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Data and Methodology

Primary source: U.S. Department of Energy’s (DOE’s) National Renewable Energy Laboratory’s (NREL’s) internal offshore wind database, which is built on internal research and a wide variety of data sources, including peer-reviewed literature, press releases, industry news reports, manufacturer specification sheets, and global offshore wind energy project announcements.

NREL has verified and sourced data from the following publications:

- The 4C Offshore Wind Database (4C Offshore 2024)
- Bloomberg New Energy Finance (BNEF) Renewable Energy Project Database (BNEF 2023)
- 4C Offshore Vessel Database (4C Offshore 2024)

Note: All dollar amounts are reported in 2023 U.S. dollars, unless indicated otherwise.
U.S. Offshore Wind Energy Data
# Offshore Wind Energy Project Pipeline Classification Criteria

<table>
<thead>
<tr>
<th>Step</th>
<th>Phase Name</th>
<th>Start Criteria</th>
<th>End Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning</td>
<td>Starts when a developer or regulatory agency initiates the formal site control process (e.g., designation of a lease area under a proposed sale notice [PSN])</td>
<td>Ends when a developer obtains control of a site (e.g., through competitive auction or a determination of no competitive interest in an unsolicited lease area [United States only])</td>
</tr>
<tr>
<td>2</td>
<td>Site Control</td>
<td>Starts when a developer obtains site control (e.g., a lease or other contract)</td>
<td>Ends when the developer files major permit applications (e.g., a Construction and Operations Plan [COP] or is selected for offtake agreement negotiations for electricity sales)</td>
</tr>
<tr>
<td>3</td>
<td>Permitting = COP or Offtake Pathway</td>
<td>Starts when the developer files major permit applications (e.g., a COP) or is selected for offtake agreement negotiations for electricity sales</td>
<td>Ends when regulatory entities authorize the project to proceed with construction and certify its offtake agreement</td>
</tr>
<tr>
<td>4</td>
<td>Approved</td>
<td>Starts when a project receives regulatory approval for construction activities</td>
<td>Ends when the sponsor announces a “financial investment decision” and has signed contracts for construction work packages</td>
</tr>
<tr>
<td>5</td>
<td>Financial Close</td>
<td>Starts when the sponsor announces a financial investment decision and has signed contracts for major construction work packages</td>
<td>Ends when the project begins major construction work</td>
</tr>
<tr>
<td>6</td>
<td>Under Construction</td>
<td>Starts when major construction work is initiated</td>
<td>Ends when all wind turbines have been installed and the project is connected and generating power to an electrical grid</td>
</tr>
<tr>
<td>7</td>
<td>Operating</td>
<td>Starts when all wind turbines are installed and transmitting power to the grid; commercial operation date marks the official transition from construction to operation</td>
<td>Ends when the project has begun a formal process to decommission and stops feeding power to the grid</td>
</tr>
<tr>
<td>8</td>
<td>Decommissioned</td>
<td>Starts when the project has begun the formal process to decommission and stops transmitting power to the grid</td>
<td>Ends when the site has been fully restored and lease payments are no longer being made</td>
</tr>
</tbody>
</table>
The U.S. Offshore Wind Energy Pipeline Grew by 53% and Is Estimated To Have 80,523 MW of Capacity

<table>
<thead>
<tr>
<th>Status</th>
<th>2023 Total (As of May 31)</th>
<th>Change From Last Year</th>
<th>2024 Total</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating</td>
<td>42 MW</td>
<td>132 MW</td>
<td>174 MW</td>
<td>South Fork Wind Farm became operational.</td>
</tr>
<tr>
<td>Under Construction</td>
<td>932 MW</td>
<td>3,165 MW</td>
<td>4,097 MW</td>
<td>Revolution Wind (704 MW), and Coastal Virginia Offshore Wind (2,587 MW) began construction. Vineyard Wind 1 (806 MW) remains in construction.</td>
</tr>
<tr>
<td>Financial Close</td>
<td>0 MW</td>
<td>No Change</td>
<td>3,378 MW</td>
<td>Empire Wind 1, Sunrise Wind, and New England Wind 1 and 2 all had Records of Decision and were approved by Bureau of Ocean Energy Management (BOEM).</td>
</tr>
<tr>
<td>Approved</td>
<td>1,100 MW</td>
<td>2,278 MW</td>
<td>19,793 MW</td>
<td>New Jersey Board of Public Utilities awarded two new offtakes to Attentive Offshore Wind Energy 2 and Leading Light Wind. Several projects that lost offtake were moved back to site control.</td>
</tr>
<tr>
<td>Permitting</td>
<td>20,978 MW</td>
<td>-1,184 MW</td>
<td>22,870 MW</td>
<td>Ocean Wind 1 New Jersey Offshore Wind Renewable Energy Certificate (OREC) award and Record of Decision suspended, now in site control category. Skipjack 1 and 2 canceled their Maryland OREC agreement and did not submit COP. RWE Offshore US Gulf won the Gulf of Mexico Auction 1 lease.</td>
</tr>
<tr>
<td>Site Control</td>
<td>24,596 MW</td>
<td>-1,725 MW</td>
<td>22,870 MW</td>
<td>New lease area designations occurred in the Gulf of Maine, Central Atlantic, and Oregon.</td>
</tr>
<tr>
<td>Planning</td>
<td>5,039 MW</td>
<td>25,172 MW</td>
<td>30,211 MW</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52,687 MW</strong></td>
<td><strong>25,172 MW</strong></td>
<td><strong>80,523 MW</strong></td>
<td></td>
</tr>
</tbody>
</table>

*a Sunrise Wind and Empire Wind 1 have both entered construction since the report cutoff date of May 31, 2024. There are approximately 6 GW of capacity currently under construction. For the purpose of the report, their capacity is attributed to the “approved” stage of the pipeline.*
The U.S. Project Pipeline Has More Than 27 GW of Projects at or Beyond the Permitting Stage as of May 31, 2024

- Three operating projects have an estimated capacity of 174 MW.
- Three projects are under construction (4,097 MW).
- Two projects have their permits approved and an offtake agreement, and two projects have their permits approved and are attempting to secure offtake agreements (3,378 MW).
- Eighteen projects (19,793 MW) are currently in the permitting phase.
Economic Indicators Suggest Long-Term U.S. Market Growth While Inflationary Cost Increases May Hinder Near-Term Growth

- In the United States, key offshore wind energy market indicators point toward sustained, long-term market growth.
- Economic headwinds may delay near-term development.
- Challenges with the deployment of first projects lead to some uncertainty.

Locations of U.S. offshore wind energy pipeline activity and Call Areas as of May 31, 2024. Maps by John Frenzl, NREL
Massachusetts, New York, and New Jersey Account for More Than 40% of the Capacity in the U.S. Project Pipeline

- Although in “planning,” Maine potentially has the most capacity.
- State capacity for “site control” and “planning” (hashed colored bars) are assigned to the state where the wind energy area is located.
- State capacity for “permitting” and more advanced classification categories (solid colors) are based on where the energy will be delivered under a contracted offtake agreement.

Allocation of U.S. pipeline capacity by state. The asterisks (*) indicate that planning and site control pipeline capacity will be reallocated and assigned to the state where the offtake agreements are negotiated.
Offshore Wind Energy Pipeline Projects in the North Atlantic Are
the Most Advanced in the United States

• The 132-MW South Fork wind farm became the first commercial operating offshore wind project in the United States.

• The Vineyard Wind 1 (806 MW) and Revolution Wind (704 MW) projects are under construction.

• On May 1, 2024, BOEM issued a Proposed Sale Notice for eight lease areas in the Gulf Of Maine, which have the potential to generate approximately 15 GW.

• Sunrise Wind has entered the construction phase since the May 31, 2024, report cutoff date.
The Coastal Virginia Offshore Wind Project (2,587 MW) is under construction.

Empire Wind 1 (810 MW) has entered the construction phase since the May 31, 2024, report cutoff.

On Aug. 14, 2024, BOEM held an offshore wind lease sale in the U.S. Central Atlantic. There were two provisional awards for lease areas OCS-A 0557 and OCS-A 0558.
• On Aug. 29, 2023, BOEM held its first Gulf of Mexico lease sale, and one lease was awarded to RWE Offshore US Gulf LLC.

• On March 21, 2024, BOEM issued a proposed sale notice for a second Gulf of Mexico offshore wind lease sale; however, the sale was canceled due to a lack of competitive interest.

• Vestas’ Steelhead Americas and Mitsubishi-owned Diamond Offshore Wind signed agreements with the state of Louisiana to explore development in state waters.

U.S. Offshore Wind Energy Pipeline Projects in the Gulf of Mexico
U.S. Offshore Wind Energy Pipeline Projects in the Pacific

U.S. offshore wind energy pipeline for Hawaii (left) and the Pacific (right).
Maps by John Frenzl, NREL
The planning targets total 115,130 MW of offshore wind capacity by 2050. The mandated procurement totals 45,730 MW of offshore wind capacity by 2040.

As of May 31, 2024, 15 offtake agreements have been signed, which are associated with 12,378 MW of contracted capacity.
## State Planning Goals, Mandated State Procurements, and Offtake Contracts Awarded by Year

<table>
<thead>
<tr>
<th>State</th>
<th>Planning Targets</th>
<th>Mandated Procurement</th>
<th>Offtake Contracts Awarded (MW)</th>
<th>Awarded Projects (MW)</th>
<th>Supporting Policies and Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capacity (MW)</td>
<td>Year</td>
<td>Capacity (MW)</td>
<td>Year</td>
<td></td>
</tr>
<tr>
<td>ME</td>
<td>3,000</td>
<td>2040</td>
<td>3,000</td>
<td>2040</td>
<td>12 Aqua Ventus (12)</td>
</tr>
<tr>
<td>MA</td>
<td>23,000</td>
<td>2050</td>
<td>5,600</td>
<td>2035</td>
<td>806 Vineyard Wind 1 (806)</td>
</tr>
<tr>
<td>RI</td>
<td>1,430</td>
<td>2030</td>
<td>1,430</td>
<td>2030</td>
<td>430 Block Island Wind Farm (30) Revolution Wind (400)</td>
</tr>
<tr>
<td>CT</td>
<td>2,000</td>
<td>2030</td>
<td>2,000</td>
<td>2030</td>
<td>304 Revolution Wind (304)</td>
</tr>
<tr>
<td>NY</td>
<td>20,000</td>
<td>2050</td>
<td>9,000</td>
<td>2035</td>
<td>1,866 South Fork Wind (132) Empire Wind 1 (810) Sunrise Wind 1 (924)</td>
</tr>
<tr>
<td>NJ</td>
<td>11,000</td>
<td>2040</td>
<td>11,000</td>
<td>2040</td>
<td>5,252 Atlantic Shores Offshore Wind South (Project 1) (1,510) Attentive Energy Two (1,342) Leading Light Wind (2,400)</td>
</tr>
</tbody>
</table>
### State Planning Goals, Mandated State Procurements, and Offtake Contracts Awarded by Year

<table>
<thead>
<tr>
<th>State</th>
<th>Planning Targets</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capacity (MW)</td>
<td>Year</td>
<td>Capacity (MW)</td>
<td>Year</td>
<td></td>
</tr>
<tr>
<td>MD</td>
<td>8,500</td>
<td>2031</td>
<td>8,500</td>
<td>2031</td>
<td>1,109 MarWin (300) Momentum Wind (809)</td>
</tr>
<tr>
<td>NC</td>
<td>8,000</td>
<td>2040</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CA</td>
<td>25,000</td>
<td>2045</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LA</td>
<td>5,000</td>
<td>2035</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OR</td>
<td>3,000</td>
<td>2030</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>115,130</td>
<td>2050</td>
<td>45,730</td>
<td>2040</td>
<td>12,378</td>
</tr>
</tbody>
</table>
Since May 31, 2023, there were three lease areas available for auction in the Gulf of Mexico, but only one was sold, receiving a bid of $5.6 million.
On April 24, 2024, the U.S. Department of the Interior announced a new 5-year offshore wind leasing schedule:

- The schedule includes up to 12 offshore wind lease sales across the Atlantic, Gulf of Mexico, Pacific, and U.S. territories.
- BOEM held Central Atlantic lease sale on Aug. 14, 2024.
- Lease sales are planned for the Gulf of Maine and offshore Oregon in 2024 with a total of 12 proposed lease areas. (The planned September 2024 lease sale in the Gulf of Mexico was canceled.)
Offshore wind ports, vessels, and manufacturing supply chain facilities emerging near project development sites indicate regional economic development and domestic supply chain growth.
The U.S. Offshore Wind Vessel Fleet Has 22 Vessels in Operation and 30 Vessels Announced as of May 31, 2024

The following table lists operational and announced U.S.-flagged vessels to serve the offshore wind energy industry:

<table>
<thead>
<tr>
<th>Vessel Category</th>
<th>Operational</th>
<th>Announced</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew transfer vessel (CTV)</td>
<td>13</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>Service operation vessel (SOV)</td>
<td>3</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Barge</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Tug</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

- In April 2024, the only Jones Act compliant wind turbine installation vessel, Charybdis, was successfully launched to water in Brownsville, Texas; its estimated time of arrival after sea trials is expected to be late 2024 or early 2025 (Dominion Energy n.d., 2024).
- An SOV constructed in Edison Chouest shipyard in Louisiana was delivered in May 2024 and is expected to be in operation for the operations and maintenance support of the Ørsted Northeast portfolio (Ferry 2023; Ørsted 2024).
- In May 2024, the keel for Acadia, which will become the first U.S.-built subsea rock installation vessel for the offshore wind industry, was laid at the Philly Shipyard in Philadelphia, Pennsylvania (Buljan 2024).
## More Than $2 Billion in Announced Port and Supply Chain Investments Since the Start of 2023

<table>
<thead>
<tr>
<th>Type of Investment</th>
<th>State</th>
<th>Port (If Applicable)</th>
<th>Announced Investment</th>
<th>Funding Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary steel manufacturing</td>
<td>MD</td>
<td>Tradepoint Atlantic</td>
<td>$14,000,000</td>
<td>Ørsted, Riggs Distler</td>
</tr>
<tr>
<td>Tower manufacturing</td>
<td>-</td>
<td>-</td>
<td>$700,000,000</td>
<td>US Forged Rings</td>
</tr>
<tr>
<td>Port development</td>
<td>CA</td>
<td>Port of Humboldt</td>
<td>$8,670,000</td>
<td>DOT Maritime Administration – Port Infrastructure Development Program</td>
</tr>
<tr>
<td>Port development</td>
<td>CA</td>
<td>Port of Humboldt</td>
<td>$426,700,000</td>
<td>DOT INFRA program</td>
</tr>
<tr>
<td>Monopile manufacturing</td>
<td>NJ</td>
<td>Paulsboro Marine Terminal</td>
<td>$58,850,000</td>
<td>Attentive Wind/TotalEnergies</td>
</tr>
<tr>
<td>Monopile manufacturing</td>
<td>NJ</td>
<td>Paulsboro Marine Terminal</td>
<td>$105,250,000</td>
<td>Leading Light Wind/Invenergy</td>
</tr>
<tr>
<td>Port development</td>
<td>NY</td>
<td>South Brooklyn Marine Terminal</td>
<td>$861,000,000</td>
<td>Skanska</td>
</tr>
</tbody>
</table>

**Total announced investment**  
(Jan. 1, 2023–May 31, 2024):  
$2,174,470,000  
-  

Data sourced from DOE’s Clean Energy tracking efforts (DOE n.d.)
From January 2023 to May 31, 2024, the U.S. Offshore Wind Industry Has Made Significant Port and Supply Chain Developments and Announced Investments

• In January 2024, the Humboldt Bay Harbor District secured a $426.7 million grant from the U.S. Department of Transportation’s Nationally Significant Multimodal Freight & Highway Projects to support the construction and maintenance of offshore wind infrastructure (Huffman 2024).

• Also in January 2024, Attentive Energy committed $58.85 million, and Invenergy committed $105.25 million toward the completion of the EEW Foundation Manufacturing Facility in New Jersey (State of New Jersey 2024a, 2024b).

• In February 2024, US Forged Rings Inc. announced a $700 million investment in a tower and rolled ring fabrication facility (US Forged Rings Inc. 2024).

• In April 2024, Skanska announced an $861 million contract award to transform the 73-acre South Brooklyn Marine Terminal into a dedicated offshore wind port (Skanska 2024).
Grid Progress To Support Offshore Wind Development Is Evident Nationwide

• In February 2023, the New York Public Service Commission (NY PSC) approved 62 Phase 2 transmission projects in New York, representing a $4.4 billion investment aimed at integrating clean energy into upstate renewable generation areas (NY PSC 2023a).

• In June 2023, the New York Independent System Operator (NYISO) selected the $3.26 billion T051 Alternate Solution 5 project to meet Long Island’s Offshore Wind Export Public Policy Transmission Need (NYISO 2023).

• The Northern California and Southern Oregon Offshore Wind Transmission Study, published in October 2023, estimates that developing offshore wind resources on the northern California and southern Oregon coasts will require $35–$40 billion in new transmission infrastructure (Zoellick et al. 2023).

• The Atlantic Offshore Wind Transmission Study, published by DOE and NREL in March 2024, addresses gaps in offshore transmission planning along the Atlantic seaboard (Brinkman et al. 2024).

• In April 2024, the California Independent System Operator (CAISO) released their draft 2023–2024 Transmission Plan, with $4.59 billion devoted to infrastructure to carry offshore wind power from the northern coast to the San Francisco Bay Area. The plan received approval from CAISO’s Board on May 23 (CAISO 2024).
Global Offshore Wind Energy Development
Global Cumulative Offshore Wind Energy Installed Capacity Reaches 68,258 MW

- Total installed capacity reached 68,258 MW across 319 operating projects and more than 13,096 operating offshore wind turbines.
- This growth in cumulative operating capacity represents an increase of 10.2% compared to the end of 2022.
China Continues To Lead in Global Offshore Wind Deployment, Followed by the United Kingdom

• In 2023, 6,326 MW of offshore wind energy were deployed globally.

• Installed capacity in 2023 is the fourth largest annual installed capacity ever.

• Nearly half of the new capacity (46.1%) was commissioned in China, totaling 2,918.2 MW.
As of Dec. 31, 2023, the Global Offshore Wind Energy Pipeline Total Capacity Was Assessed To Be More Than 453 GW

- The assessed total capacity of more than 453 GW is an increase of 27 GW (6.3%) compared to the approximately 426 GW reported in the Offshore Wind Market Report: 2023 Edition (Musial et al. 2023).
- Globally, there are 68.3 GW of operational offshore wind energy projects.
There were 35,573 MW of offshore wind capacity under construction as of Dec. 31, 2023.

- There was approximately 64% more offshore wind energy capacity under construction in 2023 compared with 21,717 MW in 2022.
- 5,745 MW were originally estimated to be completed in 2023 but is now estimated for completion in 2024.
- 19,889 MW of projects entered the construction phase in 2023.
Global Installed Capacity Could Reach 193 GW by 2029 Based on Developer-Announced Commercial Operation Dates

Estimated cumulative fixed-bottom and floating offshore wind capacity by country based on developer-announced commercial operation dates.
Based on Developer-Announced CODs, 14,186 MW of Floating Offshore Wind Capacity May Be Installed Globally by 2029

- Because most projects are still in the planning phase, there is a high degree of uncertainty about their timing and likelihood of completion.
- The potential surge after 2028 indicates the transition from pilot-scale to commercial-scale projects.
- Most of the developer-announced deployment through 2029 is in the United Kingdom (4,242 MW), Italy (4,160 MW), Taiwan (1,530 MW), China (1,052 MW), and Spain (995 MW).

14,186 MW has been announced through 2029.

Estimated cumulative floating offshore wind capacity by country based on announced CODs through 2029.
Operating Floating Offshore Wind Capacity Grew 91% to 234 MW in 2023 From Successful Commissioning of Pilot Projects

The following floating offshore wind energy projects larger than 1 MW achieved significant installation milestones in 2023:

- The 88-MW Hywind Tampen project in Norway was fully commissioned in August 2023, making it the largest operational floating offshore wind plant in the world (Equinor 2023). There are 11 SG 8.0-167 direct-drive turbines operating at the project (Siemens Gamesa Renewable Energy [SGRE] 2019).

- The 25-MW Provence Grand Large pilot project installed three turbines (8.4-MW Siemens Gamesa turbines) on tension-leg floating platforms near Marseille, France (SBM Offshore 2023).

- The 3.6-MW Guoneng Sharing pilot project installed a single turbine on a semisubmersible platform near Longyuan Nanri Island in China (Shanghai Electric 2023; M. Lewis 2023).

- The 2-MW DemoSATH demonstration project in Spain achieved first power in September 2023 (RWE 2023).

- The China National Offshore Oil Corporation Limited connected a Mingyang Smart Energy MySE 7.25-MW wind turbine on a semisubmersible platform to the grid of the Wenchang oilfield in May 2023 (Buljan 2023; China National Offshore Oil Corporation 2023).
Targets have the potential to catalyze investment, reduce costs, and provide guidance for energy planners, aiming to ensure lasting market stability.

Some targets are legally binding like those in Greece, and others are not presently legally binding, such as the U.S. target.

Tables A-1, A-2, and A-3 (Appendix A) present national deployment objectives and procurement targets for the United States, and countries in North and South America, Oceania, Europe, and Asia.
Offshore Wind Energy Technology Trends
Global Projects Installed Increasingly Far From Shore

- The operational project with the greatest distance to shore in the NREL database is the Hornsea I Project in the United Kingdom at nearly 115 kilometers (km).
- For announced projects through 2028, the data indicate that projects in Asia are approaching, but not yet converging, with the global average distances from shore in other regions.
- For the rest of the world, projects coming online in the Netherlands, Denmark, France, Germany, and the United States are all less than 40 km from shore—leading to the drop in global average distance from shore through 2028.
Fixed-Bottom Projects Could Become Commercially Viable Beyond the Conventional Limit of 60 Meters

- The deepest operational fixed-bottom offshore wind turbine is installed on a jacket substructure in water that is 58.6 meters (m) deep at the Seagreen project in Scotland (Seagreen Wind Energy Limited 2023).

- The data from announced projects suggest that fixed-bottom projects could be installed in maximum water depths of up to 65 m in the coming years.

*Maximum water depths for global fixed-bottom offshore wind energy projects (excludes floating)*
Floating Substructure Technologies Are Rapidly Maturing, With Operating Demonstration-Scale Floating Projects

- Of the 68,258 MW of operational projects, monopiles represent more than half (55.6%), followed by jackets (13.4%), pile caps (7.6%), gravity-base (1.3%), and tripod (1.6%) designs; about 19.9% are unreported in the database as of Dec. 31, 2023.

- Pile cap substructures are more common in Asia than Europe and include multiple piles driven into the seabed, joined by a cap to which the wind turbine tower is mounted (Wang et al. 2018).
For the 72,027 MW of Future Projects (16% of Pipeline Capacity), Monopiles Are Expected To Remain the Dominant Choice

- Monopiles make up 75.4% share of announced capacity—even as floating technologies are commercialized.
- Jacket substructures are expected to make up 8.8% of the announced market.
- Semisubmersibles are expected to represent a 14.2% share of the announced market for all substructure types.
Global installations in 2023 had a capacity-weighted-average turbine rating of 9.7 MW (26% year-over-year increase), rotor diameter of 183.4 m (5% year-over-year increase), and hub height of 124.0 m (6% year-over-year increase).

The global capacity-weighted average turbine rating made a large jump to nearly 10 MW this year as the market has begun adopting the 12–15-MW turbine platform.

Wind turbines of up to 13 MW were operating at commercial-scale projects in Europe and North America in 2023 and early 2024 (Memija 2023a; NYSERDA 2023a; General Electric 2023; Copenhagen Offshore Partners 2024).
Offshore Wind Turbines Show an Upscaling Trend

- The 11-MW Siemens Gamesa (SGRE) and 13-MW GE turbine models, which produced power in 2020 as prototypes, produced power in large-scale projects in Europe and North America in 2023 and early 2024.
- The Vestas 15-MW model, which produced its first power near the end of 2022 as a prototype, was type-certified by the end of 2023 and is expecting its first deliveries in 2025 (Memija 2023b; Vestas 2024).
- In April 2024, the first of 60 14-MW Siemens Gamesa turbines was installed in Scotland (Durakovic 2024). This model produced power for the first time as a prototype in 2021.
- Timelines demonstrate that Western turbine OEMs typically require approximately 3 years from the initial power generation of a prototype model to the first power generation at a commercial-scale project.
Vestas wind turbines are the next-largest share of the operational market at 14%, followed by Mingyang (11.4%), Goldwind (6.5%), and Envision Energy (4.9%).
SGRE Is Expected To Hold a 39.4% Share of Wind Turbine Manufacturing for Future Project Announced Capacity

- Vestas is expected to hold a 32.5% share, followed by GE Vernova (18.1%), Doosan Heavy Industries (4.5%), and Mingyang (2.2%).
- While Chinese manufacturers have focused on the domestic market to date, Mingyang, Envision Energy, Dongfang, Goldwind, Windey, and Harbin Electric have all secured contracts for projects outside China representing a potential for greater competition in global offshore wind turbine markets (Barla 2023).
Cost and Price Trends
Rising interest rates, supply chain constraints, and higher commodity prices during 2021–2023 have led to higher offshore wind energy costs globally and in the United States.

Rising costs primarily affect projects planned for commercial operation between 2023 and 2026 because of a 1–3-year lag between the placement of supply chain orders and the start of commercial operations.

Projects planned for later commercial operation might be less affected because of the actions taken at the state and federal levels and may have time to wait for macroeconomic conditions to return to prior levels.

The cost reporting and figures in this section focus on projects that have attained commercial operation date in 2023.
The unsubsidized average levelized cost of energy (LCOE) in 2023 of $125 per megawatt-hour (MWh) is estimated by data providers using mid-case estimates for a hypothetical commercial-scale fixed-bottom U.S. offshore wind project.

Sources report a wide range of $75/MWh to $149/MWh across scenarios.

Cost differences can often be explained by the represented siting conditions, such as higher wind speeds, closer proximity to port and grid infrastructure, varying financing assumptions, forecast error from a small cost record, and others.

These costs represent an average increase of more than 45% when compared to the 2023 edition of this report (Musial et al. 2023).

Global offshore wind costs have declined by more than 50% since 2013, even though LCOE has increased since 2022 (Moné et al. 2015).
Short-Term Cost Trends

- Compared to earlier contract prices established for the Empire Wind 1 and Sunrise Wind projects in 2018 (New York ORECRPF18-1), recent awards from 2024 (New York ORECRFP23-1) for the same projects suggest an increase of the levelized OREC contract price of 36% and 27%, respectively.
- OREC prices released for offshore wind power projects in New Jersey have also shown significant increases.
- The OREC first-year (nominal) price for the Attentive Energy Two project was $131/MWh, and the Leading Light Wind project was priced at $112.50/MWh (New Jersey Board of Public Utilities 2024a, 2024b; TotalEnergies 2024). These prices, both awarded in 2024, represent a substantial jump from previous OREC prices in New Jersey.
- Ørsted’s New Jersey Ocean Wind 2 project was awarded an OREC first-year (nominal) price of $83.40/MWh in 2021.
After Mid-2020, Several Key Commodities Experienced Considerable Price Increases

- Between 2020 and 2024, the Secured Overnight Financing Rate (SOFR, blue line) surged from close to 0% to nearly 5%, mirrored by other debt cost indicators (e.g., 20-year treasuries).
- During the same period, key offshore wind commodities increased by approximately 34% and 38% for New York’s first and second round of offshore wind solicitations (NY1 and NY2).

Offshore wind commodity price index (left axis) and SOFR (right axis), 2018–2024. Notes: (1) NY 4 composite index was calculated based on the NY4 price formula (NYSERDA 2024); (2) represents the time of offer proposal submission. Quarterly data. Source: Federal Reserve Bank of St. Louis (2024a, 2024b); NYSERDA (2023b); U.S. Bureau of Labor Statistics (2024a, 2024b, 2024c); U.S. Energy Information Administration (2023)
## The Price of Key Offshore Wind Commodities Changed Between Bid Submission and the Fourth Quarter of 2023

<table>
<thead>
<tr>
<th>Commodity</th>
<th>NY1 Bid Submission Through Q4 2023</th>
<th>NY2 Bid Submission Through Q4 2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>+21%</td>
<td>+15%</td>
</tr>
<tr>
<td>Fabrication and Machinery Material</td>
<td>+42%</td>
<td>+34%</td>
</tr>
<tr>
<td>Steel</td>
<td>+35%</td>
<td>+63%</td>
</tr>
<tr>
<td>NY Ultra-Low-Sulfur Diesel</td>
<td>+49%</td>
<td>+125%</td>
</tr>
<tr>
<td>Copper</td>
<td>+30%</td>
<td>+12%</td>
</tr>
<tr>
<td>Index</td>
<td>+34%</td>
<td>+38%</td>
</tr>
</tbody>
</table>

a NY1 refers to New York’s first offshore wind solicitation published in 2018 (ORECRFP18-1).
b NY2 refers to New York’s second offshore wind solicitation published in 2020 (ORECRFP20-1).

Source: Calculated using the inflation index formulas from NYSERDA (2024).
The Capacity-Weighted Average Capital Expenditure for Global Offshore Wind Projects Has Decreased Since 2015

- Globally, the 5-year rolling average (2019–2023) cost decreased to approximately $3,400 per kilowatt (kW) for projects with a 2023 commercial operation date.

- The 5-year rolling average capital expenditure (CapEx) for projects in Europe and the United States is reported to be higher at $3,900/kW. The 5-year rolling average CapEx for projects in Asia is approximately $3,000/kW. Despite the difference, the two markets have been converging since 2014.

- Reported global project data suggest 5-year rolling capacity-weighted average CapEx globally will remain roughly flat or slightly decline from $3,400/kW in 2023 to between $3,000 and $3,500/kW by the late 2020s.
The unsubsidized LCOE for U.S. floating offshore wind energy projects is estimated to decline from 2030 to 2035.

- The unsubsidized LCOE for U.S. floating offshore wind energy projects is estimated to decline from approximately $123–$278/MWh in 2030 to $92–$180/MWh in 2035.

- Generally, floating offshore wind costs are predicted to decrease through 2050 as the industry matures (Wiser et al. 2021).
  - Early-stage technologies usually experience cost reductions as their market expands.
  - Technological and commercial developments from fixed-bottom offshore wind systems might translate to floating offshore wind systems.

Unsubsidized LCOE estimates for floating offshore wind technologies in the United States. Source: NREL (2024); DNV (2023)
Offshore Wind Tax Credits

New guidance related to the implementation of clean energy tax credits passed under the IRA was issued by the Internal Revenue Service (IRS) during 2023 and early 2024.

• On March 22, 2024, IRS issued guidance that updated the eligibility criteria for offshore wind projects seeking the Energy Communities Bonus Credit passed under IRA (IRS 2024; Kearns and Daray 2024).
  – Offshore wind projects with multiple points of interconnection may benefit from credits if they locate any power conditioning and transfer equipment at one of their points of interconnection within an energy community.
  – Projects now may qualify for the bonus credit benefits if their supervisory control and data acquisition system is situated at an “eligible project port”—one with which the project has a long-term relationship and at which the project employs staff that perform essential project functions such as operations and maintenance—within an energy community.

• IRS guidance released on Nov. 22, 2023, clarifies that offshore power conditioning and transfer equipment such as export cables and onshore substations are integral to the energy property (IRS 2023) and therefore eligible for the ITC.

• The IRA also provides projects the ability to transfer tax credits to one or more other parties (Lonczak and Jones 2023).
Future Trends
The size and speed of U.S. offshore wind build-out will depend on continued regulatory efficiency, the availability of installation vessels and port infrastructure, proactive onshore and offshore grid planning and upgrades, the successful commercialization of 15-MW-class wind turbines and associated infrastructure, and sustained market demand.

These forecasts predict that most near-term (pre-2030) offshore wind energy deployment will occur on the East Coast in states with existing offshore wind energy procurement goals.

Both forecasts predict project development in the Gulf of Mexico and floating offshore wind deployment in Maine and California starting around 2030.
BNEF and 4C Offshore Forecast Cumulative Global Offshore Wind Energy Capacity of 486 GW and 421 GW by 2035, Respectively

• The BNEF (2023) and 4C Offshore (2024) forecasts show variability in longer-range deployment estimates, but both indicate strong global market growth with more than a fivefold increase in offshore wind energy deployment projected over the next decade.

• The most prominent trend in the offshore wind energy market in the 2035 forecasts is the estimated growth of the Chinese market. 4C and BNEF differ in their expectations, with 4C projecting approximately 100 GW and BNEF 150 GW of new offshore wind capacity in China by 2035, representing 24%–38% of total 2035 installed capacity.

• Per the forecasts, other countries in Asia (Taiwan, Korea, Japan, and Vietnam) will account for an additional 13%–14% of installed capacity.

• European developers will build projects at an increasing rate relative to today, with Europe holding 39%–51% of the total installed global offshore wind capacity by 2035.

• The forecasts project the U.S. portion of installed capacity to be about 9% of the global total by 2035.
The latest projections of floating offshore wind now include a range of estimates, predominantly falling between 6 and 10 GW by 2030 (4C Offshore 2024; Global Wind Energy Council 2023; DNV 2023; Wood Mackenzie 2023b).

Other independent entities adopt an even more conservative approach, forecasting 2 GW of floating offshore wind capacity by 2030 (AEGIR Insights 2023; BNEF 2024a).

The 2030–2035 period is expected to welcome new entrants like developers, OEMs, and other offshore wind development players into the sector, positioned to capitalize on the insights gained from early experiences and newly constructed infrastructure (AEGIR Insights 2023).
Summary of Key Findings and Future Trends

- The U.S. Offshore wind energy pipeline grew by 53% to nearly 81 GW, in large part due to 12 new BOEM proposed lease areas in the Gulf of Maine, Central Atlantic, Gulf of Mexico, and Oregon.

- Many projects are advancing through the U.S offshore wind energy pipeline. The first fully operational commercial offshore wind farm, South Fork Wind Farm, was installed in the United States. Three projects totaling more than 4 GW of capacity are under construction, with an additional 3 GW of capacity approved awaiting to begin construction.a

- Forecasted global projections for offshore wind energy indicate strong market growth over the next decade, with more than a fivefold increase with upward of 490 GW deployed by 2035.

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a Sunrise Wind and Empire Wind 1 have both entered construction since the report cutoff date of May 31, 2024. There are approximately 6 GW of capacity currently under construction. For the purpose of the report, their capacity is attributed to the “approved” stage of the pipeline.
Summary of Key Findings and Future Trends

• Rising interest rates, supply chain constraints, and higher commodity prices during 2021–2023 have led to higher offshore wind energy costs globally and in the United States, with costs in the United States increasing by more than 45% from the previous edition of this report, however global offshore wind costs have declined by more than 50% since 2013.

• States have quickly responded to economic headwinds and power contract cancellations. Most states have reaffirmed their original offshore wind commitments and timelines. Multiple states have restructured their procurement strategies and opened new solicitation rounds to enable canceled projects to re-bid with updated offtake prices, such as by introducing inflation indexing.

• The U.S. offshore wind energy market continues to be driven by state-level offshore wind procurement, planning activities, and energy policies. As of May 31, 2024, state mandates totaled over 45 GW from eight states.
References
References


References


References


References


References


References


References


References


<table>
<thead>
<tr>
<th>Country</th>
<th>Installed Capacity in 2023 (GW)</th>
<th>Planning Targets</th>
<th>Key Developments or Procurements</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>2.26</td>
<td>5.4–5.8</td>
<td>The objective is to realize an additional production of 3.15–3.5 GW in the Princess Elisabeth Zone. The Minister of Energy has stated a desire for a future potential target of 8 GW by 2030.</td>
<td>Government of Belgium (2023); Wind Europe (2022a)</td>
</tr>
<tr>
<td>Denmark</td>
<td>2.65</td>
<td>10 35</td>
<td>The Danish government signed a joint declaration to make the North Sea a green powerhouse in Europe.</td>
<td>ESG today (2022)</td>
</tr>
<tr>
<td>Finland</td>
<td>0.04</td>
<td>-</td>
<td>The national climate and energy strategy to become carbon neutral by 2035 intends to have the first large-scale offshore wind energy projects operational by 2030, and several more in production by 2035.</td>
<td>Ministry of Economic Affairs and Employment of Finland (2022)</td>
</tr>
<tr>
<td>France</td>
<td>0.98</td>
<td>18 40</td>
<td>The French government signed an offshore sector deal with the wind energy industry to organize auctions for a minimum of 2 GW of new offshore wind capacity each year starting in 2025 and build more than 50 offshore wind plants by 2050.</td>
<td>Wind Europe (2022b)</td>
</tr>
<tr>
<td>Germany</td>
<td>8.28</td>
<td>30 50 70</td>
<td>The current statutory targets in Germany are for offshore wind to reach a cumulative installed capacity of 30 GW in 2030, 40 GW in 2035 and 70 GW in 2045 as per the reformed Wind Energy at Sea Act 2022.</td>
<td>Reuters (2023a); Ivanova (2022)</td>
</tr>
<tr>
<td>Country</td>
<td>Installed Capacity in 2023 (GW)</td>
<td>Key Developments or Procurements</td>
<td>Source</td>
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</tr>
<tr>
<td>Greece</td>
<td>0.00</td>
<td>The parliament approved Greece’s first offshore wind law.</td>
<td>Tisheva (2023)</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>0.03</td>
<td>The Irish government increased the 2030 offshore wind target from 5 to 7 GW.</td>
<td>renews.biz (2022)</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>0.03</td>
<td>Italy sent its revised energy and climate plan to the European Union setting a target of 2.1 GW of offshore wind capacity by 2030.</td>
<td>Reuters (2023b)</td>
<td></td>
</tr>
<tr>
<td>Lithuania</td>
<td>0.00</td>
<td>The Lithuanian government approved legislation amendments by the Ministry of Energy to expedite renewable energy development. By 2030, Lithuania aims for a total green energy capacity of 7 GW, including 1.4 GW from offshore wind.</td>
<td>Baltic Wind (2022)</td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>0.09</td>
<td>Norway’s prime minister announced the country’s goal of 30 GW of offshore wind capacity by 2040.</td>
<td>Wind Europe (2022c)</td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td>0.00</td>
<td>The EU Commission endorsed Poland’s offshore wind farm support system, allowing installation of 5.9 GW capacity by 2030 in the initial phase and facilitating up to 11 GW capacity by 2040. There are discussions of increasing the 2030 target to 12 GW.</td>
<td>Ministry of Climate and Environment Republic of Poland (2021)</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Installed Capacity in 2023 (GW)</td>
<td>Planning Targets</td>
<td>Key Developments or Procurements</td>
<td>Source</td>
</tr>
<tr>
<td>-------------</td>
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<td>------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.03</td>
<td>2</td>
<td>The Portuguese government has ambitions for 2 GW in operation and 10 GW of leased projects by 2030.</td>
<td>Norwegian Offshore Wind (2024)</td>
</tr>
<tr>
<td>Spain</td>
<td>0.01</td>
<td>3</td>
<td>The Spanish government has approved an offshore wind roadmap that aims to install up to 3 GW of floating offshore wind energy in Spanish waters by 2030.</td>
<td>Wind Europe (2021)</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.19</td>
<td>-</td>
<td>The Swedish government has launched a search for areas to support the plan to generate 120 terawatt-hours annually.</td>
<td>Durakovic (2022)</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>3.12</td>
<td>4.5</td>
<td>The Climate Agreement (2019) and the coalition agreement (2021) include a commitment to maintain the offshore wind energy policy.</td>
<td>Government of the Netherlands (n.d.); Buljan (2022)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21</td>
<td>The government has presented its offshore wind energy roadmap.</td>
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<td></td>
<td></td>
<td>70</td>
<td></td>
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<td></td>
<td></td>
<td>2023</td>
<td></td>
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<td></td>
<td></td>
<td>2030</td>
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<tr>
<td></td>
<td></td>
<td>2050</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>14.75</td>
<td>50</td>
<td>The UK Energy Strategy aims to dedicate 5 GW to floating offshore wind.</td>
<td>Wind Europe (2022d)</td>
</tr>
</tbody>
</table>
Table A-2. National Offshore Wind Energy Targets for Countries in Asia

<table>
<thead>
<tr>
<th>Country</th>
<th>Installed Capacity in 2023 (GW)</th>
<th>Planning Targets Capacity (GW)</th>
<th>Key Developments or Procurements</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>38.62</td>
<td>60</td>
<td>Mainland China has provincial 5-year targets, for a cumulative 60 GW by 2025, and the regional cumulative targets by 2030 increased to 90 GW.</td>
<td>Wood Mackenzie (2023a); BNEF (2024a)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90</td>
<td></td>
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<td></td>
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<td>2025</td>
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<td></td>
<td>2030</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2025</td>
<td>Mainland China has provincial 5-year targets, for a cumulative 60 GW by 2025, and the regional cumulative targets by 2030 increased to 90 GW.</td>
<td>Wood Mackenzie (2023a); BNEF (2024a)</td>
</tr>
<tr>
<td>India</td>
<td>0.00</td>
<td>30</td>
<td>The Union Ministry of New and Renewable Energy has set a target of installing 30 GW by 2030.</td>
<td>Infrastructure Investor (2018)</td>
</tr>
<tr>
<td>Japan</td>
<td>0.27</td>
<td>10</td>
<td>The Japanese government aims to deploy 45 GW by 2040 as part of its 2050 decarbonization target.</td>
<td>Muto (2022)</td>
</tr>
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<td></td>
<td></td>
<td>30–45</td>
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<tr>
<td></td>
<td></td>
<td>2030</td>
<td>The Japanese government aims to deploy 45 GW by 2040 as part of its 2050 decarbonization target.</td>
<td>Muto (2022)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2040</td>
<td>The Japanese government aims to deploy 45 GW by 2040 as part of its 2050 decarbonization target.</td>
<td>Muto (2022)</td>
</tr>
<tr>
<td>South Korea</td>
<td>0.14</td>
<td>12</td>
<td>South Korea’s president reaffirms goal of 12 GW of offshore wind energy by 2030. The Framework Act on Low Carbon, Green Growth sets an optimistic scenario of 18–20 GW by 2030.</td>
<td>InfoLink Consulting (2021); Skopljak (2020)</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.00</td>
<td>21</td>
<td>The Department of Energy of the Philippines published its Offshore Wind Roadmap to aim for 21 GW by 2040.</td>
<td>Pinsent Masons (2022)</td>
</tr>
<tr>
<td>Taiwan</td>
<td>1.21</td>
<td>15</td>
<td>The Ministry of Economic Affairs said that 1.5 GW of offshore wind capacity would be added each year from 2026 until 2035, instead of the previously planned 1 GW.</td>
<td>Upstream (2021); BNEF (2024a)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2030</td>
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<td></td>
</tr>
</tbody>
</table>
# Table A-3. National Offshore Wind Energy Targets for Countries in Other World Regions

<table>
<thead>
<tr>
<th>Country</th>
<th>Installed Capacity in 2023 (GW)</th>
<th>Planning Targets</th>
<th>Key Developments or Procurements</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>0.04</td>
<td>30</td>
<td>The current midterm national target is 30 GW by 2030. Achieving this target could unlock a pathway to 110 GW by 2050.</td>
<td>The White House (2021)</td>
</tr>
<tr>
<td>Canada</td>
<td>0.00</td>
<td>5</td>
<td>Nova Scotia has set a target to offer leases for 5 GW of offshore wind energy by 2030.</td>
<td>Nova Scotia (2022)</td>
</tr>
<tr>
<td>Australia</td>
<td>0.00</td>
<td>2</td>
<td>The Victorian Offshore Wind Policy Directions Paper sets nation-leading policy targets.</td>
<td>The Victorian Government (2022)</td>
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<td>4</td>
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<td>9</td>
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<td></td>
<td></td>
<td>2032</td>
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<td></td>
<td>2035</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>2040</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>0.00</td>
<td>16</td>
<td>Brazil’s government long-term energy expansion plan sees the potential to deploy 16 GW by 2050.</td>
<td>Radowitz (2020)</td>
</tr>
<tr>
<td>Colombia</td>
<td>0.00</td>
<td>0.2–1</td>
<td>The Colombian Ministry for Mines and Energy launched the Roadmap for the Deployment of Offshore Wind Energy in Colombia. The roadmap shows the offshore wind potential from a low-case to a high-case scenario.</td>
<td>Argus (2022)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5–3</td>
<td></td>
<td></td>
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<tr>
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<td></td>
<td>1.5–9</td>
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<td>2030</td>
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<td>2040</td>
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<td></td>
<td></td>
<td>2050</td>
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<td></td>
</tr>
</tbody>
</table>
Appendix B

Global Pipeline Database Updates
# Table B-1. Global Floating Offshore Wind Energy Pipeline by Country and Project Phase

<table>
<thead>
<tr>
<th>Country</th>
<th>Operating (MW)</th>
<th>Under Construction (MW)</th>
<th>Permitting (MW)</th>
<th>Site Control (MW)</th>
<th>Planning (MW)</th>
<th>Total (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>11,250.0</td>
<td></td>
<td></td>
<td></td>
<td>11,250.0</td>
<td></td>
</tr>
<tr>
<td>Bulgaria</td>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>23.0</td>
<td>216.6</td>
<td>12.0</td>
<td>800.0</td>
<td>1,051.6</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>2.0</td>
<td>90.2</td>
<td></td>
<td>2,063.0</td>
<td>2,155.2</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>5410.0</td>
<td></td>
<td></td>
<td>5410.0</td>
<td>5,410.0</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>11,186.0</td>
<td></td>
<td></td>
<td>11,186.0</td>
<td>11,186.0</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>5.0</td>
<td>16.8</td>
<td></td>
<td>225.0</td>
<td>246.8</td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>2,000.0</td>
<td></td>
<td></td>
<td>95.0</td>
<td>195.9</td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>100.9</td>
<td></td>
<td></td>
<td>6,420.0</td>
<td>6,420.0</td>
<td></td>
</tr>
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<td></td>
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<td></td>
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<td>4,015.0</td>
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<tr>
<td>Spain</td>
<td>2.0</td>
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<td></td>
<td>1,543.5</td>
<td>1,545.5</td>
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<td>12,200.0</td>
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<td>6,450.0</td>
<td>18,650.0</td>
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<td>Taiwan</td>
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<td></td>
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<td>1,890.0</td>
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<tr>
<td>United Kingdom</td>
<td>77.5</td>
<td>950.4</td>
<td></td>
<td>11,270.0</td>
<td>12,297.9</td>
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<tr>
<td>United States</td>
<td>6,042.0</td>
<td></td>
<td></td>
<td>19,074.0</td>
<td>25,116.0</td>
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<tr>
<td><strong>Total</strong></td>
<td>235.4</td>
<td>323.6</td>
<td>15,607.4</td>
<td>6,042.0</td>
<td>81,751.5</td>
<td>103,959.9</td>
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Appendix C

Commissioned U.S.-Flagged Vessels
<table>
<thead>
<tr>
<th>Vessel Category</th>
<th>Companies Backing</th>
<th>Commissioning</th>
</tr>
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<tbody>
<tr>
<td>CTV - Gripper</td>
<td>American Offshore Services, Blount Boats</td>
<td>Not listed</td>
</tr>
<tr>
<td>CTV - Atlantic Endeavor</td>
<td>Atlantic Wind Transfers, Blount Boats Inc., Chartwell Marine Ltd.</td>
<td>Not listed</td>
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<tr>
<td>CTV</td>
<td>Coast Line Transfers</td>
<td>2023</td>
</tr>
<tr>
<td>CTV - Gaspee</td>
<td>McAllister Towing</td>
<td>Not listed</td>
</tr>
<tr>
<td>CTV - Roger Williams</td>
<td>McAllister Towing</td>
<td>Not listed</td>
</tr>
<tr>
<td>CTV - Courageous</td>
<td>WINDEA CTV LLC</td>
<td>2023</td>
</tr>
<tr>
<td>CTV - Intrepid</td>
<td>WINDEA CTV LLC</td>
<td>2023</td>
</tr>
<tr>
<td>CTV - Enterprise</td>
<td>WINDEA CTV LLC</td>
<td>2023</td>
</tr>
<tr>
<td>CTV - Journey</td>
<td>WindServe Marine</td>
<td>Not listed</td>
</tr>
<tr>
<td>CTV - Explorer</td>
<td>WindServe Marine</td>
<td>2024</td>
</tr>
<tr>
<td>CTV - Odyssey</td>
<td>WindServe Marine, Ørsted</td>
<td>2020</td>
</tr>
<tr>
<td>CTV - Genesis</td>
<td>WindServe Marine, Ørsted, Senesco</td>
<td>Not listed</td>
</tr>
<tr>
<td>SOV - ECO Edison</td>
<td>Edison Chouest Offshore, Ørsted</td>
<td>2024</td>
</tr>
<tr>
<td>SOV - Paul Candies</td>
<td>Siemens Gamesa, US Otto Candies, LLC</td>
<td>2018 (retrofit)</td>
</tr>
<tr>
<td>SOV - Cade Candies</td>
<td>US Otto Candies, LLC</td>
<td>2010 (retrofit)</td>
</tr>
<tr>
<td>Barge - 455-8</td>
<td>Crowley Maritime Corporation</td>
<td>2010</td>
</tr>
<tr>
<td>Barge - Marmac 400</td>
<td>Foss Maritime</td>
<td>2001</td>
</tr>
<tr>
<td>Barge - Prevailing Winds</td>
<td>Foss Maritime</td>
<td>Not listed</td>
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<tr>
<td>Tug - Ocean Sky</td>
<td>Crowley Maritime Corporation</td>
<td>2013</td>
</tr>
<tr>
<td>Tug - Michele Foss</td>
<td>Foss Maritime</td>
<td>2015</td>
</tr>
<tr>
<td>Tug - Nicole Foss</td>
<td>Foss Maritime</td>
<td>2017</td>
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Appendix D
## Detailed Status of U.S. Offshore Wind Energy Projects in the North Atlantic

<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>Name</th>
<th>Developer</th>
<th>Lease Area</th>
<th>Offtake Agreement</th>
<th>Status</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ME</td>
<td>New England Aqua Ventus 1</td>
<td>UMaine, Diamond Offshore</td>
<td>State Lease</td>
<td>Power Purchase Agreement (PPA) – ME</td>
<td>Permitting</td>
<td>12 MW</td>
</tr>
<tr>
<td>2</td>
<td>ME</td>
<td>Maine Research Array</td>
<td>State of Maine</td>
<td>TBD</td>
<td>TBD</td>
<td>Planning</td>
<td>144 MW</td>
</tr>
<tr>
<td>3</td>
<td>ME</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-A 0562</td>
<td>TBD</td>
<td>Planning</td>
<td>1,964 MW</td>
</tr>
<tr>
<td>4</td>
<td>ME</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-A 0563</td>
<td>TBD</td>
<td>Planning</td>
<td>2,143 MW</td>
</tr>
<tr>
<td>5</td>
<td>ME</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-A 0564</td>
<td>TBD</td>
<td>Planning</td>
<td>1,786 MW</td>
</tr>
<tr>
<td>6</td>
<td>ME</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-A 0565</td>
<td>TBD</td>
<td>Planning</td>
<td>1,866 MW</td>
</tr>
<tr>
<td>7</td>
<td>ME</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-A 0566</td>
<td>TBD</td>
<td>Planning</td>
<td>2,062 MW</td>
</tr>
<tr>
<td>8</td>
<td>ME</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-A 0567</td>
<td>TBD</td>
<td>Planning</td>
<td>1,993 MW</td>
</tr>
<tr>
<td>9</td>
<td>ME</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-A 0568</td>
<td>TBD</td>
<td>Planning</td>
<td>2,172 MW</td>
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<tr>
<td>10</td>
<td>ME</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-A 0569</td>
<td>TBD</td>
<td>Planning</td>
<td>1,716 MW</td>
</tr>
<tr>
<td>11</td>
<td>RI/MA/CT</td>
<td>Revolution Wind</td>
<td>Ørsted/GIP</td>
<td>OCS-A 0486</td>
<td>PPA – RI (400 MW)</td>
<td>Under Construction</td>
<td>704 MW</td>
</tr>
<tr>
<td>12</td>
<td>RI/MA/CT</td>
<td>South Fork Wind</td>
<td>Ørsted/GIP</td>
<td>OCS-A 0517</td>
<td>OREC – NY</td>
<td>Operational</td>
<td>132 MW</td>
</tr>
<tr>
<td>13</td>
<td>RI</td>
<td>Block Island Wind</td>
<td>Ørsted</td>
<td>State Lease</td>
<td>PPA – RI</td>
<td>Operational</td>
<td>30 MW</td>
</tr>
<tr>
<td>14</td>
<td>RI/MA/CT</td>
<td>Sunrise Wind a</td>
<td>Ørsted</td>
<td>OCS-A 0487</td>
<td>OREC – NY</td>
<td>Permitting</td>
<td>924 MW</td>
</tr>
<tr>
<td>15</td>
<td>RI</td>
<td>Sunrise Wind (Residual)</td>
<td>Ørsted</td>
<td>OCS-A 0487</td>
<td>TBD</td>
<td>Planning</td>
<td>TBD</td>
</tr>
<tr>
<td>16</td>
<td>RI/MA/CT</td>
<td>New England Wind 1 and 2</td>
<td>Avangrid</td>
<td>OCS-A 0534</td>
<td>TBD</td>
<td>Approved</td>
<td>1,644 MW</td>
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<tr>
<td>17</td>
<td>RI/MA/CT</td>
<td>Bay State Wind</td>
<td>Ørsted</td>
<td>OCS-A 0500</td>
<td>TBD</td>
<td>Site Control</td>
<td>2,334 MW</td>
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<tr>
<td>18</td>
<td>RI/MA/CT</td>
<td>Vineyard Wind 1</td>
<td>Vineyard Offshore</td>
<td>OCS-A 501</td>
<td>PPA – MA</td>
<td>Under Construction</td>
<td>806 MW</td>
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<tr>
<td>19</td>
<td>RI/MA/CT</td>
<td>Beacon Wind 1 and 2</td>
<td>BP</td>
<td>OCS-A 0520</td>
<td>TBD</td>
<td>Permitting</td>
<td>2,085 MW</td>
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<tr>
<td>20</td>
<td>RI/MA/CT</td>
<td>SouthCoast Wind 1a,1b, and</td>
<td>Ocean Winds</td>
<td>OCS-A 0521</td>
<td>TBD</td>
<td>Permitting</td>
<td>2,062 MW</td>
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<tr>
<td>21</td>
<td>RI/MA/CT</td>
<td>Vineyard Northeast</td>
<td>Vineyard Offshore</td>
<td>OCS-A 0522</td>
<td>TBD</td>
<td>Site Control</td>
<td>2,600 MW</td>
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</tbody>
</table>

*a Sunrise Wind has entered the construction phase since the May 31, 2024, report cutoff.*
<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>Name</th>
<th>Developer</th>
<th>Lease Area</th>
<th>Offtake Agreement</th>
<th>Status</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>NY</td>
<td>Empire Wind 1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Equinor</td>
<td>OCS-A 0512 OREC– NY</td>
<td>Approved</td>
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<td>23</td>
<td>NY</td>
<td>Empire Wind 2</td>
<td>Equinor</td>
<td>OCS-A 0512 TBD</td>
<td>Site Control</td>
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<tr>
<td>24</td>
<td>NY</td>
<td>Excelsior Wind</td>
<td>Vineyard Offshore</td>
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<td>25</td>
<td>NY</td>
<td>Bluepoint Wind</td>
<td>OW Ocean Winds East, LLC</td>
<td>OCS-A 0537 TBD</td>
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<tr>
<td>26</td>
<td>NJ</td>
<td>Attentive Energy One</td>
<td>Total Energies, Rise Light &amp; Power, and Corio Generation</td>
<td>OCS-A 0538 TBD</td>
<td>Site Control</td>
<td>1,365 MW</td>
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</tr>
<tr>
<td>27</td>
<td>NJ</td>
<td>Attentive Energy Two</td>
<td>Total Energies, Rise Light &amp; Power, and Corio Generation</td>
<td>OCS-A 0538 OREC – NJ</td>
<td>Site Control</td>
<td>1,342 MW</td>
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<tr>
<td>28</td>
<td>NJ</td>
<td>Community Offshore Wind</td>
<td>RWE Offshore, National Grid</td>
<td>OCS-A 0539 TBD</td>
<td>Site Control</td>
<td>1,314 MW</td>
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</tr>
<tr>
<td>29</td>
<td>NJ</td>
<td>Community Offshore Wind (Residual)</td>
<td>RWE Offshore, National Grid</td>
<td>OCS-A 0539 TBD</td>
<td>Site Control</td>
<td>725 MW</td>
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<tr>
<td>30</td>
<td>NJ</td>
<td>Atlantic Shores Offshore Wind Bight</td>
<td>EDF/Shell</td>
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<td>Site Control</td>
<td>2,500 MW</td>
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<td>31</td>
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<td>Leading Light Wind</td>
<td>Invenergy</td>
<td>OCS-A 0542 OREC – NJ</td>
<td>Permitting</td>
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<tr>
<td>32</td>
<td>NJ</td>
<td>Atlantic Shores Offshore Wind North</td>
<td>EDF/Shell</td>
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<td>Site Control</td>
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<td>33</td>
<td>NJ</td>
<td>Atlantic Shores Offshore Wind South 1</td>
<td>EDF/Shell</td>
<td>OCS-A 0499 OREC – NJ</td>
<td>Permitting</td>
<td>1,510 MW</td>
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<tr>
<td>34</td>
<td>NJ</td>
<td>Atlantic Shores Offshore Wind South 2</td>
<td>EDF/Shell</td>
<td>OCS-A 0499 TBD</td>
<td>Permitting</td>
<td>1,350 MW</td>
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</tr>
</tbody>
</table>

<sup>a</sup> Empire Wind 1 has entered the construction phase since the May 31, 2024, report cutoff.
## Detailed Status of U.S. Offshore Wind Energy Projects in the Mid and South Atlantic

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<thead>
<tr>
<th>No.</th>
<th>Location</th>
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<th>Developer</th>
<th>Lease Area</th>
<th>Offtake Agreement</th>
<th>Status</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>NJ</td>
<td>Ocean Wind 1</td>
<td>Ørsted</td>
<td>OCS-A 0498</td>
<td>TBD</td>
<td>Site Control</td>
<td>1,223 MW</td>
</tr>
<tr>
<td>36</td>
<td>NJ</td>
<td>Ocean Wind 2</td>
<td>Ørsted</td>
<td>OCS-A 0532</td>
<td>TBD</td>
<td>Site Control</td>
<td>1,375 MW</td>
</tr>
<tr>
<td>37</td>
<td>DE</td>
<td>Garden State Offshore Energy</td>
<td>Ørsted</td>
<td>OCS-A 0482</td>
<td>TBD</td>
<td>Site Control</td>
<td>1,080 MW</td>
</tr>
<tr>
<td>38</td>
<td>DE</td>
<td>Skipjack 1</td>
<td>Ørsted</td>
<td>OCS-A 0519</td>
<td>TBD</td>
<td>Site Control</td>
<td>426 MW</td>
</tr>
<tr>
<td>39</td>
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<td>TBD</td>
<td>Site Control</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>MD</td>
<td>MarWin</td>
<td>US Wind</td>
<td>OCS-A 0490</td>
<td>OREC – MD</td>
<td>Permitting</td>
<td>300 MW</td>
</tr>
<tr>
<td>41</td>
<td>MD</td>
<td>Momentum Wind</td>
<td>US Wind</td>
<td>OCS-A 0490</td>
<td>OREC – MD</td>
<td>Permitting</td>
<td>809 MW</td>
</tr>
<tr>
<td>42</td>
<td>MD</td>
<td>MarWin Residual</td>
<td>US Wind</td>
<td>OCS-A 0490</td>
<td>OREC – MD</td>
<td>Site Control</td>
<td>600 MW</td>
</tr>
<tr>
<td>43</td>
<td>DE</td>
<td>Proposed Lease Area(^a)</td>
<td>TBD</td>
<td>OCS-A 0557</td>
<td>TBD</td>
<td>Planning</td>
<td>1,642 MW</td>
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<tr>
<td>44</td>
<td>VA</td>
<td>Proposed Lease Area(^b)</td>
<td>TBD</td>
<td>OCS-A 0558</td>
<td>TBD</td>
<td>Planning</td>
<td>2,857 MW</td>
</tr>
<tr>
<td>45</td>
<td>VA</td>
<td>Coastal Virginia Offshore Wind Pilot</td>
<td>Dominion Energy</td>
<td>OCS-A 0497</td>
<td>Utility Owned</td>
<td>Operational</td>
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</tr>
<tr>
<td>46</td>
<td>VA</td>
<td>Coastal Virginia Offshore Wind Commercial</td>
<td>Dominion Energy</td>
<td>OCS-A 0483</td>
<td>Utility Owned</td>
<td>Under Construction</td>
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<tr>
<td>47</td>
<td>NC</td>
<td>Kitty Hawk North</td>
<td>Avangrid</td>
<td>OCS-A 0559</td>
<td>TBD</td>
<td>Permitting</td>
<td>631 MW</td>
</tr>
<tr>
<td>48</td>
<td>NC</td>
<td>Kitty Hawk South</td>
<td>Avangrid</td>
<td>OCS-A 0508</td>
<td>TBD</td>
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</tr>
<tr>
<td>49</td>
<td>NC/SC</td>
<td>TotalEnergies</td>
<td>TotalEnergies</td>
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<td>TBD</td>
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<tr>
<td>50</td>
<td>NC/SC</td>
<td>Duke Energy</td>
<td>Duke</td>
<td>OCS-A 0546</td>
<td>TBD</td>
<td>Site Control</td>
<td>893 MW</td>
</tr>
</tbody>
</table>

\(^{a,b}\) These lease areas have entered the site control phase since the May 31, 2024, report cutoff.
### Detailed Status of U.S. Offshore Wind Energy Projects in the Gulf of Mexico

<table>
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<tr>
<th>No.</th>
<th>Location</th>
<th>Name</th>
<th>Developer</th>
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<th>Offtake Agreement</th>
<th>Status</th>
<th>Capacity</th>
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</thead>
<tbody>
<tr>
<td>51</td>
<td>LA</td>
<td>RWE Offshore US Gulf, LLC</td>
<td>RWE</td>
<td>OCS-G 37334</td>
<td>TBD</td>
<td>Site Control</td>
<td>1,659 MW</td>
</tr>
<tr>
<td>52</td>
<td>TX</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-G 37962</td>
<td>TBD</td>
<td>Planning</td>
<td>1,659 MW</td>
</tr>
<tr>
<td>53</td>
<td>TX</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-G 37963</td>
<td>TBD</td>
<td>Planning</td>
<td>1,567 MW</td>
</tr>
<tr>
<td>54</td>
<td>TX</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-G 37964</td>
<td>TBD</td>
<td>Planning</td>
<td>1,752 MW</td>
</tr>
<tr>
<td>55</td>
<td>LA/TX</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-G 37965</td>
<td>TBD</td>
<td>Planning</td>
<td>1,660 MW</td>
</tr>
</tbody>
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## Detailed Status of U.S. Offshore Wind Energy Projects in the Pacific and Hawaii

<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>Name</th>
<th>Developer</th>
<th>Lease Area</th>
<th>Offtake Agreement</th>
<th>Status</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>OR</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-P 0566</td>
<td>TBD</td>
<td>Planning</td>
<td>991 MW</td>
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<tr>
<td>57</td>
<td>OR</td>
<td>Proposed Lease Area</td>
<td>TBD</td>
<td>OCS-P 0567</td>
<td>TBD</td>
<td>Planning</td>
<td>2,166 MW</td>
</tr>
<tr>
<td>58</td>
<td>CA</td>
<td>California North Floating</td>
<td>Copenhagen Infrastructure Partners (CIP)</td>
<td>OCS-P 0562</td>
<td>TBD</td>
<td>Site Control</td>
<td>1,117 MW</td>
</tr>
<tr>
<td>59</td>
<td>CA</td>
<td>Canopy Offshore Wind</td>
<td>RWE</td>
<td>OCS-A 0561</td>
<td>TBD</td>
<td>Site Control</td>
<td>1,025 MW</td>
</tr>
<tr>
<td>60</td>
<td>CA</td>
<td>Golden State Wind</td>
<td>EDPR/ENGIE</td>
<td>OCS-P 0564</td>
<td>TBD</td>
<td>Site Control</td>
<td>1,302 MW</td>
</tr>
<tr>
<td>61</td>
<td>CA</td>
<td>Even Keel Wind</td>
<td>Invenergy</td>
<td>OCS-P 0565</td>
<td>TBD</td>
<td>Site Control</td>
<td>1,302 MW</td>
</tr>
<tr>
<td>62</td>
<td>CA</td>
<td>Atlas Winds</td>
<td>Equinor</td>
<td>OCS-P 0563</td>
<td>TBD</td>
<td>Site Control</td>
<td>1,296 MW</td>
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<tr>
<td>63</td>
<td>CA</td>
<td>CADEMO</td>
<td>Floventis, Cierco, SBM</td>
<td>State Lease</td>
<td>TBD</td>
<td>Permitting</td>
<td>60 MW</td>
</tr>
<tr>
<td>64</td>
<td>HI</td>
<td>Oahu North Call Area</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>65</td>
<td>HI</td>
<td>Oahu South Call Area</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
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On April 30, 2024, BOEM announced a proposed lease sale in Oregon for two lease areas totaling 194,995 acres.

www.nrel.gov

NREL/PR-5000-90897

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