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SUMMARY

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U.S. Offshore Wind Energy Development: Overview and Issues for the 118th Congress

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 13 million gigawatt hours per year of wind-based electricity—more than three times the amount of electricity used annually in the United States in recent years—although these estimates do not take into account economic feasibility. The Biden Administration has announced a government-wide effort to deploy 30 gigawatts (GW) of offshore wind energy by 2030 and a related goal to deploy 15 GW of installed floating offshore wind capacity by 2035. Thirty gigawatts would be equivalent to more than 2% of the U.S. utility-scale electricity generating capacity and approximately 23% of total U.S. wind electricity generating capacity (which currently comes almost entirely from onshore development).

Several U.S. offshore wind projects have been developed, or are under development, in state-owned and 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. Department of the Interior (DOI) officials have approved the construction and operations plans for four commercial-scale projects on federal leases: Vineyard Wind off the coast of Massachusetts (approved May 2021), South Fork Wind off the coasts of Rhode Island and Massachusetts (approved November 2021), Ocean Wind 1 off the coast of New Jersey (approved July 2023), and Revolution Wind off the coast of Rhode Island (approved August 2023). DOI's Bureau of Ocean Energy Management (BOEM), which oversees leasing and permitting of offshore wind projects on the U.S. outer continental shelf, has awarded additional leases for wind energy in the Atlantic and Pacific regions that are at earlier stages of development. BOEM also held an August 2023 lease sale for 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. For example, P.L. 117-169, commonly known as the Inflation Reduction Act of 2022, appropriated funding for offshore wind transmission planning and established new tax credits available to offshore wind developers and manufacturers, among other provisions. Some stakeholders seek to further expedite federal offshore wind leasing to assist coastal states in meeting renewable power commitments, facilitate a transition away from fossil fuel energy, and promote employment in the offshore wind sector. Others have expressed concerns that offshore wind leasing may be proceeding too quickly, especially given potential conflicts with other ocean uses, such as fishing; potential impacts of offshore wind development on birds and marine mammals; and issues related to the variability of wind as an energy source. Congress also may continue to consider offshore wind deployment issues related to domestic capacity for infrastructure installation, 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 (DOE's) National Renewable Energy Laboratory (NREL) has estimated that offshore regions of the contiguous United States and Hawaii have the net technical potential to generate more than 13 million gigawatt hours per year of wind-based electricity—more than three times 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 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] In September 2022, the Administration announced a related goal to deploy 15 GW of installed floating offshore wind by 2035.[4] For comparison, in 2021, the total U.S. utility-scale electricity nameplate generating capacity was approximately 1,242 GW, with more than 133 GW of that capacity (approximately 11%) produced from wind energy resources, virtually all onshore.[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 development offshore due to 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 [nm] from shore) to at least 200 nm 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,

[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; and *Wind*, September 2022, at https://www.iea.org/reports/wind-electricity; and *Renewable Energy Market Update—May 2022*, May 2022, at https://www.iea.org/reports/renewable-energy-market-update-may-2022.

[2] Anthony Lopez et al., *Offshore Wind Energy Technical Potential for the Contiguous United States*, National Renewable Energy Laboratory (NREL), NREL/PR-6A20-83650, August 15, 2022, pp. 14-16, at https://www.nrel.gov/docs/fy22osti/83650.pdf (hereinafter cited as NREL, *2022 Assessment*). NREL previously estimated that the Alaska offshore region could technically contribute an estimated 12 million gigawatt 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 on certain assumptions, such as turbine height and capacity power density (electricity generation per land or ocean surface area) in addition to siting assumptions.

[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/. Also see Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," Section 207, January 27, 2021, 86 *Federal Register* 7619; and 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] White House, "Biden-Harris Administration Announces New Actions to Expand U.S. Offshore Wind Energy," fact sheet, September 15, 2022, at https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/15/fact-sheet-biden-harris-administration-announces-new-actions-to-expand-u-s-offshore-wind-energy/.

[5] U.S. Energy Information Administration (EIA), *Electric Power Annual*, "Table 4.3 Existing Capacity by Energy Source," November 7, 2022, 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.

[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 (nm) from shore. For more information, see CRS Report R40175, *Offshore Wind Energy Development: Legal Framework*, 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."

the Department of the Interior's (DOI's) Bureau of Ocean Energy Management (BOEM) has awarded more than 30 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.

The 117th Congress conducted oversight and enacted legislation concerning offshore wind development. For example, P.L. 117-169, commonly known as the Inflation Reduction Act of 2022 (IRA), appropriated funding for offshore wind transmission planning and established new tax credits available to offshore wind developers and manufacturers, among other relevant provisions.[10] The 118th Congress may consider additional issues related to offshore wind leasing, permitting, deployment, and revenues.

Global Deployment and Variability of Offshore Wind Energy

In 2022, the global installed capacity of offshore wind energy totaled more than 59 gigawatts (GW), with nearly 17% of total capacity—or more than 8 GW—installed in 2022. China's capacity growth in 2021 and 2022 (with a combined total of nearly 20 GW) has split global offshore wind deployment between Europe and Asia. In 2020, 76% of the global offshore wind capacity was located in Europe; in 2022, approximately 51% of global installed capacity was in Europe and nearly 49% was in Asia.

Wind energy is a variable energy source in that it can produce electricity only when the wind is blowing. In the North Sea, weather conditions in 2021 resulted in lower-than-expected wind energy generation, increasing demand for electricity from fossil fuel-fired generators in the United Kingdom. The United Kingdom—with more than 11 GW of offshore wind capacity in 2021—generated 11.5% (35,510 gigawatt hours [GWh]) of its total electricity from offshore wind resources in 2021. This is less than the percentage of total electricity generated from offshore wind resources in 2020 (12.9% or 40,681 GWh) and 2022 (13.8% or 45,020 GWh). According to the July 2023 Digest of UK Energy Statistics, "Capacity increases and wind speeds returning to more normal levels after 2021's unusually low values led to wind generation increasing 24% on 2021 levels, to 80.3 TWh [terawatt hours for both onshore and offshore]."

In the United States, current levels of generation from variable renewable energy sources have not created widespread reliability issues because sufficient dispatchable capacity usually is available. 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*.

Sources: Department of Energy, *Offshore Wind Market Report: 2023 Edition*, DOE/GO-102023-6059, August 2023, pp. 52-53; UK Department for Energy Security and Net Zero, *Digest of UK Energy Statistics (DUKES)*, p. 4, Table 5.6, "Electricity Fuel Use, Generation and Supply," and Table 5.12, "Plant Installed Capacity," updated July 27, 2023.

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 turbines. Other distinguishing features

[8] As of the date of this report, the Bureau of Ocean Energy Management (BOEM) had issued 33 offshore wind leases that remain active. In addition to these, BOEM awarded several other leases that expired or were relinquished (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 (CVOW)," at https://www.boem.gov/renewable-energy/state-activities/coastal-virginia-offshore-wind-project-cvow.

[10] For further discussion of offshore wind provisions in P.L. 117-169, see CRS Insight IN11980, *Offshore Wind Provisions in the Inflation Reduction Act*, by Laura B. Comay, Corrie E. Clark, and Molly F. Sherlock.

of offshore wind turbines include the supporting structures or foundations for the turbines and the support vessels required for offshore wind development.

The wind flowing over a body of water turns the blades of an offshore wind turbine; 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.[11] Key factors that affect the amount of electricity generated from a wind turbine 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.

Different turbine configurations and characteristics can affect performance. As mentioned, offshore wind turbines are typically taller and larger than onshore wind turbine systems.[12] **Figure 1** depicts a typical offshore wind turbine configuration.[13]

Fixed-bottom turbine support structures are the predominantly deployed offshore wind technology.[14] These structures, also referred to as *foundations*, secure the tower with the turbine components to the seafloor (**Figure 2**). Several types of foundation technologies include monopiles, jackets, and gravity-based foundations. Monopiles, which accounted for approximately 60% of the global operating offshore wind capacity in 2022, are cylindrical structures driven or drilled into the seafloor and attached to the bottom of the turbine tower.[15] Jacket structures, which accounted for more than 10% of the global operating offshore wind capacity in 2022, typically consist of four legs connected by braces and attached via anchors or drilled piles into the seafloor.[16] Gravity-based foundations are placed on the seafloor and rely on the weight of the structure 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.

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[11] The size and number of undersea electrical cables and the types 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 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.

[12] DOE reports that "Offshore wind turbines in the 15-MW class are advancing toward commercial production. All three leading wind turbine manufacturers active in Europe and the U.S. market—Siemens Gamesa, Vestas, and General Electric—have announced that their 14-MW and 15-MW wind turbine prototypes have generated power and are moving toward commercial development with the goal of them being available for purchase by 2024." DOE, *Offshore Wind Market Report: 2023 Edition*, DOE/GO-102023-6059, August 2023, p. xiii (hereinafter cited as DOE, *2023 Market Report*).

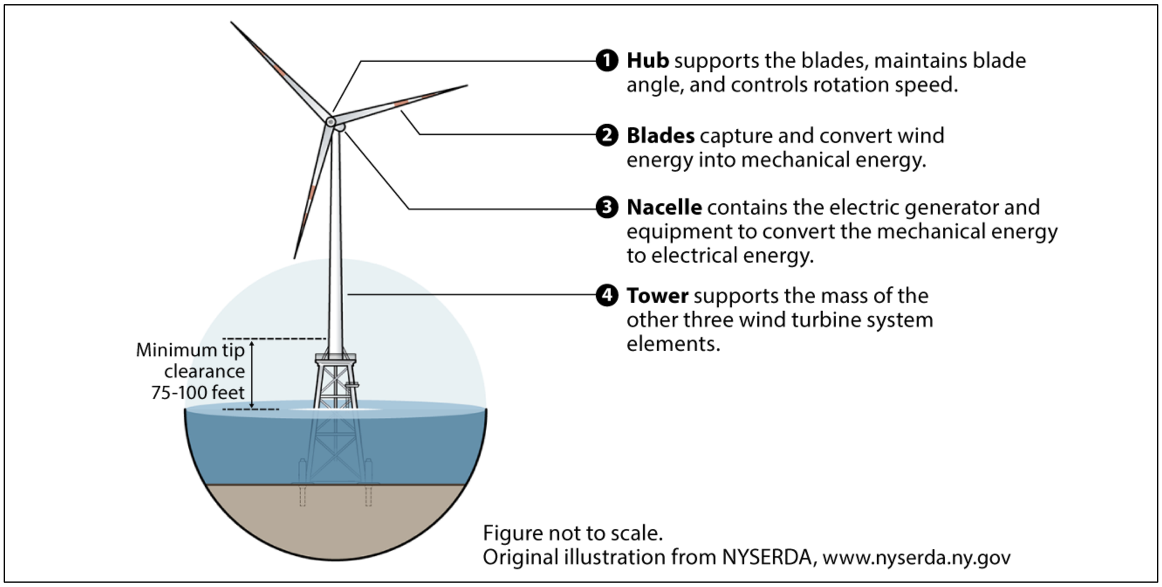
[13] There are two basic types of wind turbine configurations: horizontal-axis turbines and vertical-axis turbines. The wind turbine depicted in **Figure 1** is a horizontal-axis configuration.

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

[15] DOE, *2023 Market Report*, p. 72.

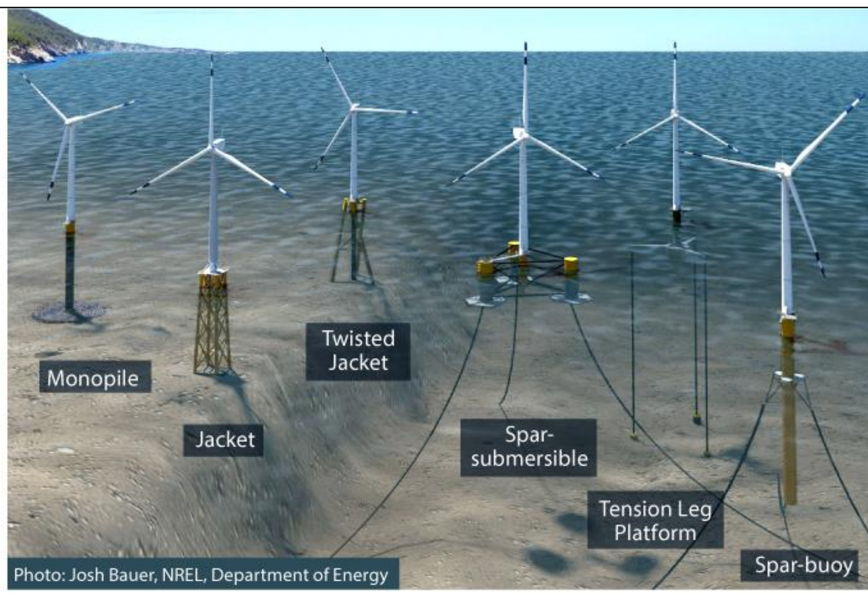
[16] Ibid.

Figure 1. Offshore Wind Turbine Components



Source: CRS adaptation of illustration from New York State Energy Research and Development Authority (NYSERDA), "Offshore Wind 101," November 2021.

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.

In addition to fixed-bottom structures, the offshore wind industry is beginning to use floating structures, which are not set into the seafloor but instead have a mooring system that is anchored to maintain a fixed position. **Figure 2** depicts several types of fixed-bottom and floating structures. Floating structures are a potential option for projects in deep water (approximately 60 meters or 200 feet in depth, or deeper), such as deepwater areas in the Gulf of Maine and off the

Pacific coast and Hawaii.[17] Most planned floating projects use semisubmersible structures; other floating structure designs can include barge, tension leg platform, and spar technology.[18] Tension leg platforms are buoyant structures that have arms connected through tension to a foundation or anchor system.[19] Spar technology relies on spar buoys, ballasted cylindrical buoys that keep the center of gravity below the center of buoyancy.[20] Total global floating offshore wind capacity is more than 123 megawatts (MW) (or 0.123 GW).[21]

Leasing and Permitting

BOEM oversees leasing for offshore wind energy on the OCS and has primary responsibility for approving wind projects on developed leases.[22] BOEM granted its first leases for wind energy development in 2009 and administered 33 active wind leases as of August 2023.[23] BOEM characterizes its commercial wind leasing and permitting process as consisting of four broad phases: planning and analysis; leasing; site assessment; and construction and operations.[24] In January 2023, BOEM proposed regulatory changes that would alter some steps in the process (for instance, to reflect current technologies and practices or to alter steps identified by developers as overly burdensome), while retaining the overall four phases.[25]

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*.[26] 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. Based partly on the

[17] DOE, *2023 Market Report,* p. 54. BOEM's December 2022 California lease sale included areas expected to be developed with floating structures. The sale offered a 20% credit to bidders for commitments to support the floating wind industry through workforce training programs and/or development of a U.S. domestic supply chain. According to DOI, "[t]his credit will result in over $117 million in investments for these critical programs or initiatives" (DOI, "Biden-Harris Administration Announces Winners of California Offshore Wind Energy Auction," press release, December 7, 2022, at https://doi.gov/pressreleases/biden-harris-administration-announces-winners-california-offshore-wind-energy-auction).

[18] Ibid., p. 73.

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

[20] Ibid., p. 5.

[21] DOE, *2023 Market Report,* pp. xii.

[22] For a discussion of the statutory framework underlying the BOEM process, see CRS Report R40175, *Offshore Wind Energy Development: Legal Framework*, by Adam Vann. In January 2023, BOEM transferred some management responsibilities for renewable energy development to a sister agency, DOI's Bureau of Safety and Environmental Enforcement (BSEE). See BOEM and BSEE final rule, 88 *Federal Register* 6376, January 31, 2023; and CRS Insight IN12096, *Offshore Wind Regulatory Framework: New Developments*, by Laura B. Comay and Adam Vann. The transferred responsibilities primarily relate to ensuring workplace safety and enforcing environmental compliance. Other agencies also have permitting roles for some offshore wind activities.

[23] BOEM, "Lease and Grant Information," at https://www.boem.gov/renewable-energy/lease-and-grant-information. Also see CRS Congressional Distribution Memorandum, *Status of Active Federal Offshore Wind Leases*, available from the authors.

[24] BOEM, "Wind Energy Commercial Leasing Process: Fact Sheet," May 2021, at https://www.boem.gov/sites/default/files/documents/about-boem/Wind-Energy-Comm-Leasing-Process-FS-01242017Text-052121Branding.pdf, hereinafter cited as BOEM Leasing Process Fact Sheet. BOEM has awarded most wind leases through the commercial leasing process, but agency regulations (30 C.F.R. §585.202) also allow BOEM to offer "limited leases" for projects (e.g., pilot or research projects) that do not result in commercial production exceeding a specified level.

[25] BOEM, "Renewable Energy Modernization Rule," notice of proposed rulemaking, 88 *Federal Register* 5968, January 30, 2023, hereinafter cited as BOEM, Renewable Energy Modernization proposed rule.

[26] 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 (30 C.F.R. §585.211 and 585.230).

feedback received, BOEM may identify, within the call area, targeted *wind energy areas* (WEAs) that appear "most suitable" for leasing.[27] The WEA identification process includes public input and environmental evaluation under the National Environmental Policy Act (NEPA).[28] Over the past decade, BOEM has identified call areas and WEAs in multiple locations off the Atlantic and Pacific coasts, off Hawaii, and in the Gulf of Mexico (**Figure 3**).

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 there is competitive interest, BOEM holds a lease auction.[29] To date, BOEM has held 12 offshore wind lease auctions, 10 in the Atlantic region, 1 in the Pacific region, and 1 in the Gulf of Mexico region. The lease auctions may use any of several formats, as provided in BOEM regulations.[30] Recent auctions have used a "multiple-factor" bidding format, in which bidders may receive credit for specified factors in addition to their cash bid—for example, for commitments to invest in activities that build domestic supply chains or train U.S. workers in the offshore wind industry.

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. Currently, developers must prepare a site assessment plan (SAP) and obtain BOEM approval for these activities through a process that includes environmental review under NEPA.[31] BOEM's proposed regulatory changes would eliminate the need for SAPs in many circumstances, although permits could still be needed from other agencies for some site assessment activities.[32]

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) along with necessary permits from other federal agencies.[33] The COP approval process requires additional environmental review and public comment. To date, BOEM has approved four COPs, and construction has begun on two leases. Other COPs are at various review stages.

[27] BOEM Leasing Process Fact Sheet.

[28] 42 U.S.C. §4321. For more information on National Environmental Policy Act (NEPA), see CRS In Focus IF11549, *The Legal Framework of the National Environmental Policy Act*, by Nina M. Hart and Linda Tsang.

[29] 30 C.F.R. §585.210. BOEM must afford a competitive process for offshore wind leasing unless it determines after public notice that there is no competitive interest (30 C.F.R. §585.201). If no competitive interest exists, BOEM may negotiate a lease noncompetitively after consultation with affected federal agencies, state and local governments, and Indian tribes (30 C.F.R. §585.231). BOEM has awarded several commercial wind leases noncompetitively, including two currently active leases off the coast of Delaware for the GSOE 1 and Skipjack projects (see **Figure 3**).

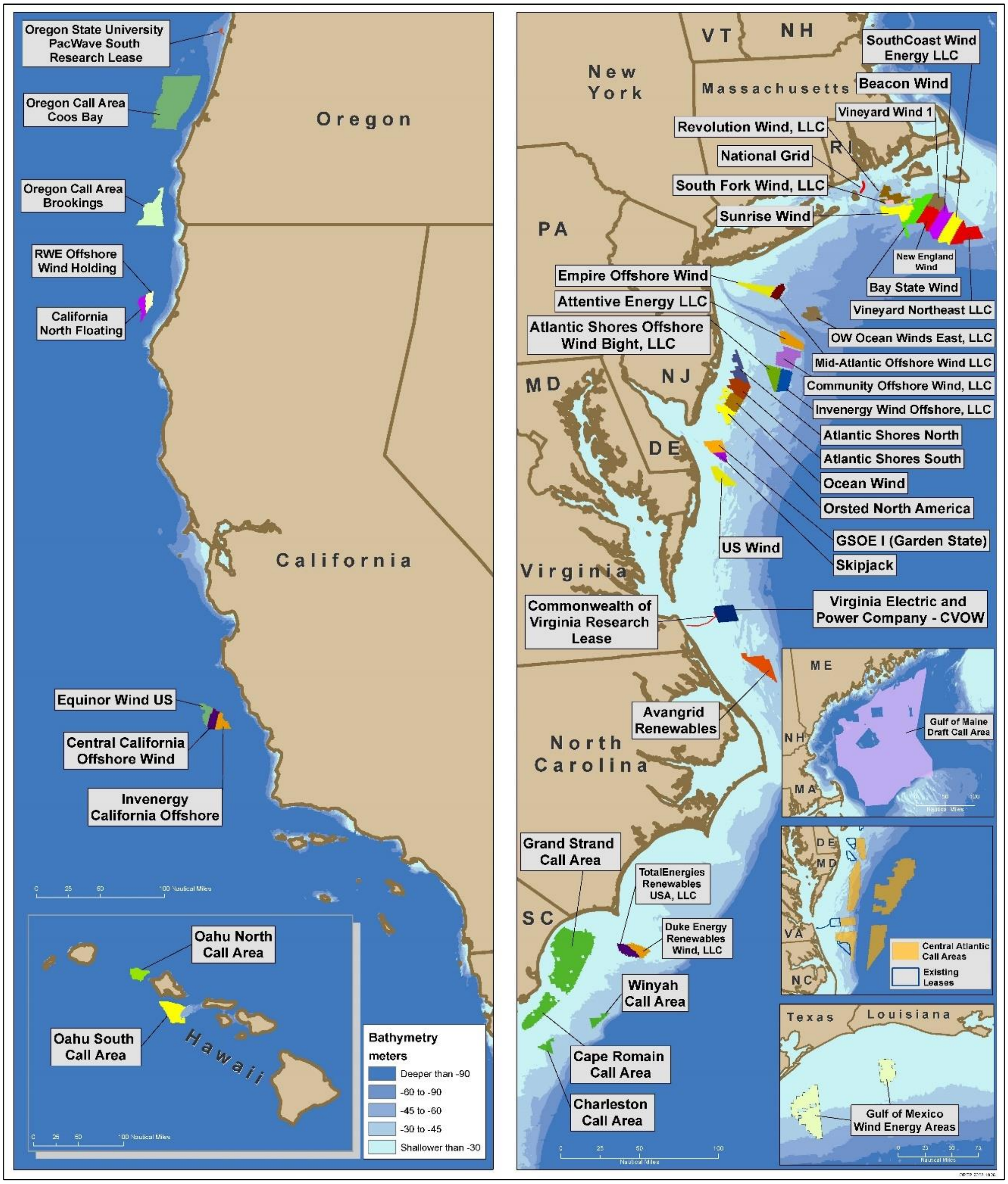
[30] 30 C.F.R. §§585.220-585.221. BOEM's January 2023 proposed rule would modify the auction format regulations to "reorganize, simplify, and clarify" the auction procedures (BOEM, Renewable Energy Modernization proposed rule). The amendments would retain the option for multiple-factor auctions.

[31] For recent leases, BOEM typically has conducted NEPA compliance for projected site assessment activities early in the leasing process, as part of its evaluations of proposed wind energy areas for leasing.

[32] Under the proposed rule, SAPs would not be required for meteorological buoys, which the agency states have "minimal environmental impacts," but would continue to be required for meteorological towers. According to BOEM, the industry has largely transitioned to buoys rather than towers for site assessment, and the regulatory change likely would result in "relief from the SAP requirement for nearly all future development of OCS renewable resources" (BOEM, Renewable Energy Modernization proposed rule). The buoys may still require other permits, such as from the U.S. Army Corps of Engineers (USACE) under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. §403).

[33] For example, permits may be required from the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) for the incidental take of protected species under the Marine Mammal Protection Act (16 U.S.C.§1371), and from USACE under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. §403) and Section 404 of the Clean Water Act (33 U.S.C. §1344).

Figure 3. Map of BOEM's Renewable Energy Leases and Planning Areas



Source: Bureau of Ocean Energy Management (BOEM), "Outer Continental Shelf Renewable Energy," 2023, at https://www.boem.gov/sites/default/files/documents/renewable-energy/All-States-Poster_0.pdf.

Note: Map includes offshore wind leases and planning areas, along with a limited research lease for the PacWave offshore wave energy project off the Oregon coast.

Lease Sale Scheduling

Congress has expressed interest in the frequency and regularity with which BOEM schedules offshore wind lease sales under its current process. Unlike for oil and gas—where the OCSLA requires BOEM to prepare comprehensive five-year leasing programs that evaluate all available areas to determine when and where lease sales will take place—offshore wind lease sales are scheduled individually, based on either unsolicited lease applications or area evaluations undertaken at BOEM's discretion.[34] Under this process, BOEM has conducted 12 competitive wind lease sales in total (typically awarding multiple leases at each sale), and the frequency of lease sales has varied. For instance, BOEM held one wind lease sale in each of 2016, 2017, and 2018; none in 2019, 2020, or 2021; three in 2022; and one to date in 2023.[35]

Some Members of Congress and other stakeholders have advocated for greater predictability and regularity in BOEM's offshore wind leasing program.[36] They contend that a more comprehensive program would ensure a consistent offshore wind supply, facilitate state clean energy targets, and spur supply chain investments.[37] A five-year planning requirement akin to that for the offshore oil and gas program also could result in broader-scale environmental evaluations of offshore wind at a programmatic level, whereas the current process is more focused on evaluating individual leases and projects.[38] Others have expressed concern about a standardized leasing process for offshore wind, arguing for the importance of maintaining flexibility in scheduling lease sales.[39]

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

[35] The December 2016 lease sale was for an area off New York, the March 2017 sale was for an area off North Carolina, and the December 2018 sale was for areas off Massachusetts. The three sales in 2022 were for areas off New York and New Jersey (the New York Bight), North Carolina (Carolina Long Bay), and California. The sale in 2023 was for areas in the Gulf of Mexico. Prior to 2016, BOEM had held two commercial lease sales for offshore wind in 2013 (Rhode Island/Massachusetts and Virginia), one in 2014 (Maryland), and two in 2015 (Massachusetts and New Jersey).

[36] For example, S. 3214 in the 117th Congress would have required the Secretary of the Interior to "immediately review and make proposals for the offshore wind leasing program for the Atlantic and Pacific Regions of the outer Continental Shelf in order to reach the goal of conducting a minimum of 2 region-wide lease sales annually" in each region.

[37] 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, https://www.governor.ny.gov/sites/default/files/2021-06/Joint_Governors_Letter_to_Biden_Admin_OSW_priorities_FINAL.pdf.

[38] The offshore oil and gas five-year program is accompanied by a programmatic environmental impact statement (EIS) under NEPA, evaluating the impacts of leasing in all outer continental shelf (OCS) areas under consideration. For more information, see CRS Report R44504, *Five-Year Offshore Oil and Gas Leasing Program: History and Background*, by Laura B. Comay and Adam Vann. Subsequent NEPA compliance for individual lease sales and for exploration and development plans tiers off of the broader programmatic EIS for the relevant five-year program. BOEM has stated based on judicial rulings that the programmatic EISs for the oil and gas program are voluntary rather than required by NEPA. See, for example, BOEM, *2023-2028 National Outer Continental Shelf Oil and Gas Leasing Program: Draft Programmatic Environmental Impact Statement*, July 2022, pp. 2-3, at https://www.boem.gov/sites/default/files/documents/oil-gas-energy/national-program/2023-2028-NationalOCSOilGasLeasingDraftPEISVol1.pdf.

[39] See, for example, 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.

BOEM's January 2023 proposed regulatory changes would include publication by the agency of periodic proposed five-year leasing schedules for the renewable energy program.[40] BOEM states that the schedules would provide "increased certainty and enhanced transparency, and facilitate planning by industry, the States, and other stakeholders."[41] The renewable energy leasing schedules would differ from oil and gas five-year programs; for instance, they would not have public comment requirements, and BOEM would appear to have more flexibility to deviate from the schedules than is provided in OCSLA for the oil and gas program. Based on BOEM's description in the proposed rule, it appears that the proposed schedules likely would not involve preparation of a programmatic environmental impact statement (EIS) under NEPA. Absent a programmatic EIS, the proposed schedules may play a limited role in addressing the concerns of those who seek to shift evaluation of the impacts of OCS offshore wind leasing to a broader, programmatic level.

A separate issue concerns restrictions on offshore wind lease sales imposed by P.L. 117-169, the IRA.[42] For the 10 years following that law's August 2022 enactment, BOEM may not issue offshore wind leases unless an offshore oil and gas lease sale meeting certain criteria has been held in the previous year. In the 118th Congress, H.R. 4936 would repeal this provision.

Regional Leasing Decisions

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.[43] Most of the leasing to date has been in the Atlantic region. BOEM held a lease sale in the Pacific region in December 2022 and a sale in the Gulf of Mexico region in August 2023.

- **Atlantic Region.** The Atlantic OCS, especially off the northeast coast, has strong average wind speeds (**Figure 4**) and relatively high wind energy potential.[44] Multiple East Coast states have committed to sourcing portions of their overall power from renewable sources in general or offshore wind in particular. Compared with some other parts of the country, the region has relatively little land available for onshore renewable development, making offshore development potentially attractive. The ocean depth in many places allows for use of fixed-bottom foundations.[45] BOEM has awarded wind leases off the coasts of Delaware, Maryland, Massachusetts, New Jersey, New York, North Carolina, Rhode Island, South Carolina, and Virginia and has initiated planning for leasing

40 BOEM, Renewable Energy Modernization proposed rule. The schedules would be updated at least once every two years, and would include "a list of locations under consideration for leasing and a leasing schedule that BOEM intends to follow in announcing its future renewable energy lease sales." For further discussion, see CRS Insight IN12096, *Offshore Wind Regulatory Framework: New Developments*, by Laura B. Comay and Adam Vann.

41 Ibid.

42 P.L. 117-169, Section 50265.

43 NREL, *2016 Assessment*; NREL, *2017 Alaska Assessment*. BOEM divides the OCS into these four regions for administrative purposes. Offshore wind also has been pursued in the Great Lakes, but BOEM does not administer those efforts because the Great Lakes are state waters. The federal government cooperates with Great Lakes states through a memorandum of understanding on offshore wind (Great Lakes Offshore Wind Energy Consortium, "Memorandum of Understanding" and "Fact Sheet," 2012, both available at https://www.glc.org/library/2012-great-lakes-offshore-wind-memorandum-of-understanding).

44 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.

45 See section on "Overview of Offshore Wind Technology."

in the Gulf of Maine.[46] In August 2022, the IRA authorized potential further leasing in the southern Atlantic, reversing an earlier ban by President Trump.[47] Some support additional Atlantic lease sales, for example, to facilitate state renewable power goals and generate employment in the offshore wind sector. Others advocate for limiting further wind leasing in the Atlantic, in consideration of potential conflicts with fishing and defense activities and potential environmental impacts of development (see discussion below).[48]

- **Pacific Region.** BOEM held its first offshore wind lease sale for the Pacific region in December 2022, for two wind energy areas off the northern and central coasts of California.[49] Some observers have identified California as a promising area for offshore wind, particularly because the populous state has committed to source 100% of its electricity from zero-carbon sources by 2045.[50] Because water depths drop rapidly off the California coast, projects in federal waters likely will 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.[51] BOEM also has taken preliminary steps toward wind lease sales off the coasts of Oregon and Hawaii, which also would be expected to require floating turbines.[52]

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[46] For more information, see BOEM, "State Activities," at https://www.boem.gov/renewable-energy/state-activities. BOEM 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.

[47] P.L. 117-169, Section 50251(a), reversing wind leasing bans issued by President Trump in September 2020 under authority provided by Section 12(a) of the OCSLA (43 U.S.C. §1341(a)).

[48] In the 118th Congress, House-passed H.R. 1, §20119, would require a Government Accountability Office (GAO) report on potential adverse effects of wind energy development in BOEM's North Atlantic planning area. H.R. 4284 would prohibit commercial offshore wind development in parts of the Gulf of Maine.

[49] See BOEM, "California Activities," at https://www.boem.gov/renewable-energy/state-activities/california.

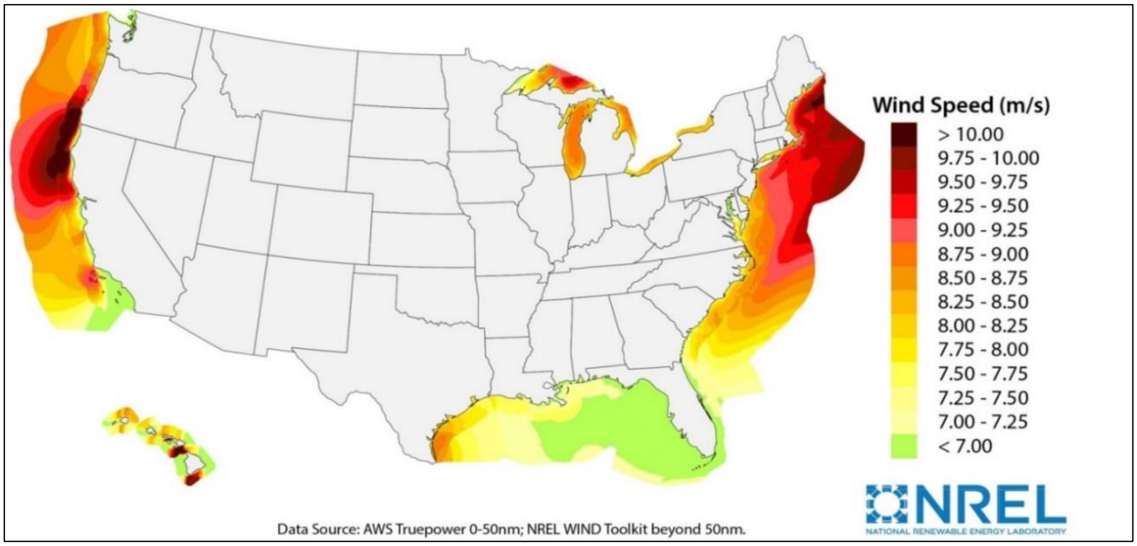
[50] On California renewable power commitments, see EIA, "California: State Profile and Energy Estimates," at https://www.eia.gov/state/analysis.php?sid=CA. California's 100 Percent Clean Energy Act of 2018 (SB 100) did not define *zero-carbon resources*. The term has been interpreted to mean energy resources that qualify as *renewable* or generate zero greenhouse gas emissions onsite (see, e.g., California Energy Commission, *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://www.energy.ca.gov/publications/2021/2021-sb-100-joint-agency-report-achieving-100-percent-clean-electricity).

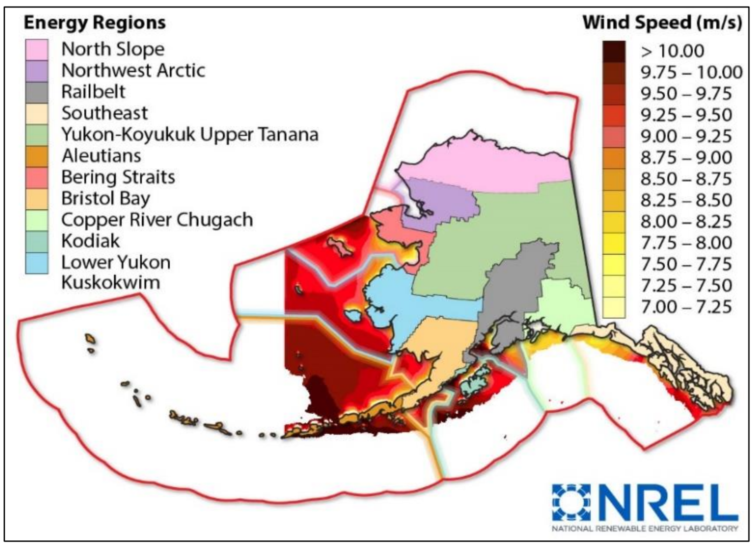
[51] For more information, see the section on "Overview of Offshore Wind Technology."

[52] BOEM, "Call for Information and Nominations—Commercial Leasing for Wind Energy Development on the Outer Continental Shelf (OCS) Offshore Oregon," 87 *Federal Register* 25529, April 29, 2022; and 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. Although BOEM established the Hawaii call area in 2016, the agency has not taken the next step of identifying WEAs, and a 2021 NREL study stated that BOEM had "no timeline or specific plan" for wind development in Hawaiian waters (NREL, *The Cost and Feasibility of Floating Offshore Wind Energy in the O'ahu Region*, October 2021, p. iv, at https://www.boem.gov/sites/default/files/documents/regions/pacific-ocs-region/environmental-science/BOEM-2021-070.pdf).

Figure 4. U.S. Offshore Wind Speed Estimates

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





Source: National Renewable Energy Laboratory (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 ocean surface, a typical height for offshore wind turbine hubs; nm = nautical miles; m/s = meters per second.

- **Gulf of Mexico Region.** BOEM held an August 2023 lease sale for the Gulf of Mexico region. One lease was awarded off the coast of Lake Charles, LA; two leases off the coast of Galveston, TX, did not receive bids.[53] A study by BOEM and NREL found the Gulf advantageous for offshore wind development in

[53] BOEM, "Gulf of Mexico Activities," at https://www.boem.gov/renewable-energy/state-activities/gulf-mexico-activities.

several ways.[54] For example, the 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, particularly the need to adapt wind technologies to withstand the region's hurricane potential, relatively low average wind speeds (**Figure 4**), and soft soils on the seafloor. Additionally, most Gulf states do not have renewable energy mandates,[55] although some have expressed interest in offshore wind development in the region.[56] A specific issue is whether wind leasing should be permitted in the Eastern Gulf offshore of Florida—an area of active military testing and training. The IRA opened this area for wind leasing;[57] some 118th Congress legislation (H.R. 970, S. 279) would prohibit wind leasing in this area for a specified time period. More broadly, the general development of U.S. offshore wind has been of interest to Gulf states 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 U.S. offshore wind supply vessels for projects in the Atlantic region (see section on "Deployment Issues," below).[58]

- **Alaska Region.** An NREL assessment found that Alaska has a technical offshore wind resource capacity larger than that of all other U.S. states combined.[59] 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.[60] Alaska has a goal to supply 50% of its electricity from renewable sources by 2025 and has pursued hydropower, biomass, and onshore wind projects, among others.[61] BOEM has not undertaken any offshore wind leasing activities in Alaska to date.

[54] BOEM and NREL, *Offshore Wind in the U.S. Gulf of Mexico: Regional Economic Modeling and Site-Specific Analyses*, BOEM 2020-018, February 2020, at https://espis.boem.gov/final%20reports/BOEM_2020-018.pdf.

[55] A Texas mandate that 10,000 MW (or 10 GW) of the state's electricity-generating capacity come from renewable sources by 2025 has already been exceeded, owing to onshore wind energy generation as well as non-wind sources. See EIA, "Texas: State Profile and Energy Estimates," at https://www.eia.gov/state/analysis.php?sid=TX.

[56] See, for example, 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.

[57] P.L. 117-169, Section 50251(a).

[58] 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.

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

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

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

Inflation Reduction Act Provisions on Offshore Wind and U.S. Territories

P.L. 117-169 (commonly known as the Inflation Reduction Act of 2022 or IRA) contains provisions in Section 50251(b) authorizing the Bureau of Ocean Energy Management (BOEM) to pursue offshore wind leasing in federal waters off U.S. territories. 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 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. Prior to the amendments made by the IRA, the Outer Continental Shelf Lands Act (OCSLA) and its offshore wind leasing provisions (43 U.S.C. §1337(p)) had not applied to the exclusive economic zones (EEZs) of U.S. territories and possessions. In addition to amending OCSLA to apply to the territories, the IRA requires BOEM to issue calls for information and nominations for offshore wind leasing in the EEZs of American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands. BOEM is authorized to subsequently conduct wind lease sales in areas deemed feasible and of sufficient interest, after consultation with the territorial governor.

Permitting Decisions

To date, DOI has approved four construction and operations plans (COPs) for offshore wind projects—the COP submitted by Vineyard Wind, LLC, for the Vineyard Wind 1 project off the coast of Massachusetts; 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; the COP submitted by Ocean Wind, LLC, for the Ocean Wind 1 Offshore Wind Farm off the coast of New Jersey; and the COP submitted by Revolution Wind, LLC, for the Revolution Wind Farm, located off of the coast of Rhode Island and supplying power to Rhode Island and Connecticut.[62] DOI's approval of a COP, along with accompanying authorizations by other agencies, enables wind turbine construction and operations.[63] BOEM is working to complete review of pending COPs for other projects. By 2025, the agency anticipates completing review of "at least 16 construction and operation plans that could provide up to nearly 27 GW of new clean energy."[64]

Some offshore wind developers and other stakeholders contend that BOEM's review process has been unnecessarily slow, causing project delays.[65] Congress has considered whether BOEM needs additional staff and financial resources to review the growing number of submitted COPs. In

[62] 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); 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); DOI, *Record of Decision: Ocean Wind 1 Offshore Wind Farm Construction and Operations Plan*, July 3, 2023, at https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Ocean-Wind-1-ROD_0.pdf (hereinafter cited as DOI, Ocean Wind 1 ROD); and DOI, *Record of Decision: Revolution Wind Farm and Revolution Wind Export Cable Project Construction and Operations Plan*, August 21, 2023, at https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Revolution-Wind-Record-of-Decision-OCS-A-0486_3.pdf.

[63] Agencies other than BOEM, such as NMFS and USACE, can 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 example, these agencies all concurred on the Vineyard Wind 1 COP (BOEM, Vineyard Wind ROD, p. 3). For more information, see CRS Report R40175, *Offshore Wind Energy Development: Legal Framework*, by Adam Vann.

[64] BOEM, *Budget Justifications and Performance Information: Fiscal Year 2024*, at https://www.doi.gov/sites/doi.gov/files/fy2024-boem-greenbook.pdf-508.pdf; hereinafter cited as BOEM FY2024 budget justification. For information on the status of COP reviews, see CRS Congressional Distribution Memorandum, *Status of Active Federal Offshore Wind Leases*, available from the authors.

[65] 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/.

Interior appropriations acts for FY2020-FY2023, Congress increased appropriations to BOEM's Renewable Energy account, in part to improve permitting capacity for offshore wind projects.[66] For FY2024, BOEM requested an increase of 51% over FY2023 funding for the Renewable Energy account to support "expeditious and efficient" permitting, among other purposes.[67] Many offshore wind projects are covered under Title 41 of the Fixing America's Surface Transportation Act (FAST-41; P.L. 114-94), which requires coordination of federal agency review for covered projects.[68] Broader permitting reform provisions proposed or enacted in the 118th Congress also could affect the COP review process for offshore wind.[69]

Other stakeholders have expressed the opposing concern that BOEM's permitting of offshore wind projects is proceeding too quickly, with insufficient consideration of conflicting ocean uses and the environmental impacts of wind development. House-passed legislation in the 118th Congress would require the Government Accountability Office (GAO) to "assess the sufficiency of the environmental review processes for offshore wind projects," with attention to impacts of development on marine wildlife, commercial and recreational fishing, and military use of the ocean, among other factors.[70]

Fishing Industry Concerns

Commercial fishing groups have expressed concerns about potential impacts to their industry from offshore turbine construction and operation on the OCS, including potential effects on fish stocks and fishing vessel navigation, among others.[71] Some groups have questioned whether BOEM may be using incomplete data on fisheries or gathering insufficient input from seafood industry groups, when making leasing decisions.[72] Partly in response to such concerns, BOEM undertook a supplement to its EIS for the Vineyard Wind 1 COP to consider cumulative impacts of potentially widespread wind development throughout the Atlantic region.[73] BOEM also has completed other studies and has engaged with the fishing industry through workshops and public meetings.[74] The U.S. Coast Guard has studied turbine spacing and vessel transit in Atlantic wind lease areas and has issued turbine spacing recommendations, some of which have been contested

[66] For more information, see CRS In Focus IF11405, *Offshore Energy Agency Appropriations, FY2020*, by Laura B. Comay; CRS In Focus IF11752, *Offshore Energy Agency Appropriations, FY2021*, by Laura B. Comay; CRS In Focus IF11933, *Offshore Energy Agency Appropriations, FY2022*, by Laura B. Comay; and CRS In Focus IF12204, *Offshore Energy Agency Appropriations, FY2023*, by Laura B. Comay.

[67] BOEM FY2024 budget justification, p. 29.

[68] "Permitting Dashboard: Federal Infrastructure Projects," at https://www.permits.performance.gov/.

[69] See CRS In Focus IF12417, *Environmental Reviews and Permitting: Pending Legislation*, by Kristen Hite.

[70] H.R. 1, §20118. In June 2023, Rep. Chris Smith announced that GAO had agreed to undertake such a study in response to Member requests (Rep. Chris Smith, press release, June 15, 2023, at https://chrissmith.house.gov/news/documentsingle.aspx?DocumentID=411511).

[71] See, for example, Responsible Offshore Development Alliance (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/.

[72] See, for example, 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.

[73] 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.

[74] See BOEM, "Fishing and Offshore Renewable Energy," at https://www.boem.gov/renewable-energy/state-activities/fishing-and-offshore-renewable-energy.

by fishing groups.[75] DOI generally has relied on Coast Guard recommendations when stipulating distances between turbines as part of the COP approval process.[76]

BOEM and other stakeholders have considered ways to address potential adverse effects of offshore wind development on fishermen. In June 2022, BOEM sought feedback on draft guidelines for offshore wind lessees to mitigate impacts of their activities on commercial and recreational fisheries, including through financial compensation.[77] Some offshore wind developers already have pursued financial compensation arrangements with area fishermen.[78] Most recently, in its final sale notice for the Gulf of Mexico wind lease sale, BOEM offered a 10% bidding credit for bidders who commit to contribute to a fisheries compensatory mitigation fund "to mitigate potential negative impacts to commercial and for-hire recreational fisheries."[79]

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.[80] For example, researchers have studied potential impacts from animals' collisions with turbines or construction vessels, noise associated with project construction and operations, habitat displacement, changes in prey availability, and effects from the 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.

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[75] 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. Also see additional Coast Guard port access route studies (e.g., for the New York Bight, New Jersey, North Carolina, and the Pacific Coast) at https://www.navcen.uscg.gov/port-access-route-study-reports. For fishing industry objections, see, for example, 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.

[76] See, for example, the records of decision (RODs) and final EISs for the Vineyard Wind 1, South Fork, and Ocean Wind 1 COPs.

[77] BOEM, "Guidelines for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR Part 585," June 23, 2022, at https://www.boem.gov/sites/default/files/documents/renewable-energy/DRAFT%20Fisheries%20Mitigation%20Guidance%2006232022_0.pdf. Also see BOEM, "Reducing or Avoiding Impacts of Offshore Wind Energy on Fisheries," at https://www.boem.gov/renewable-energy/reducing-or-avoiding-impacts-offshore-wind-energy-fisheries.

[78] See, for example, Vineyard Wind and Massachusetts Executive Office of Energy and Environmental Affairs, "Agreement Regarding the Establishment and Funding of the Massachusetts Fisheries Innovation Fund," May 21, 2020, at https://static1.squarespace.com/static/5a2eae32be42d64ed467f9d1/t/5ee122f4c0502b68b9dc41cf/1591812875587/MA+Fisheries+Compensatory+Mitigation+Plan+-+May+2020.pdf; and Vineyard Wind, "Vineyard Wind 1 Fisheries Compensatory Mitigation Program for the Offshore Export Cable Corridor," at https://www.vineyardwind.com/cable-compensation-package.

[79] Final Sale Notice for Commercial Leasing for Wind Power Development on the Outer Continental Shelf in the Gulf of Mexico (GOMW-1)," 88 *Federal Register* 47173, July 21, 2023.

[80] For instance, BOEM and NOAA collaborate on research on offshore wind's impacts on marine resources under a memorandum of agreement to facilitate cooperation on "advancing wind energy while protecting biodiversity and promoting cooperative ocean use" (NOAA, "NOAA and Bureau of Ocean Energy Management Sign New Interagency Agreement on Wind Energy Development," press release, January 12, 2022, at https://www.fisheries.noaa.gov/feature-story/noaa-and-bureau-ocean-energy-management-sign-new-interagency-agreement-wind-energy). 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.

When leasing and permitting for offshore wind development, federal agencies must adhere to statutory requirements related to wildlife. For example, NEPA 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, Endangered Species Act, and Migratory Bird Treaty Act.[81]

In records of decision (RODs) issued for offshore wind projects to date, DOI and cooperating agencies have required mitigation, monitoring, and reporting to reduce potential harm to wildlife.[82] For instance, a developer's mitigation activities could include installing bird deterrent devices on turbines, adopting best management practices for construction, and adhering to seasonal work restrictions to protect marine wildlife at sensitive life stages, among others. Some stakeholders have expressed concern that projects nonetheless would cause unacceptable harm to marine wildlife and have sought further actions such as a GAO study of offshore wind's environmental impacts.[83] Federal agencies including the National Oceanic and Atmospheric Administration (NOAA) also continue to assess a variety of potential impacts, including those related to protected species.[84]

Department of Defense Activities

Offshore wind development could affect uses of the ocean by the Department of Defense (DOD). For example, wind turbine generators could affect the radar performance of DOD vessels or could physically obstruct testing and training areas.[85] BOEM has 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."[86] BOEM's offshore wind leases, like its oil and gas leases, typically provide for the temporary suspension of lease operations and/or evacuation of lease areas for national security and defense reasons in accordance with applicable laws and regulations.[87] Some stakeholders seek additional study of the potential impacts of offshore wind on defense activities and/or further restrictions on development to protect DOD operations.[88]

An example of BOEM-DOD cooperation is from May 2021, when BOEM announced an agreement under which the agency, in partnership with DOD and the State of California, identified two potential wind energy areas off the central and northern coasts of California.[89] In that case, DOD had expressed concerns about potential conflict between offshore wind development and military training and readiness activities in these areas, especially off the central

[81] Marine Mammal Protection Act, 16 U.S.C. §§1361 et seq.; Endangered Species Act, 16 U.S.C. §§1531 et seq.; Migratory Bird Treaty Act, 16 U.S.C. §§703-712.

[82] See, for example, DOI, Vineyard Wind ROD, Section 4 and Appendix A.

[83] See footnote 70.

[84] See, for example, NOAA, "Frequent Questions—Offshore Wind and Whales," at https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/frequent-questions-offshore-wind-and-whales.

[85] For information on offshore wind radar impacts, see National Academies of Sciences, Engineering, and Medicine, *Wind Turbine Generator Impacts to Marine Vessel Radar*, 2022, at https://nap.nationalacademies.org/catalog/26430/wind-turbine-generator-impacts-to-marine-vessel-radar.

[86] 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.

[87] Renewable energy regulations at 30 C.F.R. §§585.417-585.421 allow BOEM to order a lease suspension for reasons of national security or defense, and describe responsibilities of the government and the lessee in such circumstances.

[88] See, for example, H.Res. 289 in the 118th Congress.

[89] 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.

coast.[90] More recently, DOD has reportedly identified "complicated compatibility challenges" with proposed wind lease areas in the Central Atlantic, including potential conflicts with flight training operations.[91]

Another example of interagency cooperation is the Wind Turbine-Radar Interference Mitigation Working Group. BOEM, DOD, DOE, the Federal Aviation Administration, and NOAA signed a memorandum of understanding "to mitigate the technical and operational impact of wind turbine projects on critical radar missions."[92] The working group aims, by 2025, to "address wind turbine radar interference as an impact on critical radar missions, ensure the long-term resilience of radar operations in the presence of wind turbines, and remove radar interference as an impediment to future wind energy development."[93]

Visibility of Infrastructure from Shore

Some individuals and communities have objected to proposed offshore wind projects because of their potential obstruction of the seascape.[94] In response to such concerns, DOI sometimes has identified areas where no wind turbines would be allowed, in order to reduce concerns about visibility. For example, DOI's ROD for the Vineyard Wind project identified areas where "surface occupancy" (i.e., placement of wind facilities) was prohibited in order to reduce the project's visibility from shore.[95]

A 2021 BOEM study cited multiple potential strategies for mitigating visual impacts from offshore wind facilities.[96] These could include, for example, having landscape professionals participate in the project siting and design process, using intervening geographical features such as headlands to screen project views, siting turbines so as to minimize horizontal spread of the layout when viewed from shore, controlling project footprints during the construction phase, using nonreflective paints and coatings for turbines that match the color of the sea, using aircraft lights that turn on only when an aircraft is in range, and other potential strategies.

In evaluations of project developers' COPs, DOI has weighed visibility concerns against other priorities such as the statutory mandate to prevent "waste" of OCS resources in renewable energy leasing.[97] For example, in its ROD for the Ocean Wind 1 project, DOI rejected an assessed alternative that would have increased the distance of the nearest-shore turbine from 13.3 to 14.0

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[90] U.S. Navy, California Offshore Planning Areas: Informational & Operational Overview, March 12, 2018, at https://efiling.energy.ca.gov/GetDocument.aspx?tn=222926&DocumentContentId=30393.

[91] "Report: Pentagon Has Concerns About Offshore Wind off Mid-Atlantic," *Maritime Executive*, April 18, 2023, at https://maritime-executive.com/article/report-pentagon-has-concerns-about-offshore-wind-off-mid-atlantic. For information on BOEM's draft wind energy areas in the Central Atlantic, see https://www.boem.gov/renewable-energy/state-activities/central-atlantic.

[92] Department of Energy (DOE), "Wind Turbine-Radar Interference Mitigation Working Group," https://windexchange.energy.gov/projects/radar-interference-working-group. The Department of Homeland Security is an observer of the working group.

[93] Ibid.

[94] For example, visibility concerns have been at issue in the development of wind projects off the Maryland coast (e.g., 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/).

[95] DOI, Vineyard Wind ROD.

[96] BOEM, *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States*, 2021, pp. 70-78, at https://www.boem.gov/sites/default/files/documents/environment/environmental-studies/BOEM-2021-032.pdf.

[97] 43 U.S.C. §1337(p)(4)(C).

nm from shore. In rejecting the alternative, DOI stated that this "minimal change" would have done "little to reduce" effects to scenic and visual resources, but would have resulted in a reduction of up to 14% in expected annual energy production.[98]

Deployment Issues

Congress may consider multiple issues pertaining to deployment of offshore wind energy projects. It is estimated that to meet the Biden Administration's goal to deploy 30 GW of offshore wind energy by 2030, infrastructure requirements will include more than 2,100 wind turbines and foundations, more than 6,800 miles of cables, and several different types of vessels.[99] If this infrastructure buildout depended on the development of a domestic supply chain, one study estimates that it would require at least 34 new manufacturing facilities to meet demand in 2030 and an investment of more than $22.4 billion in manufacturing facilities, ports, and large installation vessels.[100] 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.[101] 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.[102] 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 (WTIV) 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

[98] DOI, Ocean Wind 1 ROD, p. 35.

[99] Vessels include 5 wind turbine installation vessels, 10 feeder barges, 58 crew transfer vessels, and 4 cable lay vessels. Matt Shields et al., *The Demand for a Domestic Offshore Wind Energy Supply Chain*, National Renewable Energy Laboratory, NREL/TP-5000-81602, June 2022, p. vii, at https://www.nrel.gov/docs/fy22osti/81602.pdf.

[100] The scenario examined for a domestic supply chain considered the number of required major component manufacturing facilities, ports, and vessels that would need to be developed by 2030 to support an annual deployment of 4-6 gigawatts (GW). According to the study, this annual deployment rate would "put the nation on a pathway to installing 110 GW by 2050 primarily using domestically produced components." Matt Shields et al., *A Supply Chain Road Map for Offshore Wind Energy in the United States*, National Renewable Energy Laboratory, NREL/TP-5000-84710, January 2023, pp. vi-xii.

[101] 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. Provisions in the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 (NDAA; P.L. 116-283, §9503) have been interpreted to clarify the applicability of the Jones Act to offshore wind project sites on the OCS (see CRS In Focus IF12413, *Offshore Energy: Vessel and Crew Nationality Requirements*, by John Frittelli and Laura B. Comay). 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, by 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).

[102] 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*).

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.[103] In both scenarios, 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.

The earliest planned offshore wind projects on the OCS are using the second strategy—transporting components with Jones Act-compliant vessels and installing them with separate, foreign-flagged WTIVs—because the United States does not yet have any completed Jones Act-compliant WTIVs. For instance, operators of the Vineyard Wind 1 project announced their use of a WTIV operated by the Belgian-based DEME Group, installing turbine components transported to the site by Jones Act-compliant feeder vessels.[104] Legislation in the 118th Congress could potentially affect this strategy.[105] Dominion Energy is constructing the first Jones Act-compliant offshore WTIV, targeted for completion in 2024.[106]

Congress may consider whether to incentivize U.S. vessel construction through financial assistance, job training programs,[107] 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.[108] Relatedly, Congress may consider the effectiveness of incentives enacted in the IRA that provide a new tax credit for the domestic production of wind components and related goods such as specialized offshore wind installation vessels.[109] Other considerations may include whether to introduce additional requirements; for example, some states have required hiring priorities for companies developing offshore wind projects.[110] Another option could be to amend

[103] 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.

[104] Vineyard Wind, "Vineyard Wind Selects DEME Offshore US for Wind Turbine Installation," news release, March 31, 2021, at https://www.vineyardwind.com/press-releases/2021/3/31/vineyard-wind-selects-deme-offshore-us-for-wind-turbine-installation.

[105] For more information, see CRS In Focus IF12413, *Offshore Energy: Vessel and Crew Nationality Requirements*, by John Frittelli and Laura B. Comay. The legislation (H.R. 2741) could add new requirements for the nationality of OCS vessel crews even when not otherwise required to comply with the nationality requirements of the Jones Act.

[106] For more information, see Dominion Energy, "Charybdis," at https://www.dominionenergy.com/projects-and-facilities/wind-power-facilities-and-projects/charybdis. The vessel is planned to be used initially for the Sunrise Wind and Revolution Wind projects off Massachusetts and Rhode Island, and then for Dominion Energy's Coastal Virginia Offshore Wind project off Virginia.

[107] Multiple proposals were 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).

[108] 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.

[109] For more information, see CRS Insight IN11980, *Offshore Wind Provisions in the Inflation Reduction Act*, by Laura B. Comay, Corrie E. Clark, and Molly F. Sherlock. For offshore wind vessels, the credit is 10% of the sales price. For other offshore wind components, the credit is a function of the type of component and the total rated capacity of the project, with credits available for blades, nacelles, towers, and offshore wind platforms. Taxpayers investing in establishing, reequipping, or expanding offshore wind energy manufacturing facilities also may be eligible for an allocation of an advanced energy project credit, as provided in Section 13501 of the IRA.

[110] 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.

the Jones Act to exempt the offshore wind industry. For further discussion of offshore wind vessel issues, see CRS In Focus IF12491, *Vessel Construction for Offshore Wind Power Generation*.

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."[111] CapEx data are typically self-reported by developers; because of this, the data are uncertain. According to DOE, the capacity-weighted average CapEx for offshore wind projects was approximately $3,550/kilowatt (kW) in 2022 globally and about $4,000/kW in European and U.S. markets.[112] NREL researchers have estimated that both CapEx and operation and maintenance expenditures for offshore wind installations were more than twice those for onshore wind installations in 2019.[113] Because the majority of costs are upfront expenditures, the financing rate of an offshore wind project can affect the lifetime project costs considerably. Some developers have sought to renegotiate power purchase agreements or terminate and rebid procurement in response to concerns about interest rates, inflation, and supply chain disruptions.[114] As a result, some state regulators are considering to what extent ratepayers' interests should be prioritized over meeting state renewable energy goals.[115]

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[111] DOE, *2023 Market Report*, p. 83.

[112] Several factors can contribute to variations in capital expenditure including spatial conditions (e.g., water depth, distance to port or interconnection point), size of project, supply chain issues, prices for commodities or energy, macroeconomic trends, and changes in appreciation of costs and risks associated with a project. DOE, *2023 Market Report*, pp. 83-84.

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

[114] Allison Good, "Offshore Wind Contract Disputes Proliferate as High Costs Jeopardize US Buildout," *S&P Global Market Intelligence*, June 16, 2023, https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/offshore-wind-contract-disputes-proliferate-as-high-costs-jeopardize-us-buildout-76164337.

[115] For example, the New York Public Service Commission sought comment in summer 2023 on Sunrise Wind's petition to modify a purchase and sale agreement (John T. McManus and Jeffrey D. Kuhn, "Verified Petition of Sunrise Wind LLC for an Order Authorizing the New York State Energy Research and Development Authority to Amend the Offshore Wind Renewable Energy Certificate Purchase and Sale Agreement," June 7, 2023, pp. 2-3; petition at State of New York Public Service Commission, "Sunrise Wind: PSC Seeks Comment on Sunrise Wind Petition Seeking to Modify Its Offshore Wind Renewable Energy Certificate Purchase and Sale Agreement," https://dps.ny.gov/event/sunrise-wind-psc-seeks-comment-sunrise-wind-petition-seeking-modify-its-offshore-wind). The petitioner stated:

> [The] Project will provide significant environmental, health, energy reliability, economic, and fiscal benefits to New York State. For example, the Climate Leadership and Community Protection Act (CLCPA) established multiple ambitious greenhouse gas (GHG) reduction mandates to combat climate change, including a requirement for the State to procure 9 gigawatts (GW) of offshore wind energy by 2035, which the Commission has recognized is a critical element of the State's overarching objectives of obtaining 70% of its electricity from renewable sources by 2030 and 100% of its electricity from zero-emission sources by 2040. The 924 MW Project will satisfy more than 10% of the CLCPA's offshore wind energy requirement and will contribute toward satisfying

(continued...)

Congress may consider whether incentives enacted in Section 13702 of the IRA that provide a 30% tax credit for offshore wind projects that begin construction before January 1, 2026, are effective.[116]

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.[117] 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.[118] Some states have set offshore wind procurement goals and have encouraged utilities to enter into power purchase agreements with offshore wind projects.[119] 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.

> the CLCPA's renewable energy and GHG emission reduction requirements.

The petitioner also stated:

> NYSERDA has recognized that the extraordinary inflation and other macroeconomic events since the start of the pandemic threaten the viability of New York State's nascent offshore wind industry, and the Phase 3 RFP thus includes inflation and interconnection cost adjustment mechanisms…. [T]he Commission should authorize NYSERDA to amend the Sunrise Wind OREC Agreement to incorporate comparable mechanisms to account for these unanticipated, extraordinary economic events…. Sunrise Wind believes that authorizing such amendments would enable it to obtain an FID [financial investment decision] for the Project to be fully constructed and thereby provide the Project's cost-effective and timely renewable energy, economic, and other benefits to the people of New York State.

[116] P.L. 117-169, Section 13702. For more on the tax credit for project developers, see CRS Insight IN11980, *Offshore Wind Provisions in the Inflation Reduction Act*, by Laura B. Comay, Corrie E. Clark, and Molly F. Sherlock.

[117] 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.

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

[119] 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.

In the Atlantic region, some have expressed concerns that MOPRs could undermine state clean energy goals and negatively affect offshore wind industry development.[120] Central to 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.[121] 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 establish a national clean energy standard, which could affect the pace of offshore wind deployment.[122]

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.[123] 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 transmission infrastructure that would be built offshore, forming either a *meshed network* of groups of wind farms or a transmission *backbone* that could deliver electricity from many groupings of wind farms, or a combination of the two approaches.[124] By building transmission infrastructure offshore and connecting to onshore electric grids at multiple points, the costs of transmission can be shared among multiple offshore wind projects. A meshed network or backbone attached to onshore grids at multiple points also could address potential reliability and congestion issues

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

[121] 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.

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

[123] 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 its incorporation 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 estimated 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. A report prepared for the American Clean Power Association and other organizations by the Brattle Group states that electricity transmission planning and coordination is needed to meet U.S. offshore wind and clean energy goals; see Johannes P. Pfeifenberger et al., *The Benefit and Urgency of Planned Offshore Transmission: Reducing the Costs of and Barriers to Achieving U.S. Clean Energy Goals*, January 24, 2023, at https://www.brattle.com/wp-content/uploads/2023/01/Brattle-OSW-Transmission-Report_Jan-24-2023.pdf.

[124] According to DOE, "a *meshed network* can link nearby offshore wind farms through shared multiterminal transmission facilities," and "a *backbone* is a shared high-voltage transmission facility, several of which can form a longer backbone or a meshed network." DOE, *Atlantic Offshore Wind Transmission Literature Review and Gaps Analysis*, DOE/EE-2503, October 2021, pp. 4-5, https://www.energy.gov/sites/default/files/2021-10/atlantic-offshore-wind-transmission-literature-review-gaps-analysis.pdf.

within a region. Such offshore transmission configurations could be managed privately or publicly.[125]

One option is for BOEM to authorize one or more private entities to develop an offshore transmission backbone or meshed network 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.[126] 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.[127]

Another option is for the federal government to develop and manage an offshore transmission backbone.[128] Such an approach could be modeled on other federal onshore projects involving 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.[129] 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.[130] 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.[131] Congress established TVA to "exist in perpetuity."[132] Although TVA's activities initially focused largely on flood control and economic development, 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.[133]

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125 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*).

126 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.

127 BOEM, "Regional Proposals: Anbaric (New York and New Jersey, Ocean Grid)," at https://www.boem.gov/renewable-energy/state-activities/regional-proposals.

128 Labor Energy Partnership, *Future of Offshore Wind Energy*, p. 7.

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

130 Each power marketing administration (PMA) also has unique elements and regional issues that affect its business. For more on PMAs, see CRS In Focus IF11549, *The Legal Framework of the National Environmental Policy Act*, by Nina M. Hart and Linda Tsang.

131 16 U.S.C. §831.

132 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.

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

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.[134] 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.[135] On the other hand, large numbers of individual connections to the onshore electric grid could complicate landfall connections and transmission planning. Some states have analyzed the potential effects of different offshore transmission options.[136] DOE has funded studies to examine coordinated transmission options for offshore wind energy along the Atlantic Coast and along the West Coast.[137]

Congress may consider whether the federal government would incentivize offshore transmission infrastructure development and to what extent that development could be coordinated. Section 50153 of the IRA provided $100 million in funding to DOE for convening stakeholders and conducting analysis related to interregional transmission development and development of transmission for offshore wind energy.[138]

Offshore Wind Revenues

DOI's Office of Natural Resources Revenue (ONRR) collects several types of revenue during the offshore wind leasing process.[139] When BOEM holds a lease sale, the winning bidder 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.[140] 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

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

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

[136] For example, concepts include individual project connections, transmission backbones, shared collectors for multiple projects, and meshed generation (combining individual project connections to shore and offshore transmission connections). New York State Department of Public Service and New York State Energy Research and Development Authority, "Appendix D: Offshore Wind Integration Study," *Initial Report on the New York Power Grid Study*, January 19, 2021, pp. D-121-D-125, https://www.nyserda.ny.gov/About/Publications/Research-and-Technical-Reports/Electric-Power-Transmission-and-Distribution-Reports/Electric-Power-Transmission-and-Distribution-Reports—Archive/New-York-Power-Grid-Study; DNV, *Maine Offshore Wind Analysis: Offshore Wind Transmission Technical Review – Initial Report*, February 18, 2022, pp. 19-23, https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/Maine%20OSW%20DNV%20Offshore%20Wind%20Transmission%20Technical%20Review%20Initial%20Report.pdf.

[137] For more information, see NREL, "Atlantic Offshore Wind Transmission Study," https://www.nrel.gov/wind/atlantic-offshore-wind-transmission-study.html; and DOE, "U.S. Department of Energy Announces New Actions to Accelerate U.S. Floating Offshore Wind Development," February 22, 2023, https://www.energy.gov/articles/us-department-energy-announces-new-actions-accelerate-us-floating-offshore-wind-deployment.

[138] P.L. 117-169, Section 50153. For more information, see CRS Insight IN11980, *Offshore Wind Provisions in the Inflation Reduction Act*, by Laura B. Comay, Corrie E. Clark, and Molly F. Sherlock.

[139] 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.

[140] 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/.

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.[141] ONRR also records other types of offshore wind revenue, such as settlement agreements and interest payments, in its *other revenues* category.

Federal revenues from OCS offshore wind have varied annually (**Table 1**). Revenues to date have been from bonus bids, rents, and other sources but not from operating fees, because no projects are yet commercially operating in federal waters. Offshore wind revenues in FY2022 were much higher than in previous years, owing to bonus bids received at wind lease sales. A February 2022 lease sale for the New York Bight yielded $4.370 billion in bonus bids, and a May 2022 lease sale in the Carolina Long Bay area brought in $315 million.[142]

Table 1. 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
FY2018	0	3.3	0	3.3
FY2019	414.2	5.9	<0.1	420.0
FY2020	0	5.2	0	5.2
FY2021	0	5.1	0	5.1
FY2022	4,632.5	6.8	<0.1	4,639.3
Total	**5,104.9**	**38.4**	**<0.1**	**5,143.3**

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

Notes: Totals may not sum precisely due to rounding. FY2010 is the earliest year for which ONRR recorded federal offshore wind revenues. BOEM did not collect operating fees during the FY2010-FY2022 period, because no projects had begun commercial electricity generation. The "Other Revenues" category includes revenues not in the other categories, such as settlement agreements or interest payments.

Under the OCSLA, revenues collected from offshore wind projects that lie within 3 nm of state waters are shared with adjacent coastal states at a rate of 27%.[143] To date, Massachusetts and

141 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)).

142 BOEM, "New York Bight: Leasing History," at https://www.boem.gov/renewable-energy/state-activities/new-york-bight; and BOEM, "Carolina Long Bay: Overview," at https://www.boem.gov/renewable-energy/state-activities/carolina-long-bay.

143 43 U.S.C. §1337(p)(2)(B). State waters in most states extend to 3 nm from shore, so the OCSLA revenue-sharing (continued...)

Rhode Island have received revenue-sharing payments in some years under this provision, with no payment totaling more than $25,000 in any year.[144] For projects farther from state waters—almost all the 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 nm 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 oil and gas leases farther from shore under the Gulf of Mexico Energy Security Act of 2006 (GOMESA).[145] GOMESA provides for revenues from qualified oil and gas leases in broad areas of the Gulf of Mexico to be shared with eligible Gulf 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.[146] Some also have proposed using offshore wind revenues to fund specified federal programs, such as the National Oceans and Coastal Security Fund or the North American Wetlands Conservation Fund.[147]

Some stakeholders who 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.[148] Prior to FY2022, revenues from offshore wind leasing had been considerably less than revenues from offshore oil and gas leasing.[149] For FY2022, the high bonus bids from lease sales made offshore wind revenues more comparable with those from offshore oil and gas leasing, with oil and gas totaling $6.537 billion while wind totaled $4.639 billion. However, DOI does not expect future offshore wind revenues over the coming decade to match the FY2022 wind totals. For instance, BOEM's two wind lease sales to date in FY2023, for California and Gulf of Mexico, received a combined $757.1 million in high bids (almost all from the California sale).[150] In its FY2024 budget justification, DOI projected annual revenues from offshore wind ranging from $170 million to $823 million for the FY2024-FY2028 period.[151]

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zone generally would be for leases lying between 3 and 6 nm 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.

144 ONRR disbursement data queries at https://revenuedata.doi.gov/query-data. The payments to Massachusetts and Rhode Island appear to relate to a right-of-way granted by BOEM for a portion of the Block Island Wind Farm transmission cable that crosses through federal waters.

145 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 and Current Issues*, by Laura B. Comay.

146 See, for example, H.R. 1, H.R. 913, H.R. 1335, H.R. 2811, and S. 373 in the 118th Congress.

147 Ibid.

148 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.

149 For example, ONRR data (https://revenuedata.doi.gov/query-data) show that federal offshore oil and gas revenues (data categories of oil, gas, oil and gas pre-production, and natural gas liquids) totaled $3.708 billion for FY2020 and $4.052 billion for FY2021, much higher than offshore wind revenues in those years (**Table 1**).

150 BOEM, "California Activities," at https://www.boem.gov/renewable-energy/state-activities/california; and "Gulf of Mexico Activities," at https://www.boem.gov/renewable-energy/state-activities/gulf-mexico-activities.

151 DOI Office of the Secretary, Department-Wide Programs, *Budget Justifications and Performance Information: Fiscal Year 2024*, p. ELR-19, Table 8, at https://www.doi.gov/sites/doi.gov/files/fy2024-os-dwp-greenbook.pdf-508.pdf.

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