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ENERGY EFFICIENCY & RENEWABLE ENERGY

# Offshore Wind Market Report: 2022 Edition

EXECUTIVE SUMMARY

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# Executive Summary

The "Offshore Wind Market Report: 2022 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 257 global operating offshore wind energy projects as well as the broader global pipeline of projects in various stages of development through December 31, 2021. To provide the most up-to-date data and discussion of this emerging industry in the United States, this report tracks the most significant U.S. domestic industry progress and events from January 1, 2021, through May 31, 2022.

## U.S. Offshore Wind Energy Market

By May 2022, the U.S. offshore wind energy project development and operational pipeline grew to a potential generating capacity of 40,083 megawatts (MW). The 40,083 MW in the U.S. offshore wind energy pipeline was 13.5% over the 35,324 MW reported in the "Offshore Wind Market Report: 2021 Edition." This expansion in the U.S. project pipeline was driven by the Bureau of Ocean Energy Management's (BOEM's) "Offshore Wind Leasing Path Forward 2021–2025," which auctioned eight new lease areas in the Atlantic and converted two California Call Areas into new wind energy areas (WEAs) (U.S. Department of the Interior 2021). Even though three of the existing WEAs were reclassified as "dormant" and removed from the pipeline, the net expansion was 4,759 MW higher than the capacity reported in May 2021. A map of the current pipeline activity and Call Areas is shown in Figure ES-1.

**States policies aim to procure at least 39,322 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. In aggregate, offshore wind policies in eight states call for deploying at least 39,322 MW of offshore wind capacity by 2040, which is approximately the same as reported in the "Offshore Wind Market Report: 2021 Edition." These policies provide a pathway to achieving the national offshore wind target of 30 gigawatts (GW) by 2030 (The White House 2021).

**BOEM announces plan to develop WEAs in up to seven U.S. regions by 2025**. In October 2021, BOEM announced its "Offshore Wind Leasing Path Forward 2021–2025," calling for plans to hold up to seven new offshore wind lease auctions including the New York Bight, Carolina Long Bay, Central Atlantic, Gulf of Maine, California, Oregon, and the Gulf of Mexico by 2025 (U.S. Department of the Interior 2021). The new lease areas will 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 technology diversification by introducing the first commercial lease opportunities for floating offshore wind.

**BOEM held lease auctions for six new lease areas in the New York Bight and two lease areas in Carolina Long Bay**. In February 2022, BOEM auctioned six lease areas in the New York Bight selling for $4.37 billion. The lease area selling prices ranged from a winning bid of $285,000,000 for OCS-A 0544 ($1,637,931/per square kilometer [$km^2$]) to a winning bid of $1,100,000,000 for OCS-A 0539 ($2,380,952/per $km^2$). The auction set records for total revenue generated from an offshore energy lease auction in the United States. In May 2022, the two lease areas in the Carolina Long Bay auction sold for a combined total of $315 million, with an average sale price of $707,894/per $km^2$.

**As of May 31, 2022, 24 offtake agreements to purchase offshore wind energy were signed in the United States.** Eight states have unique targets with varying offtake mechanisms to procure electrical generation from specific offshore wind projects. These state policies have resulted in 24 power offtake agreements, adding up to 17,597 MW of offshore wind energy contracts. From the beginning of 2021 through May 31, 2022, 10 new offtake agreements, totaling 11,874 MW, were signed.

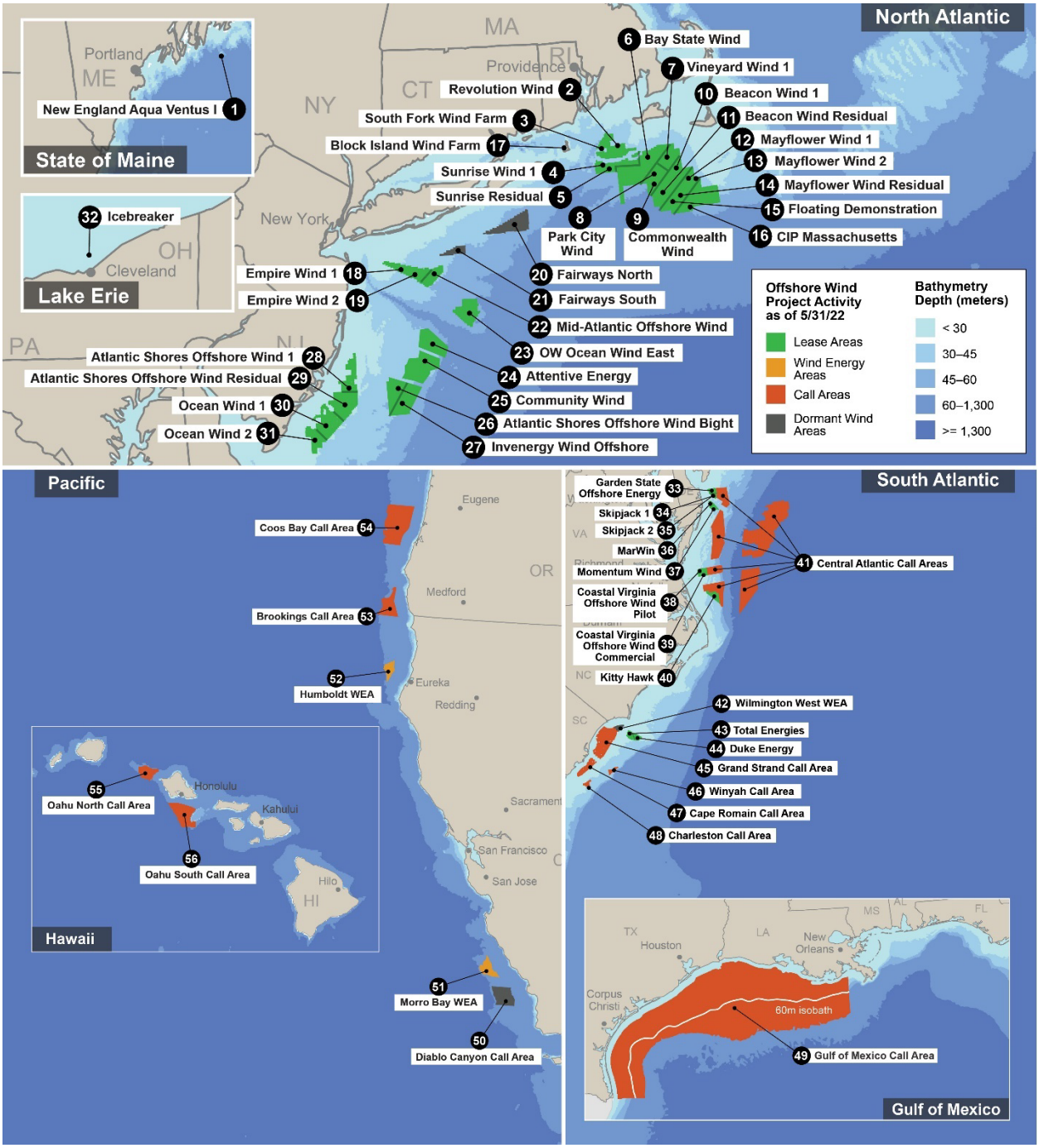


**Figure ES-1. Locations of U.S. offshore wind pipeline activity and Call Areas as of May 31, 2022.** ***Map created by NREL***

## Global Offshore Wind Energy Market

**Global offshore wind energy in 2021 had a record year for deployment with about 17,398 MW of new projects commissioned**. The surge in offshore wind energy deployment this year pushed global installed capacity past 50 GW. This growth was largely attributed to China, which

commissioned 13,790 MW—more capacity in 1 year than the entire world has installed in any single previous year. The United Kingdom had the next largest annual deployment (1,855 MW), followed by Vietnam (643 MW), Denmark (604 MW), the Netherlands (402 MW), and Taiwan (109 MW) (National Renewable Energy Laboratory Offshore Wind Database 2021). By the end of 2021, cumulative global offshore wind installed capacity grew to 50,623 MW from 257 operating projects. Projections indicate that annual global capacity additions may fall below the 2021 pace in 2022 but overall, new deployments will likely accelerate up to 2025 and beyond.

**The global generating capacity potential of the project pipeline for all offshore wind energy projects reached 368 GW in 2021.** As of December 31, 2021, the global pipeline for offshore wind energy development capacity was assessed to be 368,170 MW, up nearly 20% over the 308 GW reported in 2020. The uptick is primarily attributed to multiple new Asian projects announced this year that are entering the planning phase.

**Macroeconomic and geopolitical events have raised the level of market uncertainty in 2022.** The extended impact of monetary policy, the COVID-19 pandemic, and the ongoing conflict in Ukraine have created macroeconomic volatility, supply chain disruptions, and inflationary pressures. These complex external drivers are having both positive and negative impacts on offshore wind and broader energy industries. Increased fossil-fuel prices have led nations around the world to accelerate the development of renewable energy to mitigate rising consumer electricity costs and strengthen their energy security. On the other hand, increased commodity prices and continued supply chain disruptions threaten to slow offshore wind cost declines or potentially increase costs, which could dampen offshore deployment in the near term (Vestas 2022).

**The global pipeline for floating offshore wind energy more than doubled in 2021**. Overall, the 2021 global floating offshore wind pipeline grew from 26,529 MW to 60,746 MW, representing 34,217 MW of growth since the "Offshore Wind Market Report: 2021 Edition." This growth is attributed to several new projects in South Korea, the United Kingdom, Brazil, and Australia entering the pipeline and beginning their planning phase during 2021.

**Three floating offshore wind projects came online in 2021, totaling 57.1 MW of new floating capacity**. The largest floating offshore wind project built to date (50 MW total—2 MW of which moved from Portugal in 2021), Kincardine Offshore Wind Farm, came online in Scotland (Principle Power, Inc. 2021). A 5.5-MW floating demonstration project came online in China, which was developed by China Three Gorges Group (Russell 2021). Additionally, the 3.6-MW TetraSpar Demonstration Project was installed in Norway at a water depth of 200 meters (Stiesdal A/S 2021). With these additions, the total global floating offshore wind capacity is now 123.4 MW.

## Offshore Wind Energy Technology Trends

**Offshore wind turbines in the 15-MW class are advancing toward commercial production**. After the three leading wind turbine manufacturers announced their plans to develop wind turbines in the 15-MW class last year, a leading Chinese manufacturer, MingYang, announced its plans to deliver a 16-MW wind turbine for the commercial market by 2024. These 15-MW class wind turbines are under full development at Siemens Gamesa, Vestas, and General Electric, with intentions to have them available for purchase by 2024 or sooner. Industry announcements indicate that developers will be depending on these turbines for most U.S. projects.

## Offshore Wind Energy Cost and Price Trends

**The levelized cost of energy for fixed-bottom projects commissioned in 2021 has declined to $91/megawatt-hour (MWh) on average, with a range of $75/MWh to $116/MWh globally**. This decline represents a reduction of 4% on average compared to 2020, bringing the total cost reduction to more than 50% since 2014 (Wiser et al. 2021). For representative market scenarios, leading research entities and consultancies estimate that levelized cost of offshore wind energy will be $64/MWh on average by 2030 and range between $41 and $48/MWh by 2050.

**Record-setting lease auction prices in New York Bight are followed by auction format changes to benefit states and local stakeholders**. The $4.37 billion paid for leases in the New York Bight was unprecedented. While signaling strong confidence in the offshore wind energy market, those high lease prices translate to about $763/kilowatt and raise concerns about higher electricity costs from offshore wind. In May 2022, the BOEM auction rules were modified for the Carolina Long Bay auction using multifactor bidding criteria that allow bidding credits to be allocated for supply chain commitments. A multifactor approach is also planned in the next upcoming lease auction in California scheduled for late 2022 that will allow bidding credits for local benefits.

## Future Outlook

Although still at the beginning stages in the United States, offshore wind is now recognized globally as one of the principal energy sources to combat climate change. Global offshore wind energy deployment is forecast by 4C Offshore and BloombergNEF to increase globally to about 260 GW or more by 2030 (4C Offshore [2022]; BloombergNEF [2021]) and the number of countries currently generating from offshore wind is expected to double over the next decade (Ferris 2022). U.S. domestic offshore wind energy deployment is expected to follow global growth trends, driven by robust state-level procurement targets, and a national target of 30 GW of offshore wind energy by 2030, set in March 2021. Following BOEM's October 2021 announcement to ramp up offshore leasing on the Outer Continental Shelf, and the record-setting lease prices observed in the New York Bight auction in February 2022, the U.S. industry is signaling rapid growth, and expanding to regions outside the North and mid-Atlantic. In the coming years, national leasing plans call for offshore wind energy auctions in the Gulf of

Mexico, Pacific, South Atlantic, and the Gulf of Maine by 2024, which would allow commercial development as early as 2030. As these regions integrate offshore wind into their regional electricity markets, the industry will need to tackle new technical challenges, such as hurricane survival, deeper water, and lower average wind speeds, but through continued industry research the solutions are attainable (National Offshore Wind Research and Development Consortium 2021; U.S. Department of Energy 2022). In particular, the development of floating wind technology is likely to continue to gain momentum as the industry works toward cost parity with fixed-bottom wind technology through economies of scale and global market growth. Beyond the near-term leasing plans, the United States could also see offshore wind move forward by the end of the decade in regions like Hawaii, Puerto Rico, and the Great Lakes, where technical feasibility, resources, and energy demand requirements are already being investigated. The domestic and global push for clean, carbon-free electricity and complete decarbonization of all energy sectors is likely to remain a primary driver in the United States for offshore wind, but caution should be taken as the path forward is not free from obstacles. Uncertain and fluctuating policy support, stakeholder concerns, constrained global supply chains, inflation, restrictive legislation for ocean development, land-based grid limitations, and geopolitical conflicts will pose challenges that could potentially moderate or constrain the industry's progress.

The Biden administration's 30-GW-by-2030 goal suggests a strong pace of development and establishes a pathway to deploy 110 GW or more of offshore wind energy in the United States by 2050 (The White House 2021). This amount of offshore wind energy deployment would comprise a substantial part of a comprehensive U.S. decarbonization strategy, but further research is needed to determine the extent of offshore wind's role in a decarbonized energy future.

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