEE is to assist BOEM with its safety, environmental compliance, inspection, enforcement, and other specified activities, such as by advising and consulting with BOEM.

[22] 30 C.F.R. §585.202.

[23] 30 C.F.R. §585.201. For information on the award of noncompetitive leases, see 30 C.F.R. §585.230-585.232.

The commercial leasing process consists of four broad phases (**Figure 3**). In the *planning and analysis* phase, BOEM seeks industry interest in wind leasing by publishing a call for information and nominations for a selected offshore area, known as a *call area*. BOEM may proactively initiate consideration of a potential call area, or BOEM's receipt of one or more unsolicited applications for a lease could trigger such consideration.[24] Wind energy developers and other stakeholders—such as state and tribal governments, natural resource agencies, and other ocean users—may provide comments at the call stage. The responses to the call may help BOEM determine if there is competitive interest in leasing in the area.[25] Based partly on the feedback received, BOEM may identify, within the call area, targeted wind energy areas (WEAs) that appear "most suitable" for leasing.[26] The WEA identification process includes public input and environmental evaluation under the National Environmental Policy Act (NEPA).[27] For example, the U.S. Coast Guard may evaluate the impacts of potential projects on navigation safety and provide input to BOEM.[28] BOEM has previously identified call areas and/or WEAs off the Atlantic and Pacific coasts, and in November 2021, BOEM published a call for information and nominations for an area in the Gulf of Mexico.[29]

In the second phase (the *leasing* phase), BOEM determines if there is competitive interest in leases within the WEAs by publishing a request for interest in the *Federal Register*. If interest exists, BOEM holds a lease auction.[30] To date, BOEM has held lease auctions only in the Atlantic region. If no competitive interest exists, BOEM may negotiate a lease noncompetitively after consultation with affected federal agencies, state and local governments, and Indian tribes.[31]

In the third phase, a company that has obtained a lease conducts *site assessment* activities—for example, constructing a meteorological tower or installing meteorological buoys to estimate wind resources. BOEM must approve the lessee's site assessment plan (SAP) through a process that includes environmental review under NEPA. BOEM has approved multiple SAPs (**Table 1**), all of them in the Atlantic region.

The final phase is the *construction and operations* phase, in which the lessee builds and operates the wind facility after obtaining BOEM's approval of its construction and operations plan (COP). The COP approval process requires a further round of environmental review and public comment, in addition to those performed in earlier phases. To date, BOEM has approved two COPs (**Table 1**); other COPs are at various stages of review.

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[24] 30 C.F.R. §585.211 and 585.230.

[25] For example, see BOEM, "Commercial Leasing for Wind Power Development on the Outer Continental Shelf (OCS) Offshore California—Call for Information and Nominations (Call)," 83 *Federal Register* 53096, October 19, 2018.

[26] BOEM, "Wind Energy Commercial Leasing Process," fact sheet, January 2017, at http://www.boem.gov/sites/default/files/boem-newsroom/Wind-Energy-Comm-Leasing-Process-FS-01242017-%281%29.pdf.

[27] 42 U.S.C. §4321. For more information on National Environmental Policy Act (NEPA) evaluations, see CRS Report RL33152, *The National Environmental Policy Act (NEPA): Background and Implementation*, by Linda Luther.

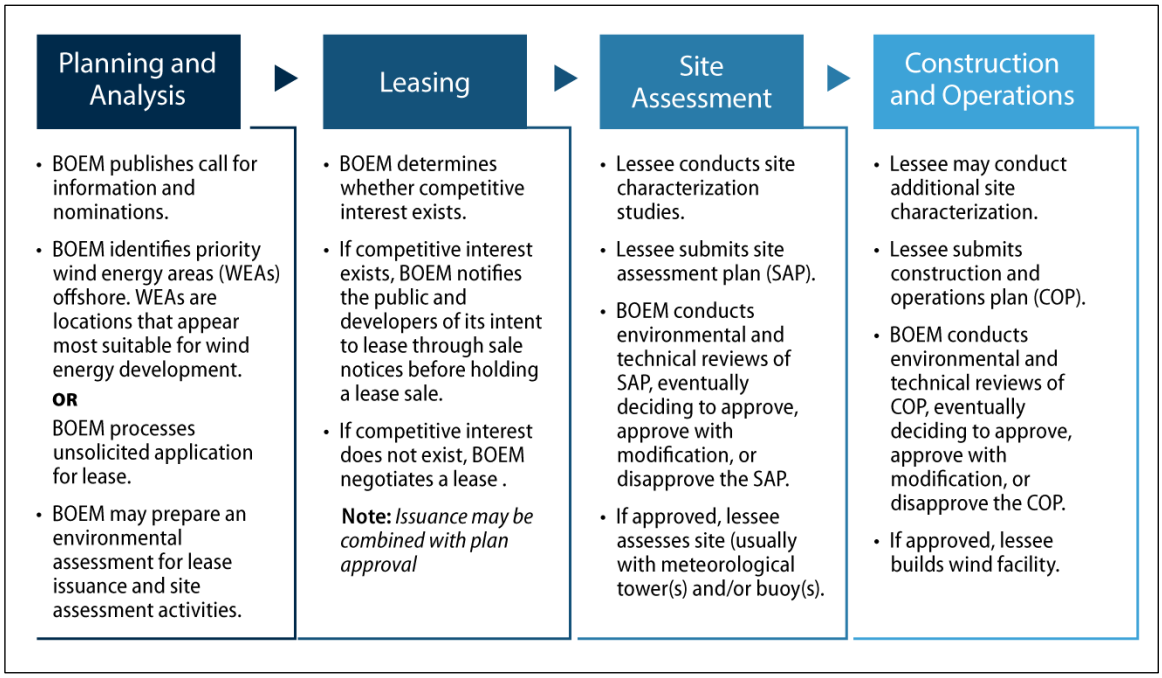
[28] U.S. Coast Guard, *Guidance on the Coast Guard's Roles and Responsibilities for Offshore Renewable Energy Installations (OREI)*, Navigation and Vessel Inspection Circular No. 01-19, August 1, 2019, at https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/5ps/NVIC/2019/NVIC%2001-19-COMDTPUB-P16700-4-dtd-01-Aug-2019-Signed.pdf?ver=2019-08-08-160540-483. Also see Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE), "BOEMRE and Coast Guard Sign Agreement Outlining Roles for Offshore Renewable Energy Installations," press release, July 27, 2011, at https://www.boem.gov/sites/default/files/boem-newsroom/Press-Releases/2011/press0727.pdf. BOEMRE was the predecessor agency to BOEM.

[29] BOEM, "Call for Information and Nominations—Commercial Leasing for Wind Power Development on the Outer Continental Shelf in the Gulf of Mexico," 86 *Federal Register* 60283, November 1, 2021.

[30] 30 C.F.R. §585.210.

[31] 30 C.F.R. §585.231.

Figure 3. Bureau of Ocean Energy Management (BOEM) Wind Energy Commercial Leasing Process



Source: CRS adaptation of BOEM, "Wind Energy Commercial Leasing Process," January 2017, at http://www.boem.gov/sites/default/files/boem-newsroom/Wind-Energy-Comm-Leasing-Process-FS-01242017-%281%29.pdf.

Table 1. Active Outer Continental Shelf (OCS) Offshore Wind Leases

(as of December 2021)

State(s)[a]	Lease No.	Year Awarded: Competitive (C) / Noncompetitive (N)[b]	Company or Project Name(s)	Site Assessment Plan (SAP) Final Approval?	Construction & Operations Plan (COP) Final Approval?	Commercial Operations?
Delaware / Maryland	OCS-A 0482	2012 (N)	Garden State Offshore Energy (GSOE 1)	Yes	—	—
	OCS-A 0519	2018 (N)	Skipjack	Yes	—	—
Maryland	OCS-A 0490	2014 (C)	U.S. Wind / MarWin	Yes	—	—
Massachusetts	OCS-A 0500	2015 (C)	Bay State Wind	Yes	—	—
			Sunrise Wind[c]	Yes	—	—
	OCS-A 0501	2015 (C)	Vineyard Wind 1	Yes	Yes	—
	OCS-A 0534	2015 (C)[d]	New England Wind / Park City / Commonwealth[d]	Yes	—	—
	OCS-A 0520	2018 (C)	Beacon Wind	Yes	—	—
	OCS-A 0521	2018 (C)	Mayflower Wind	Yes	—	—
	OCS-A 0522	2018 (C)	Liberty Wind	—	—	—

State(s)[a]	Lease No.	Year Awarded: Competitive (C) / Noncompetitive (N)[b]	Company or Project Name(s)	Site Assessment Plan (SAP) Final Approval?	Construction & Operations Plan (COP) Final Approval?	Commercial Operations?
New Jersey	OCS-A 0498	2016 (C)	Ocean Wind 1	Yes	—	—
	OCS-A 0532	2016 (C)[e]	Ocean Wind 2[e]	Yes	—	—
	OCS-A 0499	2016 (C)	Atlantic Shores	Yes	—	—
New York	OCS-A 0512	2017 (C)	Empire Wind	Yes	—	—
North Carolina	OCS-A 0508	2017 (C)	Kitty Hawk	Yes	—	—
Rhode Island / Massachusetts	OCS-A 0486	2013 (C)	Revolution Wind	Yes	—	—
	OCS-A 0487	2013 (C)	Sunrise Wind[c]	Yes	—	—
	OCS-A 0517	2013 (C)	South Fork Wind	Yes	Yes	—
Virginia	OCS-A 0483	2013 (C)	Dominion Coastal Virginia Offshore Wind (CVOW)	Yes	—	—
	OCS-A 0497	2015 (N; research lease)	CVOW pilot project	Yes[f]	Yes[f]	Yes[g]

Source: CRS.

a. Column shows the state (or states) identified by BOEM as being the adjoining coastal state(s), based on BOEM's offshore administrative boundary lines at https://www.boem.gov/oil-gas-energy/mapping-and-data/map-gallery/administrative-boundaries. Depending on offtake agreements between wind developers and power purchasers, the BOEM-identified state might not be the state where power eventually would be delivered. For example, the Revolution Wind project on Lease OCS-A 0486 lies off Rhode Island and Massachusetts, according to BOEM's administrative boundaries, but the developer has a purchase agreement to deliver some power to Connecticut.

b. All leases are commercial leases unless otherwise noted.

c. The Sunrise Wind project spans parts of two leases, OCS-A 0500 and OCS-A 0487.

d. In June 2021, BOEM approved the assignment of a portion of Lease OCS-A 0501 to become Lease OCS-A 0534. Originally known as Vineyard Wind South, the project on this lease was renamed New England Wind. The project will have two phases, known as Park City Wind (Phase 1) and Commonwealth Wind (Phase 2).

e. In March 2021, BOEM approved the assignment of a portion of Lease OCS-A 0498 to become Lease OCS-A 0532.

f. Because the CVOW pilot project was constructed on a research lease rather than a commercial lease, BOEM approved a research activities plan (RAP) rather than a SAP and COP for the project. BOEM's approval of the RAP included initial approval in March 2016 and approval of a revised RAP in June 2019. BOEM's approvals of the RAP and the revised RAP provided authorization for construction of the two-turbine project.

g. The CVOW pilot project began generating power in September 2020 and completed steps required to begin commercial operations in January 2021 (CRS communication with BOEM Office of Legislative Affairs, April 13, 2021). BOEM is not collecting an operating fee for the CVOW pilot project because the project operates on a research lease.

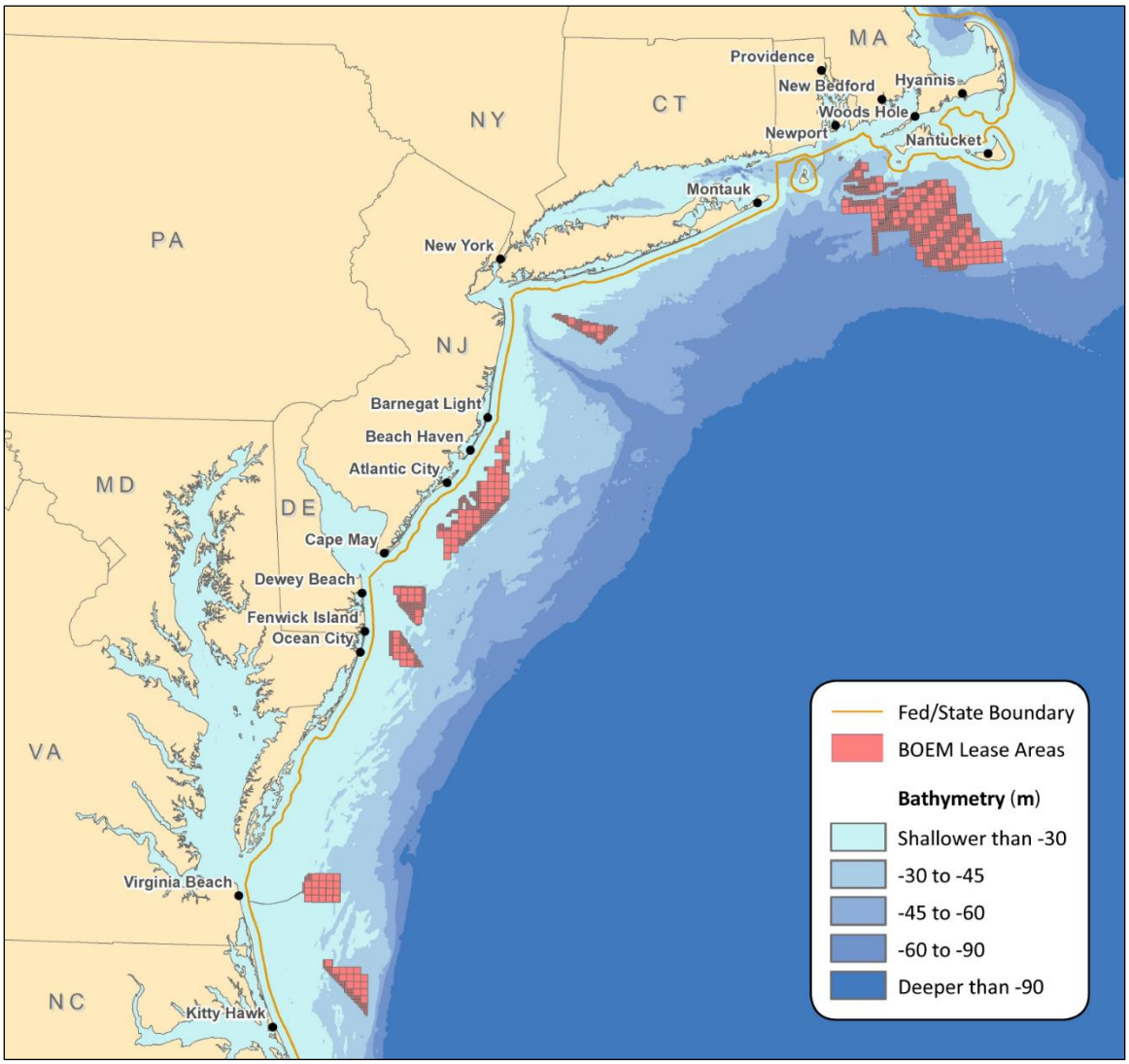
BOEM Leasing Activities

BOEM granted its first leases for wind energy development in 2009 and administered 19 active wind leases as of the date of this report (**Figure 4** and **Table 1**). BOEM issued two

noncompetitive commercial wind leases, one in 2010 and one in 2012.[32] More recently, BOEM has awarded all commercial leases through competitive auctions.[33] All of the issued leases have been in the Atlantic region.[34] BOEM has undertaken pre-leasing evaluations, including identifying call areas, in the Pacific region and the Gulf of Mexico region.

Figure 4. Map of BOEM's Renewable Energy Leases

(as of March 2021)



Source: BOEM, *Renewable Energy Map Book*, March 2021, p. 2, at https://www.boem.gov/Renewable-Energy-Lease-Map-Book/. As of November 2021, BOEM has not held new lease sales beyond those shown on the map.

[32] BOEM awarded Lease OCS-A 0478 noncompetitively to Cape Wind Associates, LLC, in 2010. The lease was relinquished in 2018. For more information, see BOEM, "Cape Wind," at https://www.boem.gov/renewable-energy/studies/cape-wind. In 2012, BOEM awarded Lease OCS-A 0482 noncompetitively to Bluewater Wind Delaware. The lease was later split into two leases and reassigned to two companies, Skipjack Offshore Energy and GSOE 1.

[33] For more information on the auction process, see 30 C.F.R. §585.210-585.225.

[34] BOEM divides the outer continental shelf (OCS) into four regions for administrative purposes: the Atlantic region, the Gulf of Mexico region, the Pacific region, and the Alaska region.

Note: Depictions of some of the smaller lease areas in the figure may appear darker compared to larger lease areas.

Frequency and Regularity of Lease Sales

The frequency and regularity with which BOEM schedules offshore wind lease sales has been a topic of congressional interest. For oil and gas, the OCSLA requires BOEM to prepare and maintain forward-looking plans (referred to as *five-year programs*) that periodically evaluate all available lease areas and determine when and where lease sales will take place.[35] There is no similar requirement for offshore wind leasing. As discussed, BOEM determines when and where to hold wind lease sales based either on unsolicited lease applications or on area evaluations undertaken at the agency's discretion. Under this process, BOEM has conducted eight competitive wind lease sales in total, with varying numbers of sales held in recent years. BOEM held one wind lease sale in 2016, one in 2017, one in 2018, and none in 2019 or 2020.[36]

Some Members of Congress and other stakeholders have advocated for greater predictability and regularity in BOEM's offshore wind leasing program, similar to that provided by the five-year planning process for oil and gas leasing. They assert that BOEM's current leasing process produces "uncertainty for a wide range of stakeholders," such as offshore wind developers, coastal communities, the Department of Defense (DOD), the fishing industry, and other ocean users.[37] They contend that a more comprehensive wind leasing program would ensure a consistent offshore wind supply, facilitate state clean energy targets, and spur investment in an offshore wind supply chain.[38] Such a program could require BOEM to evaluate all offshore regions, rather than just selected or requested areas, for wind leasing potential.

Others, including some BOEM officials, have expressed concerns about a more standardized leasing process for offshore wind, arguing for the importance of maintaining flexibility in scheduling lease sales. BOEM has noted in past years that planning for individual wind lease sales often involves revisions based on stakeholder input and has stated that any more

[35] For more information on offshore oil and gas five-year programs, see CRS Report R44504, *Five-Year Program for Offshore Oil and Gas Leasing: History and Program for 2017-2022*, by Laura B. Comay, Marc Humphries, and Adam Vann; and CRS Report R44692, *Five-Year Offshore Oil and Gas Leasing Program: Status and Issues in Brief*, by Laura B. Comay.

[36] The December 2016 lease sale was for an area off the coast of New York, the March 2017 sale was for an area off North Carolina, and the December 2018 sale was for areas off Massachusetts. Note that revenues (bonus bids) from these lease sales in **Table 2** are shown by fiscal year rather than by calendar year (e.g., bonus bids from the lease sale in December 2018 show as FY2019 revenue).

[37] U.S. Congress, House Committee on Natural Resources, "Legislative Hearing on Offshore Renewable Energy Opportunities," June 26, 2018, hearing memo on "H.R. ___, National OCS Renewable Energy Leasing Program Act" (discussion draft), available at https://republicans-naturalresources.house.gov/calendar/eventsingle.aspx?EventID=405045. Also see discussion by Senator Angus King and BOEM Director Amanda Lefton at U.S. Congress, Senate Committee on Energy and Natural Resources, *Full Committee Hearing to Examine Offshore Energy Development*, hearing, 117th Cong., 1st sess., May 13, 2021, at https://www.energy.senate.gov/hearings/2021/5/full-committee-hearing-to-examine-offshore-energy-development.

[38] See, for example, testimony of Randall Luthi, National Ocean Industries Association, in U.S. Congress, House Committee on Natural Resources, Subcommittee on Energy and Mineral Resources, *Legislative Hearing on Offshore Renewable Energy Opportunities*, hearing, 115th Cong., 2nd sess., June 26, 2018, at https://republicans-naturalresources.house.gov/UploadedFiles/6.26_Luthi_Testimony.pdf; memorandum from Vincent DeVito, Chair, Royalty Policy Committee, to Secretary of the Interior Ryan Zinke, "Royalty Policy Committee Recommendations," July 9, 2018, p. 2, at https://www.doi.gov/sites/doi.gov/files/uploads/signed_june_rpc_meeting_summary_with_memo.pdf; and letter from nine Atlantic coast governors to President Joseph Biden, "Prioritization of Offshore Wind Development," June 4, 2021, at https://www.eenews.net/assets/2021/06/07/document_gw_03.pdf.

comprehensive program must "retain the flexibility to allow BOEM to respond to rapid changes in technology and regional demand."[39] However, in hearing testimony in May 2021, the BOEM director expressed a goal "that we have a more certain leasing process in which we can demonstrate what our future lease sales will be in various wind energy areas."[40]

Leasing Activities and Issues by Region

BOEM and NREL have explored possibilities for wind development in all four of the federal offshore regions administered by BOEM: the Atlantic, Pacific, Gulf of Mexico, and Alaska regions.[41] NREL found that all the regions have offshore wind energy potential, taking into account factors such as wind speed (**Figure 5**), water depth, competing ocean uses, and environmental compatibility (but excluding economic feasibility).[42] Congress has weighed in on regional leasing issues through oversight and legislation in the 117th and previous Congresses.

Atlantic Region Activities and Issues

Many leasing issues have pertained to activities in the Atlantic region, where all offshore wind lease sales to date have occurred. Multiple factors, including but not necessarily limited to those listed below, have made the Atlantic region attractive for BOEM's initial wind leasing activities:

- **Resource Potential.** The Atlantic region, especially in the northeast, has strong average wind speeds (**Figure 5**) and relatively high wind energy potential.[43]
- **Geology**. The Atlantic OCS is relatively shallow, allowing for installation of commercially available fixed-bottom foundations.
- **Markets.** The populous eastern U.S. states offer potential demand for offshore wind-generated electricity.
- **State Renewable Power Commitments**. Many states along the East Coast have committed to timelines for sourcing fixed portions of their overall power from renewable sources in general and offshore wind in particular.
- **Land Constraints.** Compared with some other parts of the country, the heavily developed East Coast has relatively little land available for onshore renewable development, making offshore development potentially attractive.

[39] Testimony of James Bennett, BOEM Office of Renewable Energy Programs, in U.S. Congress, House Committee on Natural Resources, Subcommittee on Energy and Mineral Resources, *Legislative Hearing on Offshore Renewable Energy Opportunities*, hearing, 115th Cong., 2nd sess., June 26, 2018, at https://republicans-naturalresources.house.gov/UploadedFiles/6.26_Bennett_Testimony.pdf.

[40] Testimony of BOEM Director Amanda Lefton, in U.S. Congress, Senate Committee on Energy and Natural Resources, *Full Committee Hearing to Examine Offshore Energy Development*, hearing, 117th Cong., 1st sess., May 13, 2021, at https://www.energy.senate.gov/hearings/2021/5/full-committee-hearing-to-examine-offshore-energy-development.

[41] NREL, *2016 Assessment*; NREL, *2017 Alaska Assessment*. Offshore wind also has been pursued in the Great Lakes, but BOEM does not administer those efforts because those waters are state-owned. The federal government cooperates with Great Lakes states through a memorandum of understanding on offshore wind (Great Lakes Wind Collaborative, "State-Fed Agreement Announced to Enhance Coordination of Offshore Wind Projects in the Great Lakes," press release, March 30, 2012, at https://www.glc.org/wp-content/uploads/2016/10/glc-newsrelease-state-fed-agreement-enhance-coordination-offshore-wind-20120330-1.pdf; Great Lakes Offshore Wind Energy Consortium, "Memorandum of Understanding" and "Fact Sheet," both available at https://www.glc.org/library/2012-great-lakes-offshore-wind-memorandum-of-understanding.

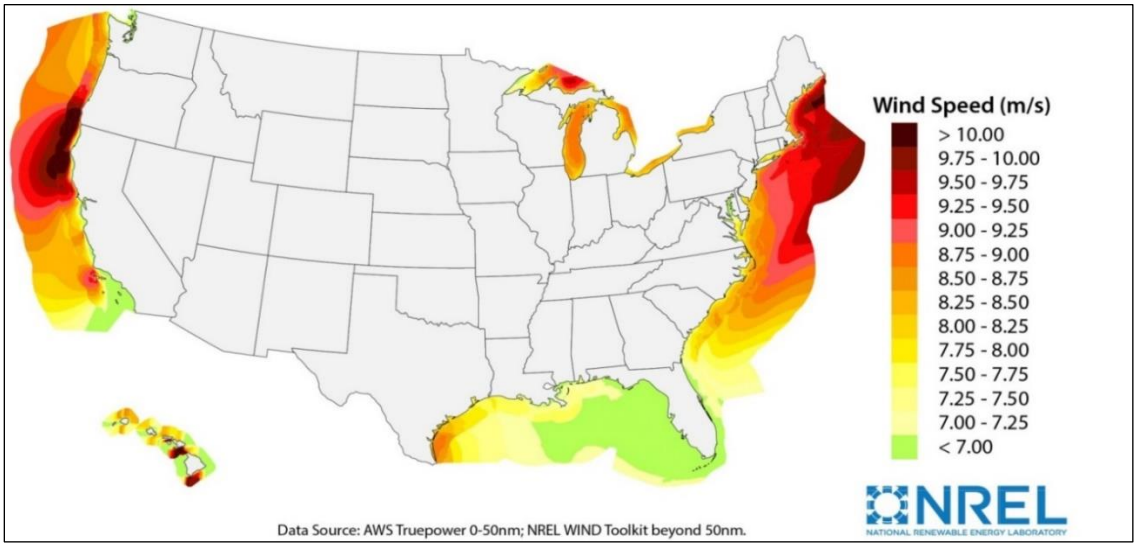
[42] NREL, *2016 Assessment*, p. viii; NREL, *2017 Alaska Assessment*, p. v.

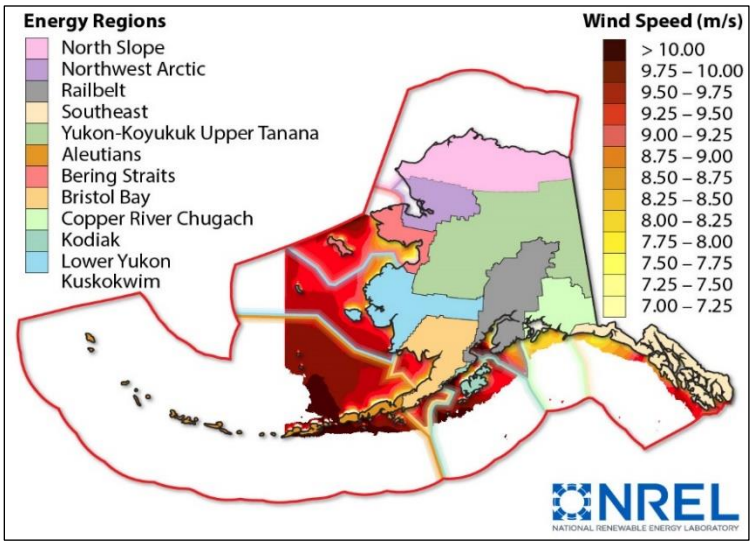
[43] For the contiguous United States and Hawaii, NREL found "the best resource, based on quality and quantity," to be offshore of northeastern states. NREL, *2016 Assessment*, p. viii.

Wind leasing efforts in the Atlantic also have encountered challenges, including those related to potential conflicts between wind energy development and other ocean uses, among others.

Figure 5. U.S. Offshore Wind Speed Estimates

(top figure shows continental United States and Hawaii; bottom figure shows Alaska)





Source: NREL, *2016 Offshore Wind Energy Resource Assessment for the United States*, Technical Report NREL/TP-5000-66599, September 2016, p. 9, at https://www.nrel.gov/docs/fy16osti/66599.pdf; and NREL, *Offshore Wind Energy Resource Assessment for Alaska*, Technical Report NREL/TP-5000-70553, December 2017, p. v, at https://www.nrel.gov/docs/fy18osti/70553.pdf.

Note: Figures show estimated annual average wind speeds at 100 meters above the surface, a typical height for offshore wind turbine hubs; nm = nautical miles; m/s = meters per second.

To date, BOEM has awarded offshore wind leases off the coasts of Delaware, Maryland, Massachusetts, New Jersey, New York, North Carolina, Rhode Island, and Virginia.[44] (BOEM

[44] For more information, see BOEM, "Lease and Grant Information," at https://www.boem.gov/renewable-energy/lease-and-grant-information; and BOEM, "State Activities," at https://www.boem.gov/renewable-energy/state-

identifies the adjoining states based on defined administrative boundaries, but, depending on offtake agreements between wind developers and power purchasers, the power could be delivered to a different state.[45]) In June 2021, BOEM issued a proposed sale notice for a new wind lease sale in the New York Bight, an ocean area lying between Long Island and the New Jersey coast.[46] In November 2021, BOEM issued a proposed sale notice for a lease sale in the Carolina Long Bay area offshore of the Carolinas (see text box, "The Carolinas and Southward: President Trump's Leasing Withdrawals").[47] BOEM also has engaged in preliminary discussions regarding wind leasing off other Atlantic states, such as through its Gulf of Maine Task Force.[48]

Congress could influence the scope and pace of BOEM's Atlantic wind leasing through legislation and oversight. Some Members and other stakeholders have advocated for expediting wind lease sales in the Atlantic, contending that additional sales are needed to enable East Coast states to meet renewable power commitments and that the sales will lead to economic benefits and employment in the offshore wind sector. For example, these advocates point to a report commissioned by offshore wind industry groups that estimated significant job creation and capital investment from a BOEM lease sale in the New York Bight.[49]

Other Members and stakeholders have expressed a contrasting concern that Atlantic wind leasing has proceeded too quickly, especially in consideration of potential conflicts with other ocean uses, such as fishing. These stakeholders have emphasized the economic benefits accruing to northeast states from the seafood industry and potential obstacles posed to that industry by a fast pace of offshore wind development. Some stakeholders have questioned whether BOEM may be using incomplete data on fisheries, or gathering insufficient input from seafood industry groups, when

activities.

[45] See **Table 1**, note (a), for additional information.

[46] BOEM, "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," 86 *Federal Register* 31524, June 14, 2021. In March 2021, BOEM announced the identification of wind energy areas (WEAs) for the New York Bight area (BOEM, "BOEM Advances Offshore Wind in Major U.S. East Coast Energy Market," press release, March 29, 2021, at https://www.boem.gov/boem-advances-offshore-wind-major-us-east-coast-energy-market). In August 2021, BOEM published a draft environmental assessment for the sale (BOEM, *Commercial and Research Wind Lease and Grant Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf of the New York Bight: Draft Environmental Assessment*, August 2021, at https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/NY-Bight-Draft-EA-2021.pdf).

[47] BOEM, "Atlantic Wind Lease Sale 9 (ATLW-9) for Commercial Leasing for Wind Power on the Outer Continental Shelf in the Carolina Long Bay Area—Proposed Sale Notice," 86 *Federal Register* 60274, November 1, 2021, at https://www.federalregister.gov/documents/2021/11/01/2021-23801/atlantic-wind-lease-sale-9-atlw-9-for-commercial-leasing-for-wind-power-on-the-outer-continental.

[48] See BOEM, "Maine Activities," at https://www.boem.gov/renewable-energy/state-activities/maine-activities.

[49] Feng Zhang, Maxwell Cohen, and Aaron Barr, *Economic Impact Study of New Offshore Wind Lease Auctions by BOEM*, Wood Mackenzie Power and Renewables, August 2020, at https://bit.ly/33qRcf6. The report estimated that leasing in the New York Bight would support up to 11.5 gigawatts of offshore wind development, would create more than 32,000 jobs annually during the construction phase and almost 6,000 jobs annually thereafter, and would generate capital investment of more than $45 billion during the construction phase and more than $750 million annually thereafter. The estimate assumed an "optimistic" policy scenario under which both "primary" and "secondary" areas identified by BOEM would be leased. The American Wind Energy Association (AWEA), National Ocean Industries Association, New York Offshore Wind Alliance, and Special Initiative on Offshore Wind at the University of Delaware commissioned the report. See National Ocean Industries Association, "Offshore Energy Industry Releases Economic Impact Study of New Federal Offshore Wind Lease Auctions," August 4, 2020, at https://www.noia.org/offshore-energy-industry-releases-economic-impact-study-new-federal-offshore-wind-lease-auctions/. For other industry estimates, see, for example, AWEA, *U.S. Offshore Wind Power Economic Impact Assessment*, March 2020, at https://cleanpower.org/resources/u-s-offshore-wind-economic-impact-assessment/.

making leasing decisions.[50] For further discussion, see the section on "Permitting Activities and Issues."

The Carolinas and Southward: President Trump's Leasing Withdrawals

Within the Atlantic region, the Bureau of Ocean Energy Management's (BOEM's) southernmost wind lease sale to date has been for the Kitty Hawk area offshore of North Carolina. On September 8 and September 25, 2020, President Trump used his authority under Section 12(a) of the Outer Continental Shelf Lands Act (OCSLA; 43 U.S.C. §1341(a)) to issue two memoranda that collectively withdraw from disposition by leasing, from July 2022 through June 2032, the southern portion of BOEM's Atlantic region. This area includes waters off North Carolina and all areas to the south, as well as the majority of the Eastern Gulf planning area in the Gulf of Mexico region. Although some previous presidential withdrawals under Section 12(a) specifically applied to oil and gas leasing or to mineral leasing, President Trump's Atlantic and Gulf of Mexico withdrawals do not contain such language. At the time of the withdrawal, BOEM reportedly stated its interpretation that the President's memoranda prohibit offshore wind leasing as well as oil and gas leasing in the affected areas. However, in November 2021, BOEM published a proposed sale notice for a lease sale in the Carolina Long Bay area, which lies within President Trump's withdrawal area. Legislation in the 117th Congress (e.g., H.R. 2635, H.R. 5376) would explicitly authorize wind leasing in the withdrawn areas, and the House-passed Interior appropriations bill for FY2022 (H.R. 4502) would prohibit the use of funds to implement President Trump's withdrawals with respect to offshore wind.

Pacific Region Activities and Issues

BOEM has engaged in preliminary offshore wind planning activities in the Pacific region, including off the coasts of California and Hawaii.[51] Some observers have identified California as a promising area for offshore wind, particularly because the populous state has enacted legislation to source 100% of its electricity from zero-carbon sources by 2045.[52] Because water depths drop rapidly off the California coast, projects in federal waters likely would require floating wind turbines; this technology has not been deployed in the United States and is costlier than the fixed-bottom turbines usable in shallower waters.[53]

In 2018, BOEM published a call for information and nominations to assess interest in offshore wind leasing in certain areas off Central and Northern California.[54] These call areas had been the

[50] See, for example, Responsible Offshore Development Alliance (RODA), "Gulf of Maine Offshore Wind," at https://rodafisheries.org/portfolio/gulf-of-maine-osw/; and letter from Senators Markey, Whitehouse, Warren, and Reed to BOEM Acting Director Walter Cruickshank, December 14, 2018, at https://www.markey.senate.gov/imo/media/doc/Minimizing%20Conflicts%20Offshore%20Wind%20&%20Fishing.pdf.

[51] BOEM also has undertaken some preliminary planning activities off the coast of Oregon but has not initiated the formal wind planning process by identifying a call area for Oregon. For more information, see BOEM, "Oregon Activities," at https://www.boem.gov/Oregon.

[52] On California renewable power commitments, see Energy Information Administration (EIA), "California: State Profile and Energy Estimates," at https://www.eia.gov/state/analysis.php?sid=CA. California's Senate Bill 100 (SB 100), The 100 Percent Clean Energy Act of 2018, did not define *zero-carbon resources*. The California Energy Commission (CEC), California Public Utilities Commission, and California Air Resources Board interpreted *zero-carbon resources* to mean energy resources that qualify as *renewable* or generate zero greenhouse gas emissions on-site in a report. See CEC, *2021 SB100 Joint Agency Report: Achieving 100 Percent Clean Electricity in California: An Initial Assessment*, CEC-200-2021-001, March 2021, p. 54, at https://efiling.energy.ca.gov/EFiling/GetFile.aspx?tn=237167&DocumentContentId=70349.

[53] For more information, see the "Overview of Offshore Wind Technology" section of this report. A floating offshore wind research array has been proposed off the coast of Maine in federal waters. For more information, see State of Maine, Governor's Energy Office, "Gulf of Maine Floating Offshore Wind Research Array," at https://www.maine.gov/energy/initiatives/offshorewind/researcharray.

[54] For more information, see BOEM, "California Activities," at https://www.boem.gov/california. In this context, a *nomination* would be the submission of a company's commercial interest in obtaining a wind energy lease within the

subject of commercial wind developers' unsolicited leasing requests to BOEM and had been identified as having high average wind speeds (**Figure 5**) and available transmission infrastructure.[55] Until May 2021, BOEM had not taken the next step of identifying WEAs most suitable for leasing within the California call areas. A complication in finalizing the WEAs was DOD's concern about potential conflict between offshore wind development and military training and readiness activities in these areas, especially off the central coast.[56] In May 2021, BOEM announced an agreement under which the agency, in partnership with DOD and the State of California, has identified two potential WEAs off the central and northern coasts of California.[57] Following the completion of environmental analysis and input from stakeholders and the public, BOEM anticipates a possible lease sale for the two WEAs in mid-2022. BOEM stated that it "will work with the Department of Defense to ensure long-term protection of military testing, training and operations, while pursuing new domestic clean energy resources."[58]

BOEM also published a call for information and nominations for areas offshore of Oahu, HI, in 2016.[59] The agency had received several unsolicited requests from commercial wind developers to lease in these areas. Hawaii has enacted legislation setting a deadline to transition to 100% renewable electricity by 2045.[60] As with California, wind projects offshore of Hawaii likely would require floating turbines, given water depths. BOEM has not yet identified WEAs within the Hawaii call areas. Supporters of Hawaiian offshore wind development contend it could reduce dependence on expensive imported petroleum for electricity, in addition to creating jobs and fostering economic growth in the state.[61] A challenge for wind development offshore of Oahu could potentially be concerns from DOD, owing to naval activities in the area.[62] Some have raised

call area.

[55] BOEM, "California Offshore Renewable Energy," fact sheet, 2017, at https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/CA/BOEM-Offshore-Renewables-Factsheet—02-22-17.pdf.

[56] See, for example, U.S. Navy, *California Offshore Planning Areas: Informational & Operational Overview*, February 15, 2018, at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-MISC-01%20. Legislative provisions passed by the House in the 116th Congress (House-passed H.R. 6395, National Defense Authorization Act for FY2021) would have specified parameters under which DOD would have been required to engage with BOEM and other entities to identify wind leasing options in California's Morro Bay call area. However, this provision was not included in the law (P.L. 116-283). Included in the House Appropriations Committee report to accompany H.R. 2968, the Department of Defense Appropriations Bill, 2020 (H.Rept. 116-84), was a direction to the Secretary of Defense to submit a report to the congressional defense committees to address "any potential national security concerns with respect to the construction of offshore wind arrays, to include an examination of legacy and new turbines, and any appropriate mitigation measures that should be implemented to address these concerns."

[57] BOEM, "Biden-Harris Administration Advances Offshore Wind in the Pacific," press release, May 25, 2021, at https://www.doi.gov/pressreleases/biden-harris-administration-advances-offshore-wind-pacific.

[58] Ibid.

[59] BOEM, "Call for Information and Nominations for Commercial Leasing for Wind Power on the Outer Continental Shelf, Offshore the Island of Oahu, Hawaii," 81 *Federal Register* 41335, June 24, 2016, at https://www.federalregister.gov/documents/2016/06/24/2016-14830/commercial-leasing-for-wind-power-on-the-outer-continental-shelf-offshore-the-island-of-oahu. For a map of the call areas, see BOEM, "Map Showing the Hawaii Call for Information and Nominations," at https://www.boem.gov/Hawaii-commercial-wind-lease-areas/. For general information, see BOEM, "Hawaii Activities," at https://www.boem.gov/renewable-energy/state-activities/hawaii-activities.

[60] EIA, "Hawaii State Energy Profile," at https://www.eia.gov/state/print.php?sid=HI; and Hawaii State Energy Office, "Hawaii Clean Energy Initiative," at http://energy.hawaii.gov/testbeds-initiatives/hcei.

[61] On potential economic impacts of offshore wind development in Hawaii, see BOEM and NREL, *Floating Offshore Wind in Hawaii: Potential for Jobs and Economic Impacts from Two Future Scenarios*, April 2016, at https://www.nrel.gov/docs/fy16osti/65481.pdf.

[62] See DOE, Office of Energy Efficiency and Renewable Energy, *2017 Offshore Wind Technologies Market Update*, August 2018, pp. 31, 69, at https://www.energy.gov/sites/prod/files/2018/08/f54/71709_0.pdf.

additional concerns about access to fishing grounds in offshore wind areas, visibility of turbines from shore, potential disturbances to marine life, and encroachment into ocean areas sacred to Native Hawaiians.[63]

Offshore Wind and U.S. Territories

OCSLA and its offshore wind leasing provisions (43 U.S.C. §1337(p)) currently do not apply to the exclusive economic zones of U.S. territories and possessions. Bills introduced in the 117th Congress (e.g., H.R. 2780, H.R. 3764, H.R. 5376) and previous Congresses would authorize BOEM to conduct wind lease sales offshore of U.S. territories and possessions, and would require the agency to study the technological and economic feasibility, as well as the environmental effects, of offshore wind leasing in the territorial jurisdictions of American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands. Congressional supporters have expressed interest in offshore wind as a potential way to address high energy costs and dependence on imported petroleum in the territories. The five territories covered by the proposed study all have set renewable energy targets, such as American Samoa's goal of 100% renewable energy by 2040 and Puerto Rico's goal of 100% renewable energy by 2050.

Gulf of Mexico Region Activities and Issues

In February 2020, BOEM and NREL completed two studies exploring possibilities for offshore wind development in the Gulf of Mexico.[64] The first study considered various offshore renewable technologies (wind, wave, tidal, current, solar, and others) and determined that offshore wind is the "leading" renewable technology for application in the Gulf, given the region's wind resource potential and the relative maturity of offshore wind compared to the other renewable technologies.[65] The second study considered the economic feasibility of offshore wind for sites in the Gulf. It found several potential development sites where wind might become cost-competitive without subsidies by 2030, including sites off Port Isabel, TX; Port Arthur, TX; and Pensacola, FL, among others. The study estimated that a single offshore wind project in the Gulf could contribute more than 4,000 jobs and $445 million in gross domestic product (GDP) to the economy during the construction phase, as well as an ongoing 150 jobs and $14 million in GDP during project operations.[66]

The BOEM and NREL studies found the Gulf advantageous for offshore wind development in several ways. For example, the presence of a robust supply chain for offshore oil and gas in the region—which could be transitioned for wind development—could lower costs for fabrication, installation, and maintenance of offshore wind infrastructure. The Gulf's shallow waters, mild temperatures, and relatively low average wave heights also could facilitate turbine siting and accessibility for maintenance. However, the study also identified challenges for offshore wind in the Gulf region, particularly the need to adapt wind technologies to withstand the region's

[63] See, for example, Heather Richards, "Hawaii NIMBY Fight Reveals Biden Offshore Wind Challenge," *Energywire*, April 6, 2021, at https://www.eenews.net/energywire/stories/1063728671/print.

[64] BOEM and NREL, *Survey and Assessment of the Ocean Renewable Energy Resources in the U.S. Gulf of Mexico*, OCS Study BOEM 2020-017, February 2020, at https://espis.boem.gov/final%20reports/BOEM_2020-017.pdf; and BOEM and NREL, *Offshore Wind in the U.S. Gulf of Mexico: Regional Economic Modeling and Site-Specific Analyses*, OCS Study BOEM 2020-018, February 2020, at https://espis.boem.gov/final%20reports/BOEM_2020-018.pdf (hereinafter cited as BOEM and NREL, *Offshore Wind in the Gulf*).

[65] BOEM, "Availability of Two New Studies on Renewable Energy in the Gulf of Mexico," press release, April 23, 2020. On the offshore wind resource potential in the Gulf, see NREL, *2016 Assessment*.

[66] BOEM and NREL, *Offshore Wind in the Gulf*, p. xv.

hurricane potential, relatively low average wind speeds (see **Figure 5**), and weak soils on the seafloor.

Unlike many Atlantic and Pacific coast states, most Gulf coast states do not have renewable energy mandates.[67] However, some Gulf coast states have expressed interest in exploring offshore wind development. In November 2020, Louisiana Governor John Bel Edwards requested that BOEM establish a task force to explore Gulf offshore wind, a potential first step toward wind leasing.[68] In June 2021, BOEM published a request for interest in offshore wind and other renewable technologies in the Central and Western planning areas of the Gulf and announced its intention to establish a Gulf of Mexico Renewable Energy Task Force.[69] BOEM's request for interest did not include the Eastern Gulf of Mexico planning area (see text box above, "The Carolinas and Southward: President Trump's Leasing Withdrawals").[70] In November 2021, BOEM took the next step in potential Gulf wind leasing by publishing a call for information and nominations for an area off the coasts of Louisiana and Texas.[71]

More broadly, the general development of offshore wind in the United States has been of interest to Gulf coast states and some of their Members of Congress, owing to potential economic opportunities the new industry could create for Gulf-based businesses that traditionally have served the offshore oil and gas industry. For example, facilities in the Gulf are participating in developing some of the first U.S. offshore wind supply vessels for work on offshore wind projects in the Atlantic region (see section on "Deployment Issues," below).[72]

Alaska Region Activities and Issues

An NREL assessment found that Alaska has a technical offshore wind resource capacity larger than that of all other U.S. states combined.[73] However, the study also identified "significant challenges [that] inhibit large-scale offshore wind deployment in Alaska," including the "remoteness" of the offshore wind resources, their distance from load centers in the state, and the "wealth of land" available for onshore wind development.[74] Alaska has a goal to supply 50% of

[67] Texas has a mandate that 10,000 megawatts (MW) of the state's electricity-generating capacity come from renewable sources by 2025, but the state has already surpassed this goal, owing mostly to its onshore wind energy generation. See EIA, "Texas: State Profile and Energy Estimates," at https://www.eia.gov/state/analysis.php?sid=TX.

[68] Louisiana Office of the Governor, "Gov. Edwards Announces Renewable Energy Initiative for Gulf of Mexico," press release, November 9, 2020, at https://gov.louisiana.gov/index.cfm/newsroom/detail/2790.

[69] BOEM, "Interior Department to Explore Offshore Wind Potential in the Gulf of Mexico," press release, June 8, 2021, at https://www.doi.gov/pressreleases/interior-department-explore-offshore-wind-potential-gulf-mexico.

[70] President Donald Trump, "Memorandum on the Withdrawal of Certain Areas of the United States Outer Continental Shelf from Leasing Disposition," September 8, 2020, at https://trumpwhitehouse.archives.gov/presidential-actions/memorandum-withdrawal-certain-areas-united-states-outer-continental-shelf-leasing-disposition/.

[71] BOEM, "Call for Information and Nominations—Commercial Leasing for Wind Power Development on the Outer Continental Shelf in the Gulf of Mexico," 86 *Federal Register* 60283, November 1, 2021, at https://www.federalregister.gov/documents/2021/11/01/2021-23800/call-for-information-and-nominations-commercial-leasing-for-wind-power-development-on-the-outer.

[72] See, for example, Rep. Garret Graves, "Graves Announces Edison Chouest Executes a Long-Term Charter Agreement for First-Ever U.S. Jones Act Compliant Windfarm Service Operation Vessel," press release, October 2, 2020, at https://garretgraves.house.gov/media-center/press-releases/graves-announces-edison-chouest-executes-long-term-charter-agreement; and Dominion Energy, "Dominion Energy Continues Development of First Jones Act Compliant Offshore Wind Turbine Installation Vessel," press release, December 16, 2020, at https://news.dominionenergy.com/2020-12-16-Dominion-Energy-Continues-Development-of-First-Jones-Act-Compliant-Offshore-Wind-Turbine-Installation-Vessel.

[73] NREL, *2017 Assessment*, p. v. Also see footnote 2.

[74] NREL, *2017 Assessment*, p. v.

its electricity from renewable sources by 2025 and has pursued hydropower, biomass, and onshore wind projects, among others.[75] BOEM has not undertaken any offshore wind leasing activities in Alaska to date.[76]

Permitting Activities and Issues

Lessees in the Atlantic region have submitted site assessment plans (SAPs) and construction and operation plans (COPs) for offshore wind projects on the leases they hold (**Table 1**). To date, DOI has approved multiple SAPs and two COPs—the COP submitted in December 2017 by the offshore lessee Vineyard Wind, LLC, for the Vineyard Wind 1 project off the coast of Massachusetts, and the COP submitted by South Fork Wind, LLC, for the South Fork Wind Farm, located off the coasts of Rhode Island and Massachusetts and supplying power to New York.[77] The approval of a COP enables the issuance of permits for wind turbine construction and operation.[78]

BOEM also has announced further work on pending COPs for other projects. In general, BOEM anticipates that construction on many Atlantic region projects, if approved, would take place between now and 2030, potentially resulting in installation of some 2,000 offshore turbines in the region with up to 22 gigawatts of generating capacity.[79]

Fishing Industry Concerns

Commercial fishing groups have expressed concerns about potential impacts to their industry from offshore turbine construction and operation in the Atlantic region, including potential effects on fish stocks and fishing vessel navigation, among others.[80] Partly in response to such concerns, BOEM undertook a supplement to its draft EIS for the Vineyard Wind 1 COP to analyze

[75] EIA, "Alaska: State Profile and Energy Estimates," at https://www.eia.gov/state/analysis.php?sid=AK.

[76] NREL has explored the potential for other types of offshore renewable energy (apart from offshore wind) in the Alaska region, such as marine hydrokinetic energy. See, for example, NREL, "Harnessing Marine Energy at All Scales, from a Village Microgrid to a Vast Tidal Inlet: NREL Leads Pioneering Alaska Projects," March 24, 2020, at https://www.nrel.gov/news/program/2020/harnessing-marine-energy-at-all-scales.html.

[77] DOI, *Record of Decision: Vineyard Wind 1 Offshore Wind Energy Project Construction and Operations Plan*, May 10, 2021, at https://www.boem.gov/renewable-energy/state-activities/final-record-decision-vineyard-wind-1 (hereinafter cited as DOI, Vineyard Wind ROD), and DOI, *Record of Decision: South Fork Wind Farm and South Fork Export Cable Project Construction and Operations Plan*, November 24, 2021, at https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Record%20of%20Decision%20South%20Fork_0.pdf (hereinafter cited as DOI, South Fork ROD). For the two-turbine pilot project operating off the coast of Virginia, DOI approved an RAP rather than a COP, because the project was leased under a research lease. See BOEM, "Coastal Virginia Offshore Wind Project (CVOW)," at https://www.boem.gov/renewable-energy/state-activities/coastal-virginia-offshore-wind-project-cvow.

[78] In addition to BOEM, the National Marine Fisheries Service (NMFS) within the National Oceanic and Atmospheric Administration (NOAA), as well as the U.S. Army Corps of Engineers, can potentially sign on to DOI's record of decision for a COP, thus fulfilling these agencies' NEPA obligations with respect to permits they administer for an offshore wind project (for more information, see CRS Report R40175, *Wind Energy: Offshore Permitting*, by Adam Vann). For example, these agencies all concurred on the Vineyard Wind 1 COP (BOEM, Vineyard Wind ROD, p. 3). Alternatively, other agencies could issue separate decisions based on their evaluations.

[79] BOEM, *Vineyard Wind 1 Offshore Wind Energy Project: Final Environmental Impact Statement*, vol 1, p. 1-6, at https://www.boem.gov/renewable-energy/state-activities/vineyard-wind-1-feis-volume-1; and vol. 2, Appendix A, at https://www.boem.gov/renewable-energy/state-activities/vineyard-wind-1-feis-volume-2.

[80] See, for example, RODA, "RODA Statement on Recent Developments in Southern New England Offshore Wind," March 3, 2021, at https://rodafisheries.org/southern-new-england-offshore-wind/; and other RODA statements at https://rodafisheries.org/.

additional fishing data and consider cumulative impacts of potentially widespread wind development throughout the region.[81] With respect to industry concerns about safe navigation for fishing vessels through wind turbine arrays, BOEM's supplemental EIS considered an alternative for Vineyard Wind's turbine layout involving a designated transit lane suggested by fishing industry groups.[82] The U.S. Coast Guard also published a study on turbine spacing and vessel transit in wind lease areas off Massachusetts and Rhode Island.[83] The Coast Guard study recommended a "standard and uniform" turbine grid layout with commercial fishing lanes measuring 1 nautical mile (nm) wide and oriented in an east-west direction. Fishing industry groups published objections to the study's findings.[84] In May 2021, DOI issued a record of decision (ROD) for the Vineyard Wind COP, approving a turbine grid arrangement largely consistent with the Coast Guard recommendations.[85]

DOI also approved a similar layout, with 1-nm spacing, in its ROD for the South Fork project, rather than a proposal by fishing industry groups for a 4-nm-wide transit lane. DOI stated that the fishing industry proposal would "unnecessarily reduce the energy production potential of the lease," given the Coast Guard's finding that turbines with 1-nm spacing would safely accommodate fishing and transit.[86] Fishing industry groups also had raised concerns about potential interference with marine radar from turbines, impacts to sensitive fish habitat, and the availability of compensatory mitigation for fishing communities.[87] DOI chose a "Habitat Alternative" for the South Fork project that reduced the number of allowed turbines (from the 15 proposed by the developer to a maximum of 12) to reduce impacts to complex fisheries habitats.

Other Permitting Issues

Some stakeholders have expressed additional concerns about offshore wind permitting as Atlantic region projects have begun to advance. For example, some individuals and communities have objected to proposed projects because of the potential visibility of offshore wind turbines from

[81] BOEM, *Vineyard Wind 1 Offshore Wind Energy Project: Supplement to the Draft Environmental Impact Statement*, June 2020, at https://www.boem.gov/sites/default/files/documents/renewable-energy/Vineyard-Wind-1-Supplement-to-EIS.pdf. BOEM stated (p. ES-2) that its assessment of the scope of future offshore wind development had "greatly expanded from what was considered in the Draft EIS, which only considered in detail projects that had submitted construction plans (approximately 130 MW) in federal waters at that time." For the supplemental EIS, BOEM assumed "approximately 22 gigawatts of Atlantic offshore wind development are reasonably foreseeable along the east coast."

[82] Ibid., pp. 2-3 to 2-6.

[83] U.S. Coast Guard, *The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study: Final Report*, Docket No. USCG-2019-0131, May 14, 2020, at https://www.regulations.gov/document?D=USCG-2019-0131-0101.

[84] See letter from RODA to U.S. Coast Guard, "REQUEST FOR CORRECTION: Massachusetts/Rhode Island Port Access Route Study; Docket No. USCG-2019-0131," June 29, 2020, at https://rodafisheries.org/wp-content/uploads/2020/07/200629-MARIPARS-correction-RODA.pdf. Some fishing groups objected to "key errors" in the study, which they characterized as including "inappropriate selection of fisheries data sources," "absence of analysis of fishing vessel operational requirements," "unjustified analysis of only one layout design rather than a range," "inclusion of clear mathematical errors," and "false assertions regarding radar interference." On October 27, 2020, the Coast Guard sent the fishing groups a response denying the request for a correction (letter from U.S. Coast Guard to RODA, October 27, 2020, at https://rodafisheries.org/wp-content/uploads/2020/10/RESPONSE-TO-RODA-SIGNED-10-27-2019.pdf).

[85] DOI, Vineyard Wind ROD. For further details, see BOEM, *Vineyard Wind 1 Offshore Wind Energy Project: Final Environmental Impact Statement*, March 12, 2021, at https://www.boem.gov/vineyard-wind.

[86] DOI, South Fork ROD, p. 15.

[87] See, for example, RODA comments on the South Fork draft EIS, February 22, 2021, at https://rodafisheries.org/wp-content/uploads/2021/02/210222-SFWF_DEIS.pdf; and "RODA Statement on Recent Developments in Southern New England Offshore Wind," March 3, 2021, at https://rodafisheries.org/southern-new-england-offshore-wind/.

shore.[88] In response to such concerns, DOI's chosen alternative for the Vineyard Wind project included an area where no surface occupancy (i.e., no wind turbines) would be allowed, in order to reduce visibility.[89] Others have cited potential impacts to birds and marine mammals from offshore wind development as a cause of concern (see text box, "Offshore Wind and Marine Wildlife").[90]

Offshore Wind and Marine Wildlife

Federal agencies and other researchers are studying the effects of offshore wind energy development on marine wildlife, including birds, marine mammals, sea turtles, fish, and other species. Research studies have considered multiple ways in which offshore wind may affect marine wildlife at different stages of wind project development. For example, researchers have studied potential impacts from animals' collisions with turbines or construction vessels, noise associated with project development, displacement from traditional habitat areas, changes in prey availability, and animals' sensitivity to changes in local geomagnetic fields from the anthropogenic electromagnetic fields emitted by power transmission cables. Some researchers also have pointed to potential benefits to marine wildlife from offshore wind development, including direct benefits, such as artificial reef development on offshore wind structures, and indirect benefits stemming from offshore wind's potential to reduce greenhouse gas emissions.

Federal agencies must adhere to statutory requirements related to wildlife, pursuant to several laws relevant to offshore wind development. For example, the National Environmental Policy Act (42 U.S.C. §4321) requires agencies to assess potential effects on wildlife in environmental analyses of offshore wind lease sales, plans, and permits. Some species also are protected under other statutes, such as the Marine Mammal Protection Act (MMPA; 16 U.S.C. §§1361 et seq.), Endangered Species Act (ESA; 16 U.S.C. §§1531 et seq.), and Migratory Bird Treaty Act (16 U.S.C. §§703-712).

In its final environmental impact statement (EIS) for the Vineyard Wind construction and operations plan, BOEM found that its preferred alternative for the project would have adverse impacts on birds, fish, marine mammals, and other living resources ranging in strength from negligible to moderate, as well as some minor to moderate beneficial impacts. The record of decision (ROD) for the Vineyard Wind project, jointly issued by BOEM and partnering agencies—the Army Corps of Engineers and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS)—requires Vineyard Wind to undertake mitigation, monitoring, and reporting activities to reduce potential harm to wildlife. For instance, the developer's mitigation activities could include installing bird deterrent devices on turbines, adopting various best management practices for construction, and adhering to seasonal work restrictions to protect marine wildlife at sensitive life stages, among others. The ROD anticipated that the mitigation steps would result in the project having overall "neutral effects" on fish and wildlife. As part of the ROD (Section 5.3.1), NMFS indicated its decision to approve an incidental harassment authorization under the MMPA to take "small numbers" of marine mammals during construction of the wind project. The MMPA (16 U.S.C. §1362) defines *take* as "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal."

Supporters of Atlantic offshore wind projects also have raised issues, including about whether the pace of BOEM's permitting has been unnecessarily slow, causing project delays for wind developers.[91] Congress has expressed interest in the pipeline of wind projects in the Atlantic

[88] For example, visibility concerns have been at issue in the development of wind projects off the Maryland shore; see, for example, Heather Richards, "NIMBY Concerns Threaten Md. Plans for Bigger Turbines," *EnergyWire*, January 2, 2020, at https://www.eenews.net/energywire/stories/1061970701/; and Heather Richards, "Inside the Fight over Md. Offshore Wind Project," *EnergyWire*, January 24, 2020, at https://www.eenews.net/energywire/stories/1062151633/.

[89] BOEM, Vineyard Wind ROD. BOEM has defined *surface occupancy* as "the placement of wind facilities" (see, e.g., BOEM, "Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore North Carolina—Call for Information and Nominations," *77 Federal Register* 74204, December 13, 2012).

[90] For BOEM studies of the wildlife impacts of offshore wind development, see BOEM, "Renewable Energy Research Completed Studies," at https://www.boem.gov/renewable-energy-research-completed-studies.

[91] See, for example, David Iaconangelo, "Largest U.S. Offshore Wind Developer May Delay 5 Projects," *EnergyWire*, April 30, 2020, at https://www.eenews.net/energywire/stories/1063007345/.

region, and legislators have considered whether BOEM needs additional staff and financial resources to review the growing number of submitted COPs.[92] In appropriations acts for FY2020 and FY2021, Congress appropriated additional funding to BOEM beyond amounts requested for the agency's Renewable Energy account to improve permitting capacity for offshore wind projects.[93] For FY2022, BOEM requested an increase of 60% over FY2021 funding for its Renewable Energy account to increase its workforce capacity, among other purposes.[94]

Deployment Issues

Congress may consider multiple issues pertaining to deployment of offshore wind energy projects. Potential issues relate to domestic capacity for construction and installation of offshore wind infrastructure in the coming years, and to the ability to sell into domestic electricity markets.

Jones Act and Port Infrastructure Considerations

The Jones Act requires that vessels transporting cargo from one U.S. point to another U.S. point be (1) U.S.-built and (2) owned and crewed by U.S. citizens. Under the Jones Act, vessels carrying offshore wind supplies and vessels for offshore wind turbine installation that travel from U.S. ports to project sites on the OCS must be built in the United States, registered under the U.S. flag, and owned and crewed by U.S. citizens.[95] The Government Accountability Office (GAO) reported in December 2020 that the United States had no domestic-built vessels capable of transporting and installing wind turbines of the size planned for many upcoming projects.[96] The GAO report described two potential strategies for wind developers to comply with the Jones Act. In the first strategy, a Jones Act-compliant wind turbine installation vessel would carry turbine components from a U.S. port to the project site and install them. In the second strategy, a foreign-flagged vessel would travel from a foreign port to install the turbines, but a Jones Act-compliant feeder vessel would transport the components to the site from a U.S. port.[97] In both scenarios,

[92] See, for example, Silvio Marcacci, "Four Federal Policies Could Help Offshore Wind Jump Start Our Coronavirus Economic Recovery," *Forbes*, March 24, 2020, at https://www.forbes.com/sites/energyinnovation/2020/03/24/these-federal-policies-could-help-offshore-wind-jump-start-americas-economic-recovery/?sh=2a0014da78cc.

[93] For more information, see CRS In Focus IF11405, *Offshore Energy Agency Appropriations, FY2020*, by Laura B. Comay; and CRS In Focus IF11752, *Offshore Energy Agency Appropriations, FY2021*, by Laura B. Comay.

[94] BOEM, *Budget Justifications and Performance Information, Fiscal Year 2022*, at https://www.doi.gov/sites/doi.gov/files/fy2022-boem-budget-justification.pdf.

[95] 46 U.S.C. §55102. For more information on the Jones Act (Section 27 of the Merchant Marine Act of 1920; P.L. 66-261), see CRS Report R45725, *Shipping Under the Jones Act: Legislative and Regulatory Background*, by John Frittelli. The National Defense Authorization Act for Fiscal Year 2021 (NDAA; P.L. 116-283, §9503) contained provisions concerning jurisdiction over the OCS; these provisions have been interpreted to clarify the applicability of the Jones Act to offshore wind project sites on the OCS. See, for example, Rep. John Garamendi, "Congress Passes Garamendi Amendment Requiring Jones Act Enforcement in Offshore Wind," press release, December 11, 2020, at https://garamendi.house.gov/media/press-releases/congress-passes-garamendi-amendment-requiring-jones-act-enforcement-offshore. Although the NDAA provisions clarified that the coastwise laws apply generally to wind projects, U.S. Customs and Border Patrol is primarily responsible for determining what activities fall under the act, namely, defining what constitutes "transportation" and whether the origin and destination of a voyage are "U.S. points" (19 C.F.R. §§4.80-4.93).

[96] GAO, *Offshore Wind Energy: Planned Projects May Lead to Construction of New Vessels in the U.S., but Industry Has Made Few Decisions amid Uncertainties*, GAO-21-153, December 2020, at https://www.gao.gov/products/gao-21-153 (hereinafter cited as GAO, *Offshore Wind Energy*).

[97] Wind turbine installation vessels (WTIVs) are designed specifically for the installation of wind turbines. WTIVs have a large deck and can elevate on legs to lift the vessel out of the water. WTIVs also have a crane to lift and place turbines. Such vessels can cost up to $500 million, according to GAO. GAO, *Offshore Wind Energy*, p. 14.

stakeholders identified a need to build new Jones Act-compliant vessels, especially to handle increasingly large turbine components expected to be used in future projects. Dominion Energy announced that it contracted with Keppel AmFELS to begin construction of the first Jones Act-compliant offshore wind turbine installation vessel.[98]

Congress may consider whether to incentivize U.S. vessel construction through financial assistance, job training programs,[99] or other mechanisms and whether to provide infrastructure funding for U.S. port facilities that could serve as staging areas for offshore wind installation activities.[100] Relatedly, Congress may consider whether to incentivize the manufacturing of offshore wind components.[101] Other considerations may include whether to introduce additional requirements; for example, some states have required hiring priorities for companies developing offshore wind projects.[102] Another option could be to amend the Jones Act to exempt the offshore wind industry.

Electricity Transmission Considerations

With offshore wind projects moving forward in the Atlantic region, some stakeholders have identified potential issues with access to markets to sell the generated electricity. One potential challenge is ensuring the markets operate in a manner that is competitive to both new generators (e.g., offshore wind farms) and existing generators. Another potential challenge is ensuring there is sufficient infrastructure and demand in place to accept the generated electricity and direct the electricity to consumers.

Access to markets is a key consideration for the success of the offshore wind industry. According to DOE, "capital expenditures (CapEx) are the single largest contributor to the life cycle costs of offshore wind power plants and include all expenditures incurred prior to the start of commercial operation."[103] CapEx data are typically self-reported by developers; because of this, the data are uncertain. For example, independent verification of the data may not be possible, and some expenditures may or may not be included in the data.[104] Researchers at the National Renewable Energy Laboratory have estimated that both CapEx and operation and maintenance expenditures

[98] Dominion Energy, "Dominion Energy Continues Development of First Jones Act Compliant Offshore Wind Turbine Installation Vessel," news release, December 16, 2020, at https://news.dominionenergy.com/2020-12-16-Dominion-Energy-Continues-Development-of-First-Jones-Act-Compliant-Offshore-Wind-Turbine-Installation-Vessel.

[99] Multiple proposals have been introduced in the 117th Congress related to job training programs for offshore wind, including proposed grant programs under the Secretary of Energy (e.g., S. 2501) and the Secretary of the Interior (e.g., H.R. 998).

[100] NREL reported on U.S. port and infrastructure investments in its *2019 Offshore Wind Technology Data Update*, October 2020, p. 21, at https://www.nrel.gov/docs/fy21osti/77411.pdf. For more information on federal programs that support maritime industry, including port infrastructure development, see CRS Report R46654, *U.S. Maritime Administration (MARAD) Shipping and Shipbuilding Support Programs*, by Ben Goldman.

[101] For example, S. 2766—the Offshore Wind American Manufacturing Act of 2021—would provide a manufacturing investment tax credit and a production tax credit for manufacturing facilities of offshore wind turbine components.

[102] The Virginia Clean Economy Act (Virginia H.B. 1526 and S.B. 851 of the 2020 Session, Chapters 1193 and 1194), as enacted, established requirements for Dominion Energy Virginia's qualified offshore wind projects, including prioritizing the hiring, apprenticeship, and training of veterans, local workers, and workers from historically economically disadvantaged communities.

[103] DOE, *2021 Market Report*, p. 75.

[104] DOE, *2021 Market Report*, p. 101.

for offshore wind installations were more than twice those for onshore wind installations in 2019.[105]

Electricity Markets

Offshore wind projects may encounter issues with access to markets to sell the generated electricity. One challenge involves ensuring market competitiveness for both existing generators and new generators, such as offshore wind farms. Regional transmission organizations (RTOs) and independent system operators (ISOs) manage the electric transmission systems and the competitive wholesale electric energy markets, under the Federal Energy Regulatory Commission's (FERC's) oversight.[106] Some regions are outside of these markets, including much of the Northwest, Southwest, and Southeast. RTOs and ISOs generally run several markets to ensure enough generation is available to reliably meet power demands. Some RTOs and ISOs use forward capacity markets to ensure sufficient generation will be available years in the future. As RTOs and ISOs developed these markets, some participants and observers raised concerns that states could incentivize new generation, which could undermine competitiveness, enabling new generators to submit artificially low offers.[107] Some states have set offshore wind procurement goals and have encouraged utilities to enter into power purchase agreements with offshore wind projects.[108] These long-term contracts, in addition to other state legislative or executive policies in support of offshore wind, could be considered "subsidies" to offshore wind projects, thus potentially allowing offshore wind developers to sell into electricity markets at lower prices than other types of generators could offer. To address concerns of artificially low prices, RTOs and ISOs may have a minimum offer price rule (MOPR), which is a specific minimum dollar amount that a resource can offer into the capacity market. Several RTOs and ISOs implement MOPRs.

In the Atlantic region, some have expressed concerns that MOPRs could undermine state clean energy goals and negatively affect offshore wind industry development.[109] At the heart of the debate is a state's authority under the Federal Power Act over in-state generation facilities, as opposed to FERC's exclusive authority over sales in interstate wholesale electricity markets.[110] Congress may consider whether states can provide incentives in federal competitive markets. Congress also may consider whether clean energy generation is a national goal and whether to

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[105] National Renewable Energy Laboratory (NREL), *2019 Cost of Wind Energy Review*, NREL/TP-5000-78471, December 2020, p. 44.

[106] An exception is the Electric Reliability Council of Texas (ERCOT), which operates a transmission system and electricity market covering much of Texas. Many aspects of ERCOT are outside Federal Energy Regulatory Commission (FERC) jurisdiction. FERC, "ERCOT," at https://www.ferc.gov/industries-data/electric/electric-power-markets/ercot.

[107] For more information on electricity markets, see CRS Report R43093, *Electricity Markets—Recent Issues in Market Structure and Energy Trading*, by Richard J. Campbell.

[108] For example, according to Rhode Island General Laws §39-26.1-8, once a developer was identified for a utility-scale offshore wind farm located offshore in Rhode Island waters or in adjacent federal waters, the developer could apply to the Rhode Island Public Utilities Commission to request a long-term contract with the electric distribution company to buy up to 150 MW from a utility-scale offshore wind power project. For the Block Island Wind Farm, Deepwater Wind Block Island and National Grid entered into a power purchase agreement in 2009; see National Grid and Deepwater Wind, *Power Purchase Agreement Between the Narragansett Electric Company, D/B/A/ National Grid and Deepwater Wind Block Island, LLC, Docket No. 41111*, December 9, 2009, at https://offshorewindhub.org/sites/default/files/resources/natlgrid_12-10-2009_docket4111deepwaterppa_0.pdf.

[109] CRS Insight IN11412, *PJM Minimum Offer Price Rule Impact on Future Renewables*, by Richard J. Campbell and Corrie E. Clark.

[110] 16 U.S.C. §§791a–825r; 16 U.S.C. §824. For discussion of federal authority over electric power, see CRS In Focus IF11411, *The Legal Framework of the Federal Power Act*, by Adam Vann.

establish a national clean energy standard, which could affect the pace of offshore wind deployment.[111]

Connections to the Electrical Grid

With interest in developing offshore wind resources, stakeholders including regulators and system operators are concerned about connecting offshore wind farms to existing transmission and distribution infrastructure.[112] One approach is to connect wind projects to onshore electric grid infrastructure as the projects are individually approved and developed (which was the approach used for the Block Island Wind Farm and the Dominion Coastal Virginia Offshore Wind pilot project). Another potential approach is to connect multiple wind projects to a transmission infrastructure that would be built offshore, forming a transmission *backbone* that could deliver electricity to onshore electric grids at multiple points and share the costs of transmission among offshore wind projects. By attaching to onshore grids at multiple points, a backbone could address potential reliability and congestion issues within a region. Such a transmission backbone could be managed privately or publicly.[113]

One option is for BOEM to authorize one or more private entities to develop an offshore transmission backbone on the OCS. For example, in June 2019, BOEM published a request for competitive interest in commercial renewable energy transmission on the OCS offshore of New York and New Jersey.[114] The request was triggered by a proposal from a private developer, Anbaric Development Partners, LLC, to build an offshore network of subsea transmission cables, including up to eight offshore collector platforms that would collect power generated from offshore wind facilities and distribute it to landings at locations from Massachusetts to the Long Island Sound.[115]

Another option is for the federal government to develop and manage an offshore transmission backbone.[116] Such an approach could be modeled on other federal onshore projects involving

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[111] For more on clean energy standards, see CRS Report R46691, *Clean Energy Standards: Selected Issues for the 117th Congress*, by Ashley J. Lawson.

[112] The New Jersey Board of Public Utilities (BPU) requested that PJM, a regional transmission organization, incorporate state public policies into its planning process and consider the development of offshore wind generation and the incorporation of offshore wind generation into New Jersey's transmission grid. In the order to PJM, New Jersey BPU noted that staff recommendations include the initiation of "a competitive solicitation process to examine whether an integrated suite of open access offshore wind transmission facilities, both on-shore and potentially off-shore, could best facilitate meeting the State's offshore wind goals in an economically efficient and timely manner." New Jersey BPU, *Order in the Matter of Offshore Wind Transmission*, Docket No. QO20100630, November 18, 2020, p. 4, at https://www.nj.gov/bpu/pdf/boardorders/2020/20201118/8D%20-%20ORDER%20Offshore%20Wind%20Transmission.pdf. PJM has examined onshore transmission needs in response to anticipated increased growth in renewable energy generation, including offshore wind. PJM estimates that upgrades to the existing onshore transmission system range between $2.16 billion and $3.21 billion for several long-term scenarios building out transmission needs to 2035. PJM Interconnection, *Offshore Wind Transmission Study: Phase 1 Results*, October 19, 2021, p. 17, at https://www.pjm.com/-/media/library/reports-notices/special-reports/2021/20211019-offshore-wind-transmission-study-phase-1-results.ashx.

[113] Labor Energy Partnership, *Roundtable Summary: The Future of Offshore Wind Energy in the United States*, April 2021, p. 7 (hereinafter cited as Labor Energy Partnership, *Future of Offshore Wind Energy*).

[114] BOEM, "Commercial Renewable Energy Transmission on the Outer Continental Shelf Offshore New York and New Jersey; Notice of Proposed Grant Area and Request for Competitive Interest," 84 *Federal Register* 28582, June 19, 2019.

[115] BOEM, "Regional Proposals: Anbaric," at https://www.boem.gov/renewable-energy/state-activities/regional-proposals.

[116] Labor Energy Partnership, *Future of Offshore Wind Energy*, p. 7.

electricity generation and transmission. One example for a federal government model generation and transmission system is the Western Area Power Administration, which is one of four power marketing administrations (PMAs) under DOE that markets and transmits power from federally owned and operated hydropower projects.[117] In general, the PMAs came into being because of the government's need to dispose of electric power produced by dams constructed largely for irrigation, flood control, or other purposes and to promote small community and farm electrification—that is, to provide service to customers whom it would not have been profitable for a private utility to serve. The government created the PMAs to market federal power and share the common mission of providing electricity at cost-based rates with preference to public customers.[118] Another example is the Tennessee Valley Authority (TVA), a federal government corporation created by Congress in 1933. The preamble to the TVA Act of 1933 lists flood control, reforestation, and agricultural and industrial development as primary considerations in the original establishment of TVA.[119] Congress established TVA to "exist in perpetuity."[120] Although TVA initially focused its activities largely on its flood control and economic development roles, TVA is now essentially a power generation company. Its business metrics focus on optimizing TVA's financial position, and its operational goals focus on providing electricity at the lowest feasible rates to its wholesale customers in the multistate Tennessee Valley region.[121]

Without a sufficient number of offshore wind projects for a coordinated offshore grid, offshore wind projects likely will be integrated by generator interconnections, which could result in a combination of many connections to the electric grid.[122] On the one hand, the use of separate interconnections for each generator is straightforward and reportedly has been the approach for many offshore wind projects in the United States and Europe.[123] On the other hand, large numbers of individual connections to the onshore electric grid could complicate landfall connections and transmission planning. Congress may consider whether the federal government would incentivize offshore transmission infrastructure development and to what extent that development could be coordinated.[124]

[117] The Western Area Power Administration (WAPA) was created by the Department of Energy Organization Act of 1977 (P.L. 95-91). Western Area Power Administration, "About WAPA," April 13, 2021, at https://www.wapa.gov/About/Pages/about.aspx.

[118] Each power marketing administration (PMA) also has unique elements and regional issues that affect its business. For more on PMAs, see CRS Report R45548, *The Power Marketing Administrations: Background and Current Issues*, by Richard J. Campbell.

[119] 16 U.S.C. §831.

[120] Many government corporations, such as the Tennessee Valley Authority, were established to exist in perpetuity. Other government corporations, such as the U.S. Enrichment Corporation, were designed to serve as transition vehicles to transform from governmental entities into private firms.

[121] For more information on the Tennessee Valley Authority, see CRS Report R43172, *Privatizing the Tennessee Valley Authority: Options and Issues*, by Richard J. Campbell.

[122] John P. Daniel et al., *National Offshore Wind Energy Grid Interconnection Study Executive Summary*, 2014, p. 35.

[123] David Iaconangelo, "Fearing Bottlenecks, States Eye New Transmission Options," *Energywire*, May 31, 2019.

[124] In the 117th Congress, H.R. 5376, "To provide for reconciliation pursuant to title II of S.Con.Res. 14," would include provisions for interregional planning for offshore wind and grants and loans for offshore wind transmission infrastructure (see Sections 30461 and 30464).

Offshore Wind Revenues

Under the OCSLA, the Department of the Interior's Office of Natural Resources Revenue (ONRR) is authorized to collect several types of revenue during the offshore wind leasing process.[125] When BOEM holds a lease sale, developers bid on the offered leases and the winning company pays the bid amount (known as a *bonus*) to the federal government. A second type of revenue is *rents*, which developers pay annually on a lease prior to the stage when a project begins commercial operations. Under BOEM regulations, annual rents on commercial offshore wind leases are set at $3 per acre, unless otherwise specified in the lease or final sale notice.[126] Third, developers pay an *operating fee* (similar to an oil and gas royalty) on electricity produced from an operating wind facility. The operating fee is calculated based on the nameplate capacity of the facility, a *capacity factor* representing the anticipated efficiency of facility operations (e.g., accounting for fluctuations in wind speeds), and the annual average wholesale electric power price in the state where the transmission cable makes landfall for each year that the operating fee applies.[127] ONRR also records other types of offshore wind revenue, such as settlement agreements and interest payments, in its *other revenues* category.

Revenue amounts from offshore wind have varied annually over the past decade, with the highest total—$420 million—collected in FY2019 (**Table 2**). The majority of revenue in that fiscal year came from a wind lease sale off the Massachusetts coast in December 2018 that yielded $405 million in winning bids, considerably more than any previous offshore wind lease sale. Generally, revenues in the past decade have been from bonus bids, rents, and other sources but not from operating fees, because no projects were commercially operating in federal waters during this period.

Table 2. Federal Offshore Wind Revenues, FY2010-FY2020

($ in millions)

Fiscal Year	Bonus Bids	Rents	Other Revenues	Total
FY2010	0	0.1	0	0.1
FY2011	0	0.2	0	0.2
FY2012	0	0.1	0	0.1
FY2013	<0.1	0.4	0	0.4
FY2014	4.7	1.7	<0.1	6.4
FY2015	9.1	2.2	0	11.4
FY2016	1.9	3.3	<0.1	5.2
FY2017	42.5	4.0	<0.1	46.5

[125] 43 U.S.C. §1337(p)(2). Also see BOEM regulations at 30 C.F.R. §585.221, 30 C.F.R. §585.503, and 30 C.F.R. §585.506.

[126] 30 C.F.R. §585.503. Rents are applied to acres that are not yet authorized for commercial operations. By comparison with the rental rate of $3/acre for offshore wind leases, rental rates for offshore oil and gas leases typically range from $7/acre to $44/acre, depending on factors such as water depth and the length of time the lease has been held (with rents increasing in later years). See BOEM, "Gulf of Mexico Rental Rate, Minimum Bid, and Royalty Rate History," at https://www.boem.gov/GOM-Lease-Term-History/.

[127] 30 C.F.R. §585.506. The regulations define the *nameplate capacity* as the "total installed capacity of the equipment you install, as specified in your approved COP" (30 C.F.R. §585.506(c)(5)). The regulations provide for capacity factor adjustments according to production data once a project is in commercial operation (30 C.F.R. §585.506(c)(3)).

Fiscal Year	Bonus Bids	Rents	Other Revenues	Total
FY2018	0	3.3	0	3.3
FY2019	414.2	5.9	<0.1	420.0
FY2020	0	5.2	0	5.2
Total	**472.4**	**26.5**	**<0.1**	**498.9**

Source: Office of Natural Resources Revenue (ONRR), Natural Resources Revenue Data, at https://revenuedata.doi.gov/query-data/?dataType=Revenue#.

Notes: FY2010 is the earliest year for which ONRR recorded federal offshore wind revenues. BOEM did not collect any offshore wind operating fees during the FY2010-FY2020 period, because no projects had begun commercial electricity generation. The "Other Revenues" category includes revenues not in the bonus, rent, or operating fee categories, such as settlement agreements or interest payments.

Under the OCSLA, revenues collected from offshore wind projects that lie within 3 nautical miles of the seaward boundary of state waters are shared with adjacent coastal states at a rate of 27%.[128] To date, the states of Massachusetts and Rhode Island have received revenue-sharing payments in some years from eligible projects in the zone adjacent to state waters, with no payment totaling more than $25,000 in any year.[129] For projects farther from state waters—the majority of the proposed projects to date—all revenues are deposited in the U.S. Treasury as miscellaneous receipts. This disposition differs from that for offshore oil and gas leases. Oil and gas revenue sharing for projects within 3 nautical miles of state waters is similar to that for wind (revenues are shared at a rate of 27% with coastal states), but there is additional revenue sharing for projects on deeper-water oil and gas leases under the Gulf of Mexico Energy Security Act of 2006 (GOMESA).[130] GOMESA provides for revenues from qualified oil and gas leases in broad areas of the Gulf of Mexico to be shared with eligible Gulf coast states at a rate of 37.5%, up to a legislated cap.

Some Members of Congress seek a revenue-sharing arrangement for offshore wind leases similar to that provided by GOMESA for qualified oil and gas leases, or alternatively seek to raise the amounts shared with states from both wind and oil and gas leasing. Legislation in the 117th Congress would provide that, for offshore wind projects farther from shore than the OCSLA revenue-sharing zone, 50% of revenues would be shared with coastal states under a prescribed formula (with no cap on amounts to be shared).[131] As with GOMESA's oil and gas revenue shares, the legislation would provide that a state could use the revenues only for specified purposes, generally related to coastal conservation and restoration.

[128] 43 U.S.C. §1337(p)(2)(B). State waters in most states extend to 3 nautical miles from shore, so the OCSLA revenue-sharing zone generally would be for leases lying between 3 and 6 nautical miles from shore. Revenues from projects lying wholly or partly within that area are shared with states under a formula detailed at 30 C.F.R. §585.540-585.543.

[129] ONRR disbursement data queries at https://revenuedata.doi.gov/query-data. Massachusetts has received a revenue-sharing payment of approximately $24,000 in each year since FY2011. Rhode Island received revenue-sharing payments of approximately $170 in each of FY2015 and FY2016 and received approximately $1,700 in FY2017.

[130] P.L. 109-432, 43 U.S.C. §1331 note. For more information, see CRS Report R46195, *Gulf of Mexico Energy Security Act (GOMESA): Background, Status, and Issues*, by Laura B. Comay and Marc Humphries.

[131] S. 2130, 117th Congress. The formula would be used to determine which coastal states were eligible for revenue shares from a given project. S. 2130 also would increase the portion of offshore oil and gas revenues shared with Gulf coast states under the Gulf of Mexico Energy Security Act of 2006 (GOMESA; P.L. 109-432, 43 U.S.C. §1331 note) from 37.5% to 50% and would eliminate the GOMESA revenue-sharing cap. Legislation for offshore wind revenue sharing with coastal states also was introduced in the 116th Congress as S. 3485; the 116th Congress legislation would have shared 37.5% of revenues with eligible coastal states.

Some legislators also have proposed using offshore wind revenues to fund specified federal programs. For example, several bills in the 116th and 117th Congresses would set aside a portion of offshore wind revenue for the National Oceans and Coastal Security Fund.[132] Some stakeholders that favor the reduction of federal oil and gas leasing have considered whether offshore wind revenues could be a potential future funding source for federal programs that currently rely on offshore oil and gas revenues, such as the Land and Water Conservation Fund and the Historic Preservation Fund.[133] To date, revenues from offshore wind leasing have been considerably less than revenues from offshore oil and gas leasing. For example, federal offshore oil and gas revenues totaled $5.566 billion for FY2019 and $3.708 billion for FY2020, more than 10 times the amount from offshore wind in FY2019 and three orders of magnitude more than in FY2020. In its FY2022 budget justification, ONRR projected future annual revenues from offshore wind ranging from $5 million to $878 million for the FY2021-FY2031 period.[134]

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[132] S. 2130 in the 117th Congress, in addition to providing for offshore wind revenue sharing with coastal states, would set aside 37.5% of offshore wind revenues for the National Oceans and Coastal Security Fund. Also in the 117th Congress, H.R. 3892 would direct that 30% of offshore wind revenues be deposited to this fund. H.R. 8253, H.R. 8632, and S. 3485, all in the 116th Congress, would have set aside differing percentages of offshore wind revenues for the National Oceans and Coastal Security Fund (16 U.S.C. §7503).

[133] For more information on the Land and Water Conservation Fund, see CRS Report RL33531, *Land and Water Conservation Fund: Overview, Funding History, and Issues*, by Carol Hardy Vincent. For more information on the Historic Preservation Fund, see CRS Report R45800, *The Federal Role in Historic Preservation: An Overview*, by Mark K. DeSantis.

[134] DOI Office of the Secretary, Department-Wide Programs, *Budget Justifications and Performance Information: Fiscal Year 2022*, p. ELR-18, Table 9, at https://www.doi.gov/sites/doi.gov/files/fy2022-os-dwp-budget-justification.pdf.