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**ENERGY**

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ENERGY EFFICIENCY &  
RENEWABLE ENERGY

# Offshore Wind Market Report: 2023 Edition

EXECUTIVE SUMMARY



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## Executive Summary

The *Offshore Wind Market Report: 2023 Edition* provides detailed information on the U.S. and global offshore wind energy industries to inform policymakers, researchers, and analysts about technology, economic, and market trends. The scope of the report covers the status of over 293 global operating offshore wind energy projects as well as the broader global pipeline of projects in various stages of development through December 31, 2022. To provide up-to-date information and discussion on this emerging industry in the United States, this report tracks the significant U.S. domestic industry progress and events from January 1, 2022, through May 31, 2023.

### U.S. Offshore Wind Energy Market

**By May 31, 2023, the U.S. offshore wind energy project development and operational pipeline reached a potential generating capacity of 52,687 megawatts.** The 52,687 megawatts (MW) in the U.S. offshore wind energy pipeline represents 15% growth from the *Offshore Wind Market Report: 2022 Edition*.<sup>1</sup> Most of the 6,915 MW of growth in the U.S. project pipeline capacity was driven by new leasing activity that created three new lease areas in the Gulf of Mexico with an estimated capacity of 4,885 MW. The first two commercial-scale offshore wind power plants in the United States, Vineyard Wind 1 and South Fork Wind, achieved major milestones by entering the wind turbine installation phase of their construction periods.<sup>2</sup> A map of the current pipeline activity and Call Areas is shown in Figure ES-1. Note the potential future offshore wind generating capacity in Call Areas is not included in any of the pipeline estimates in this report.

**The Inflation Reduction Act, signed into law in August 2022, provides incentives for investing in offshore wind energy and the domestic supply chain.** The Inflation Reduction Act (IRA) effectively extends offshore wind's eligibility for an investment tax credit (ITC) of 30% for at least a decade and makes receipt of the full credit dependent on meeting prevailing wage and apprenticeship requirements. The IRA also includes bonus credits of 10 percentage points each for meeting domestic content thresholds and for locating facilities in fossil-fuel-powered communities or on brownfield sites that can be combined for qualifying projects. The IRA also introduces per-watt manufacturing credits for domestic production of various clean energy technology components. Those components relevant to offshore wind energy include wind turbine blades, nacelles, towers, foundations, and purpose-built offshore wind vessels.

**Many U.S. offshore wind energy projects are facing economic headwinds from cost increases.** Many projects—particularly those with an expected start of commercial operations

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<sup>1</sup> The pipeline capacity calculated in 2022 was revised to adjust the capacity density of leases areas where specific project dimensions have not been announced from 3 megawatts (MW)/square kilometer (km<sup>2</sup>) to 4 MW/km<sup>2</sup>. The U.S. offshore wind energy pipeline as of May 31, 2022, was revised to 45,772 MW, from the original reported pipeline of 40,083 MW.

<sup>2</sup> South Fork Wind and Vineyard Wind 1 both began wind turbine installation after May 31, 2023.

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between 2025 and 2028—have faced challenges in maintaining economic viability because of rising capital costs and interest rates. As a result, some projects have asked their offtake counterparties or states to renegotiate the terms of their offtake agreements (e.g., Massachusetts Department of Public Utilities 2022). As a buffer to make future offtake agreements more durable, some states have now introduced inflation indexing as part of their forthcoming offshore wind procurements. The IRA may soften the adverse impact of rising inflation, supply chain constraints, and interest rates on offshore wind project costs for early-stage offshore wind projects.

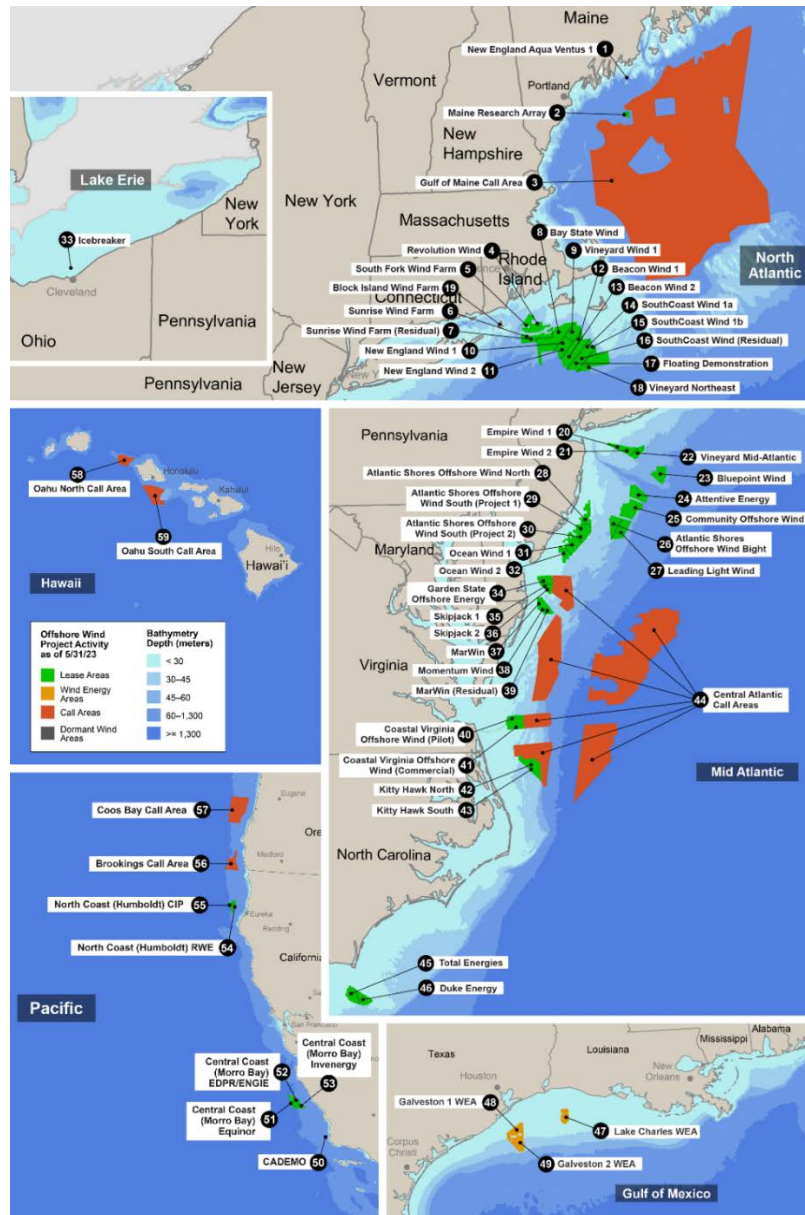


Figure ES-1. Locations of U.S. offshore wind energy pipeline activity and Call Areas as of May 31, 2023. Map created by John Frenzi, National Renewable Energy Laboratory

**The U.S. floating offshore wind energy market reached a turning point in 2022.** The first-ever commercial floating offshore wind energy lease areas, off the coast of California, were sold in December 2022, for over \$750 million. In addition, California announced a planning goal of 25 gigawatts (GW) by 2045. In September 2022, the Biden administration announced the Floating Offshore Wind Shot<sup>TM</sup>, a nationwide effort to reduce the cost of floating offshore wind by 70% to \$45/megawatt-hour (MWh) (U.S. Department of Energy 2022). In concert with the Floating Offshore Wind Shot, the U.S. Department of the Interior announced a deployment target for 15 GW of floating offshore wind capacity to be installed by 2035, with plans for additional commercial leasing for floating wind in the Atlantic and Pacific regions (U.S. Department of the Interior 2022).

**Investments in the domestic supply chain continued with \$2.7 billion announced in 2022.**

Since 2014, around \$17 billion<sup>3</sup> has been announced or invested in the U.S. offshore wind energy industry according to the Business Network for Offshore Wind. The \$2.7 billion invested in 2022 was spread across ports, vessels, supply chain, and transmission, indicating investor confidence in the U.S. offshore wind energy market (Business Network for Offshore Wind 2023). Ports and vessels in particular saw significant investment, with almost \$1 billion spread across a total of 12 marshaling, manufacturing, and operations and maintenance ports. The U.S. offshore wind energy industry currently has 8 commissioned vessels and 28 that are announced or under construction.

**The Bureau of Ocean Energy Management held three offshore wind lease auctions in 2022, collecting a total of \$5.44 billion in sales.**

The bureau held three of seven lease auctions announced in its “Offshore Wind Leasing Path Forward 2021–2025” in 2022. These auctions sold 13 leases for a total of \$5.44 billion, more than \$4 billion from the New York Bight alone. The auctions sales included six leases in the New York Bight, two leases off Carolina Long Bay, and five leases off California’s coast (U.S. Department of the Interior 2021). The new lease areas substantially increase the number of viable offshore wind energy sites in the United States, provide regional diversification beyond the north and mid-Atlantic, and enable the U.S. floating offshore wind industry in the United States by introducing the first deep-water commercial leases.

**Twenty-seven contracts to purchase 17,567 MW of electricity from offshore wind power plants have been signed, but no new offtake agreements were signed between June 2022 and May 2023.** State procurement policies have resulted in 27 offshore wind power offtake agreements, totaling 17,567 MW. Although no new offtake agreements have been signed since May 31, 2022, between January 2021 and May 31, 2022, 10 offtake agreements, totaling 11,874 MW, were signed, and multiple state procurements were open as of May 31, 2023. Several

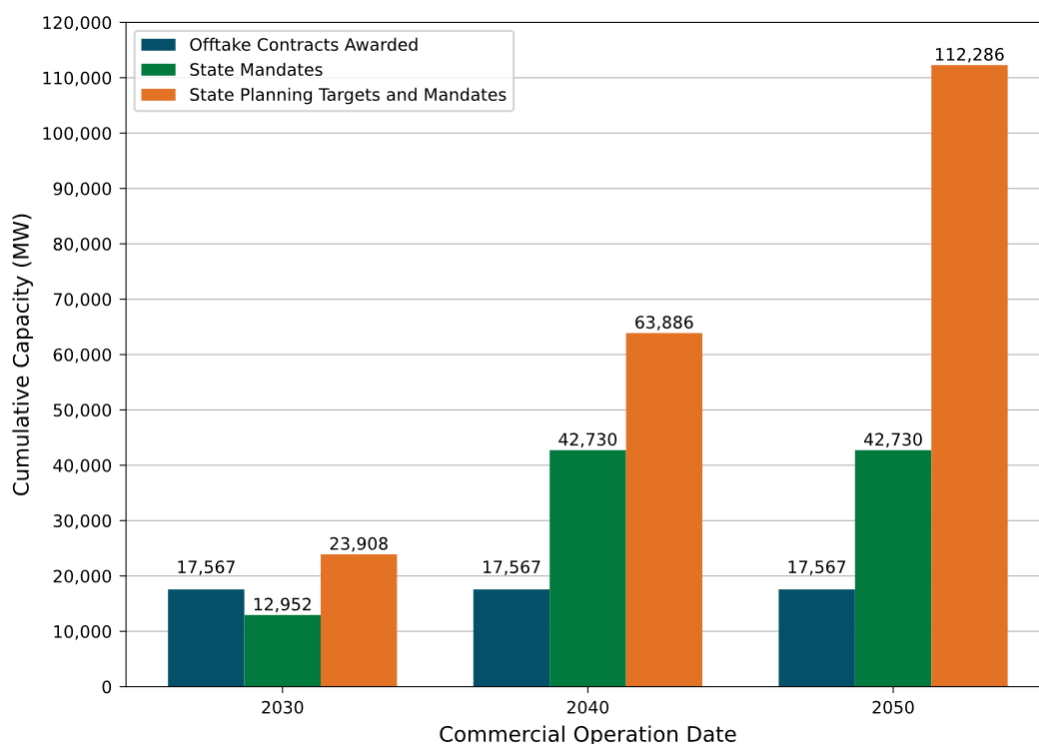
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<sup>3</sup> The Business Network for Offshore Wind includes revenue from lease sales in this total.



projects have announced they are exploring renegotiation or cancelation of their negotiated power purchase agreements, which could change the current total.

**State policies aim to procure 42,730 MW of offshore wind capacity by 2040.** The U.S. offshore wind energy market continues to be driven by state-level offshore wind procurement activities and policies. Seven states have durable statutory procurement mandates<sup>4</sup> that total 42,730 MW by 2040; about a 9% increase from the 39,322 MW reported in May 2022. Six other states have set offshore-wind-specific planning targets with varying renewable energy offtake mechanisms to procure electrical generation. In 2023, both New Jersey and Maryland increased their statutory procurement mandates to 11 and 8.5 GW, respectively. In aggregate, 13 coastal states have announced planning targets or procurement mandates for offshore wind energy that combined, add to a total of 112,286 MW of offshore wind capacity by 2050. These policies provide a solid foundation for achieving federal offshore wind energy targets of 30 GW by 2030 and 15 GW of floating offshore wind by 2035 (The White House 2021, 2022a). Figure ES-2 shows the composite timelines for state policy mandates, offtake contracts awarded, and planning targets (which include procurement mandates) as of May 31, 2023.



**Figure ES-2. U.S. offshore wind energy state planning goals, procurement mandates, and offtake contracts awarded.**

<sup>4</sup> Durable procurement targets are protected by robust legislation rather than based on a single executive order that could potentially be overturned by a change in governance.

## Global Offshore Wind Energy Market

**Global offshore wind energy in 2022 had its second-best year, commissioning 8,385 MW of new projects.** By the end of 2022, the total global capacity reached 59,009 MW from 292 operating projects and over 11,900 operating wind turbines. For the second straight year, most of the growth was attributed to China, which commissioned 5,719.6 MW. The United Kingdom had the next largest annual deployment (1,386 MW), followed by France (480 MW), Germany (342 MW), Vietnam (331 MW), and the rest of the world at (126.5 MW) (National Renewable Energy Laboratory Offshore Wind Database 2021). Projections based on projects under construction indicate that annual global capacity additions may increase slightly in 2023.

**The global generating capacity potential in the pipeline for all offshore wind energy projects nearly reached 427 GW in 2022.** As of December 31, 2022, the global pipeline for offshore wind energy development capacity was assessed to be 426,789 MW, up nearly 16% over the 368,170 GW reported in 2022. The global uptick is primarily attributed to new European projects entering the planning phase.<sup>5</sup>

### **Macroeconomic and geopolitical events have raised the level of market uncertainty in 2022.**

The extended impact of monetary policy to fight inflation and the conflict in Ukraine have created increased market volatility, disrupted the supply chain, and increased project costs. These complex external drivers are having both positive and negative impacts on offshore wind and broader energy industries. Increased fossil-fuel prices and supply uncertainty have increased commitments to renewable energy by Nations around the world to mitigate rising consumer electricity costs and strengthen their energy security. On the other hand, increases in commodity prices and continued supply chain disruptions threaten to increase offshore wind project costs, which could delay offshore wind energy deployment in the near term (Durakovic. 2022c). Higher costs are impacting all renewable and fossil-fueled power generation sources (Henze 2022), though capital-intensive sources like offshore wind energy are relatively more affected.

### **The global pipeline for floating offshore wind energy increased by nearly 42 GW in 2022.**

Overall, the 2022 global floating offshore wind pipeline grew from 60,746 MW to 102,529 MW, representing 41,783 MW of growth (approximately 69% increase) since the *Offshore Wind Market Report: 2022 Edition*. This growth is attributed to new commercial project announcements, mostly in the United Kingdom, that entered the pipeline in 2022.

**No new global floating offshore wind energy projects came online in 2022, maintaining floating wind global capacity at 123.4 MW.** Equinor began construction of their 88-MW Hywind Tampen floating wind plant in 2022 but had not yet fully commissioned all 11 turbines.

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<sup>5</sup> Note that the capacity density adjustments made to the U.S. pipeline do not affect the rest of the global pipeline.

When it is fully commissioned, likely in 2023, Hywind Tampen will be the largest operating floating offshore wind energy project in the world.

## Offshore Wind Energy Technology Trends

### **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. Industry announcements indicate that developers will depend on these turbines for most U.S. projects, and manufacturers such as General Electric have already announced they intend to extend their technology platform beyond 15 MW. Projects outside the United States could possibly use Chinese wind turbines that have also reached a 15-MW scale.

## Offshore Wind Energy Cost and Price Trends

**Supply chain constraints, high inflation, and rising interest rates have resulted in significant project cost increases of 11%–30% during 2022.** These cost increases reported in 2022 may have the greatest impact on the capital expenditures of projects planning commercial operations between 2025 and 2028 with offtake agreements already in place. Although no U.S. offshore wind energy projects were built in 2022, we estimate that a hypothetical fixed-bottom project beginning commercial operations in 2022 would have incurred an increase of 6% in its levelized cost of energy, from \$84/MWh to \$89/MWh on average. This increase is based on the assumption that supply contracts would have been awarded between 2019 and 2021 for projects with a commercial operation date in 2022. This 6% increase above the reported 2021 U.S. cost estimates still results in a total cost reduction of about 50% since 2014 (Wiser et al. 2021). For representative market scenarios, leading research entities and consultancies now estimate that average levelized cost of offshore wind energy will be \$63/MWh by 2030.

## Future Outlook

**Industry growth in the U.S. market could parallel anticipated global market growth, despite current macroeconomic challenges.** Global forecasts from BloombergNEF (2022a) and 4C Offshore (2023) show offshore wind energy could reach between 380 GW and 394 GW, respectively, by 2032, which would represent a sixfold increase in offshore wind capacity over the next decade.

**Recent national power sector scenario analysis indicates that some states will need offshore wind to decarbonize their energy supply.** A recent National Renewable Energy Laboratory study investigated multiple scenarios to achieve 100% clean electricity generation by 2035 and concluded that given increased electricity demand from electrification, the United States needs roughly two terawatts (2,000 GW) of wind and solar capacity to serve a threefold expansion of

electric energy consumption (Denholm et al. 2022). Specifically, between 1,000 GW and 1,200 GW of wind energy (land-based and offshore wind combined) will be needed, with offshore wind contributing a significant portion (Wiser et al. 2023). The study also estimated that the resulting economic and social benefits could potentially exceed the cost of decarbonization.

**In the United States, key offshore wind energy market indicators, such as commercial leasing, state energy planning targets, procurement policies, offtake agreements, and federal support for U.S. jobs and supply chain development, point toward sustained market growth when viewed together, but the macroeconomic hurdles facing the first generation of commercial projects could significantly stunt that growth.**



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