

# Offshore Wind Market Report: 2021 Edition

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# Data and Methodology

# Data Sources

This update draws data from the 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 project announcements. For the database, NREL has verified and sourced data from the following publications:

- The 4C Offshore Wind Database (4C Offshore 2021)
- Bloomberg New Energy Finance (BNEF) Renewable Energy Project Database (BNEF 2021)
- 4C Offshore Vessel Database (4C Offshore 2021)
- Wood Mackenzie Wind Turbine Trends (Wood Mackenzie 2021).

# Scope and Pipeline Definitions

- This work defines the offshore wind project pipeline as potential offshore wind development indicated by developer announcements or by areas made available for offshore wind development by regulatory agencies.
- The scope of this report covers the global fleet of projects in the pipeline through December 31, 2020.
- This report also covers recent developments and events in the United States through May 31, 2021, projects that have been completed before May 31, 2021.
- Any estimates of capacities and project dates are shown as reported by project developers or state/federal agencies.
- All dollar amounts are reported in 2020 U.S. dollars, unless indicated otherwise.
- In this analysis, the U.S. pipeline capacity includes the sum of project-specific capacities and the undeveloped lease area potential capacities based on a project density of 3 megawatts (MW)/km<sup>2</sup>.
- For further discussion on methodology and data sources, please refer to the “[2019 Offshore Wind Technology Data Update](#)” (Musial et al. 2020)

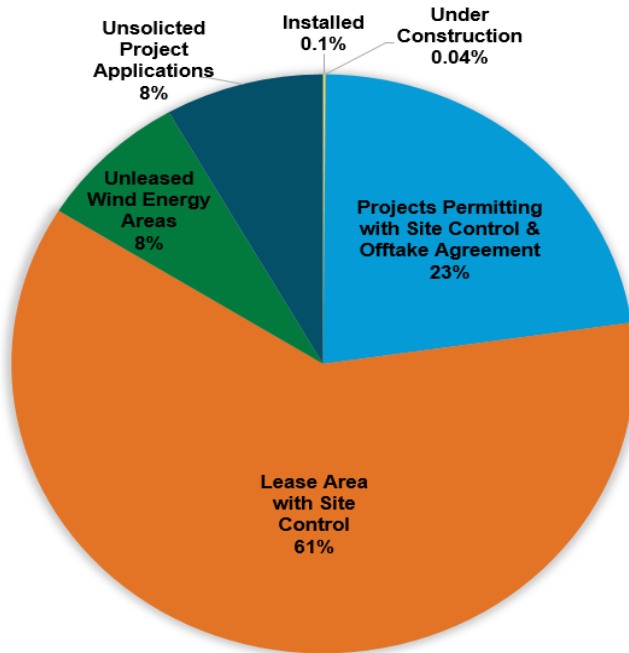
# Project Pipeline Classification System

Step	Phase Name	Start Criteria	End Criteria
1	Planning	Starts when a developer or regulatory agency initiates the formal site control process	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))
2	Site Control	Begins when a developer obtains site control (e.g., a lease or other contract)	Ends when the developer files major permit applications (e.g., a Construction and Operations Plan for projects in the United States)
3	Permitting = Site Control + Offtake Pathway	Starts when the developer files major permit applications (e.g., a Construction and Operations Plan and an offtake agreement for electricity production)	Ends when regulatory entities authorize the project to proceed with construction and certify its offtake agreement
4	Approved	Starts when a project receives regulatory approval for construction activities and its offtake agreement	Ends when sponsor announces a “financial investment decision” and has signed contracts for construction work packages
5	Financial Close	Begins when sponsor announces a financial investment decision and has signed contracts for major construction work packages	Ends when the project begins major construction work
6	Under Construction	Starts when construction is initiated	Ends when all wind turbines have been installed and the project is connected to and generating power to a land-based electrical grid
7	Operating	Commences when all wind turbines are installed and transmitting power to the grid; COD marks the official transition from construction to operation	Ends when the project has begun a formal process to decommission and stops feeding power to the grid
8	Decommissioned	Starts when the project has begun the formal process to decommission and stops transmitting power to the grid	Ends when the site has been fully restored and lease payments are no longer being made
9	On Hold/Cancelled	Starts if a sponsor stops development activities, discontinues lease payments, or abandons a prospective site	Ends when a sponsor restarts project development activity

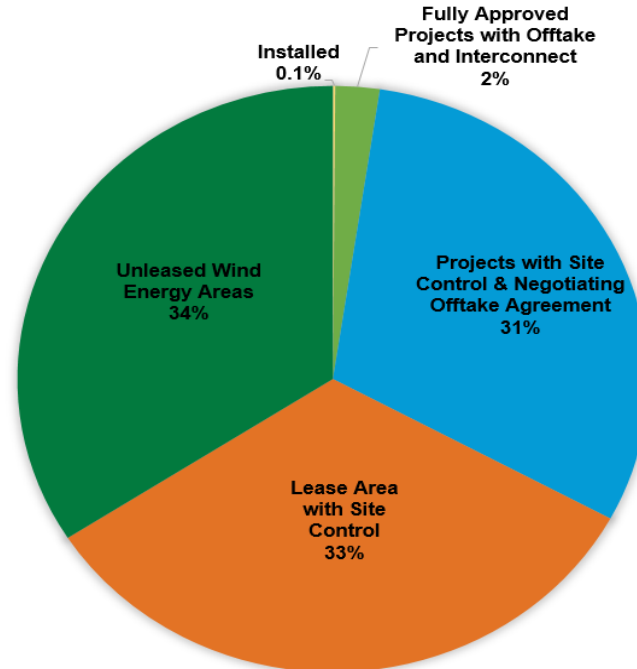
# U.S. Offshore Wind Data

# Percentages of U.S. Offshore Wind Energy Pipeline for 2019 and 2020 by Classification Category

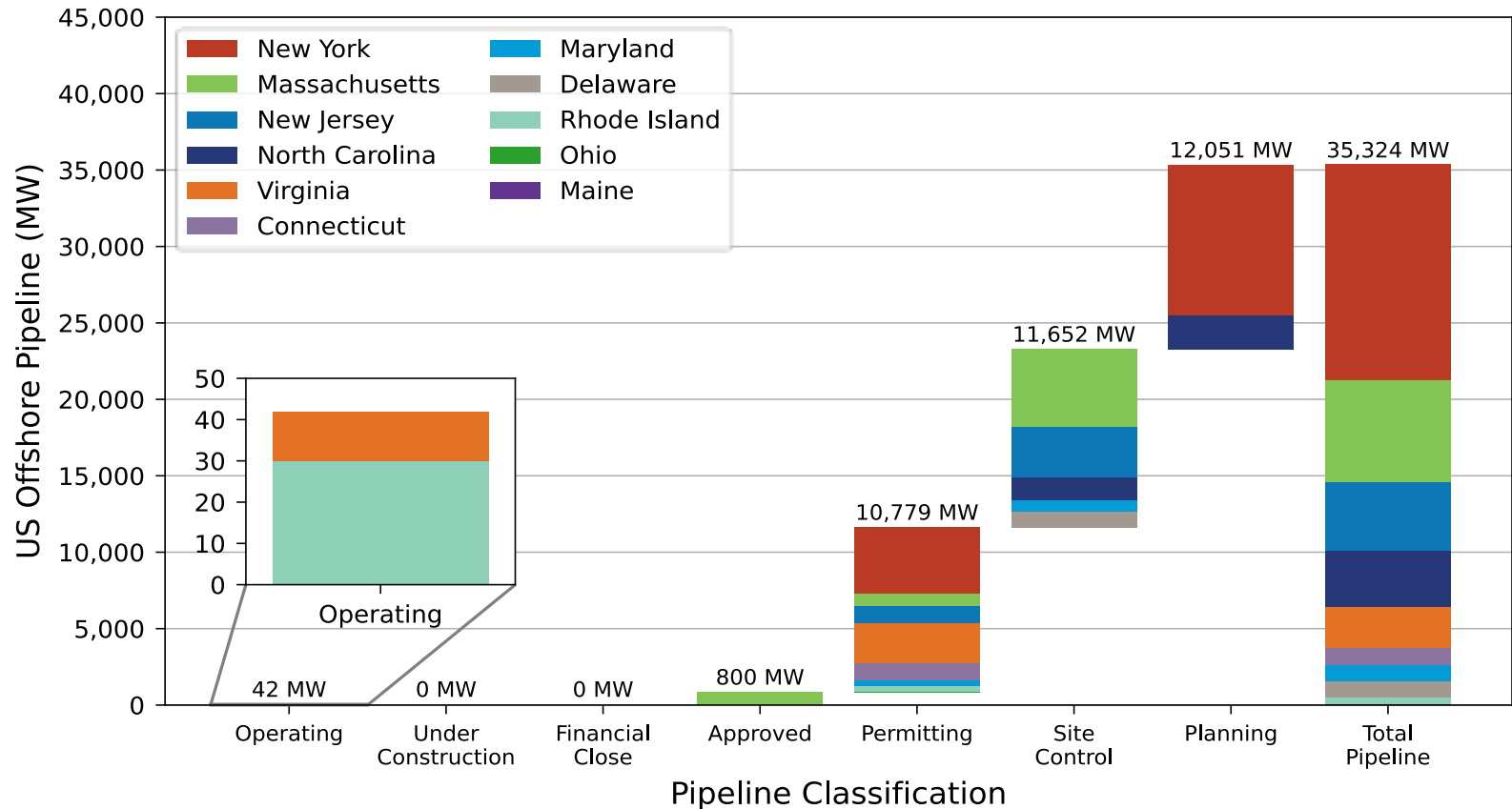
**2019 Pipeline – 25,821 Megawatts (MW)**



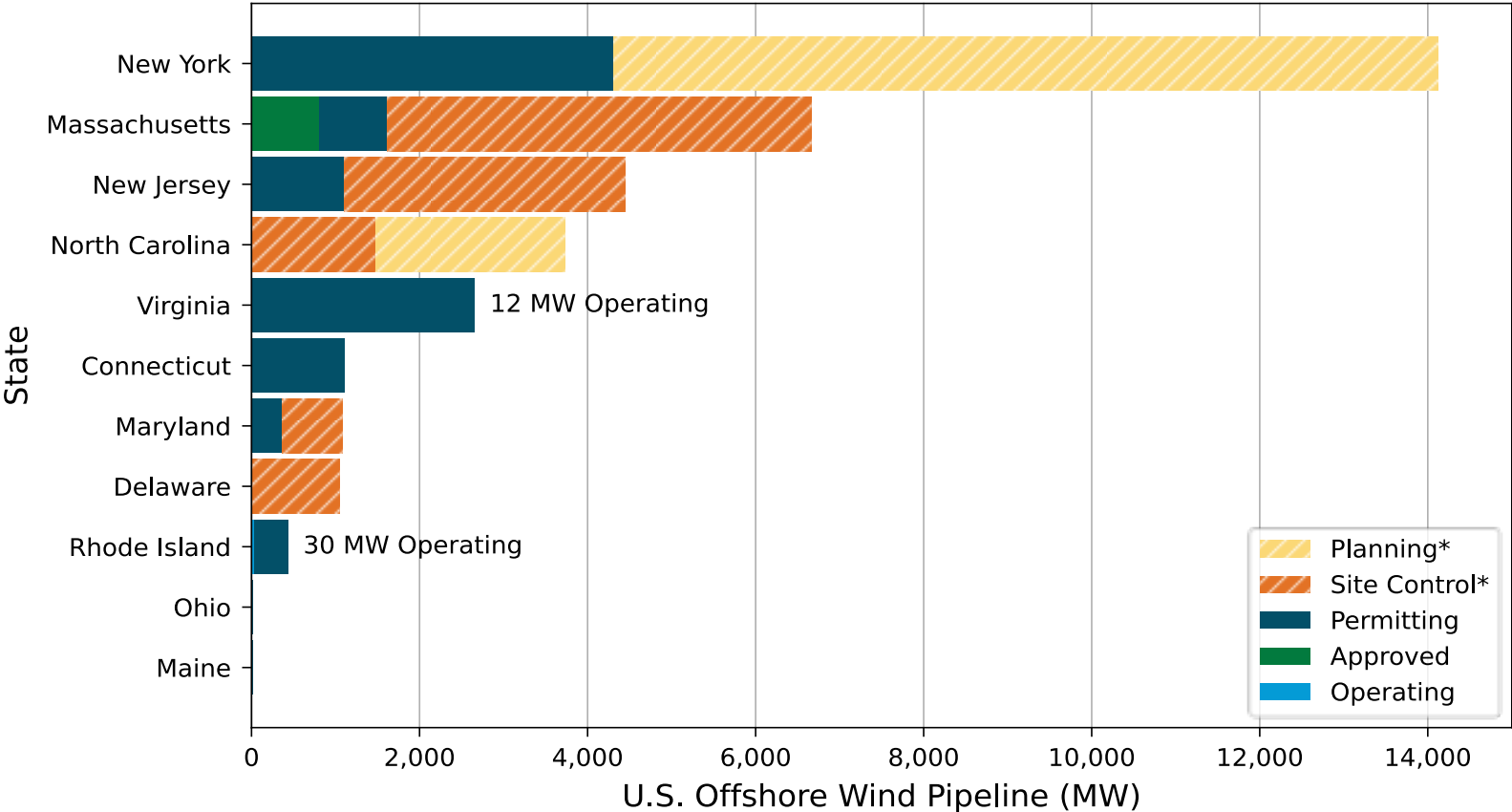
**2020 Pipeline – 35,324 MW**



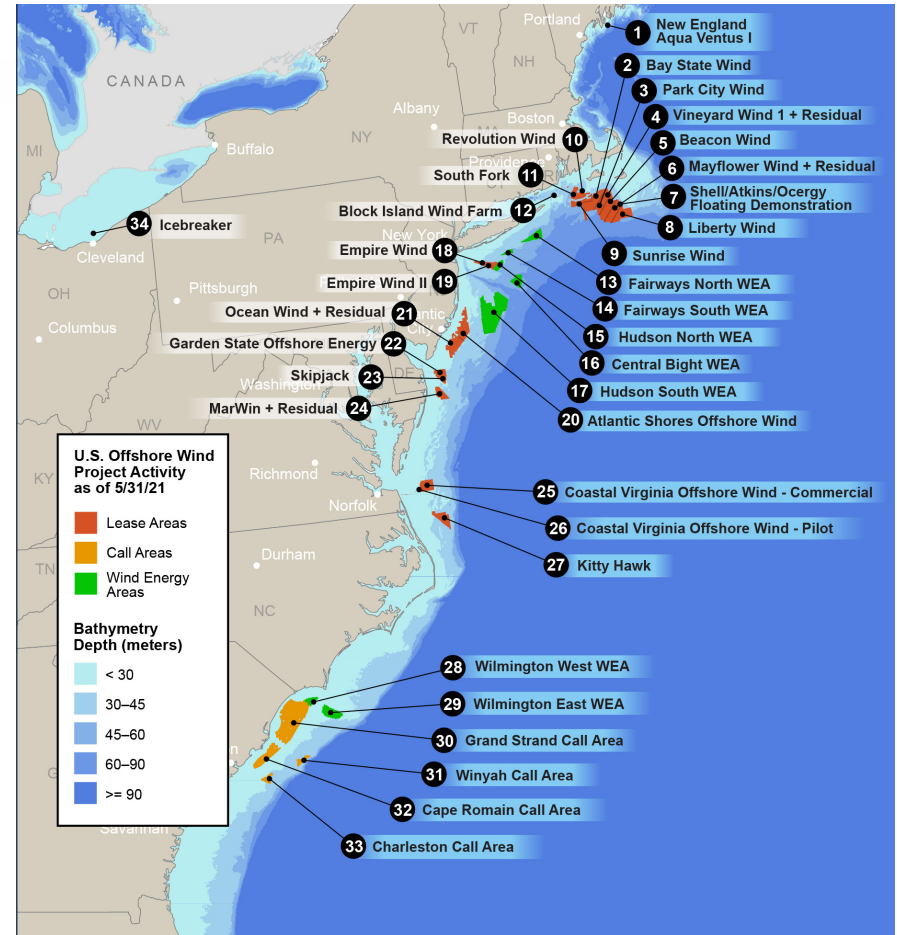
# U.S. Project Pipeline Classification by State



# U.S. Project Pipeline by State

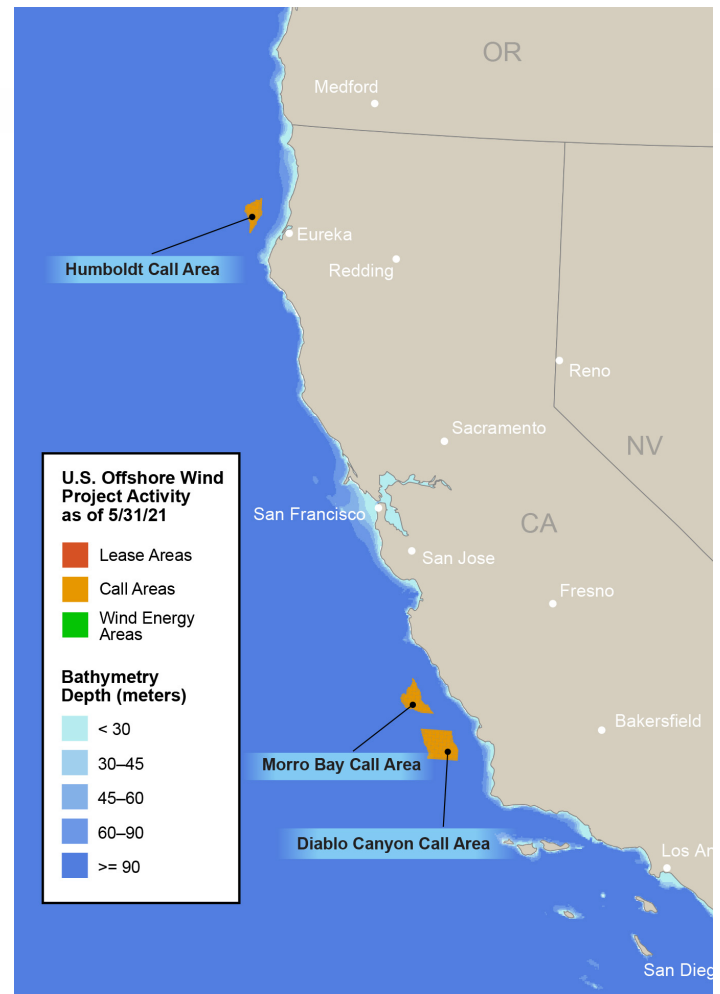


# U.S. Atlantic Coast Offshore Wind Energy Pipeline and Call Areas



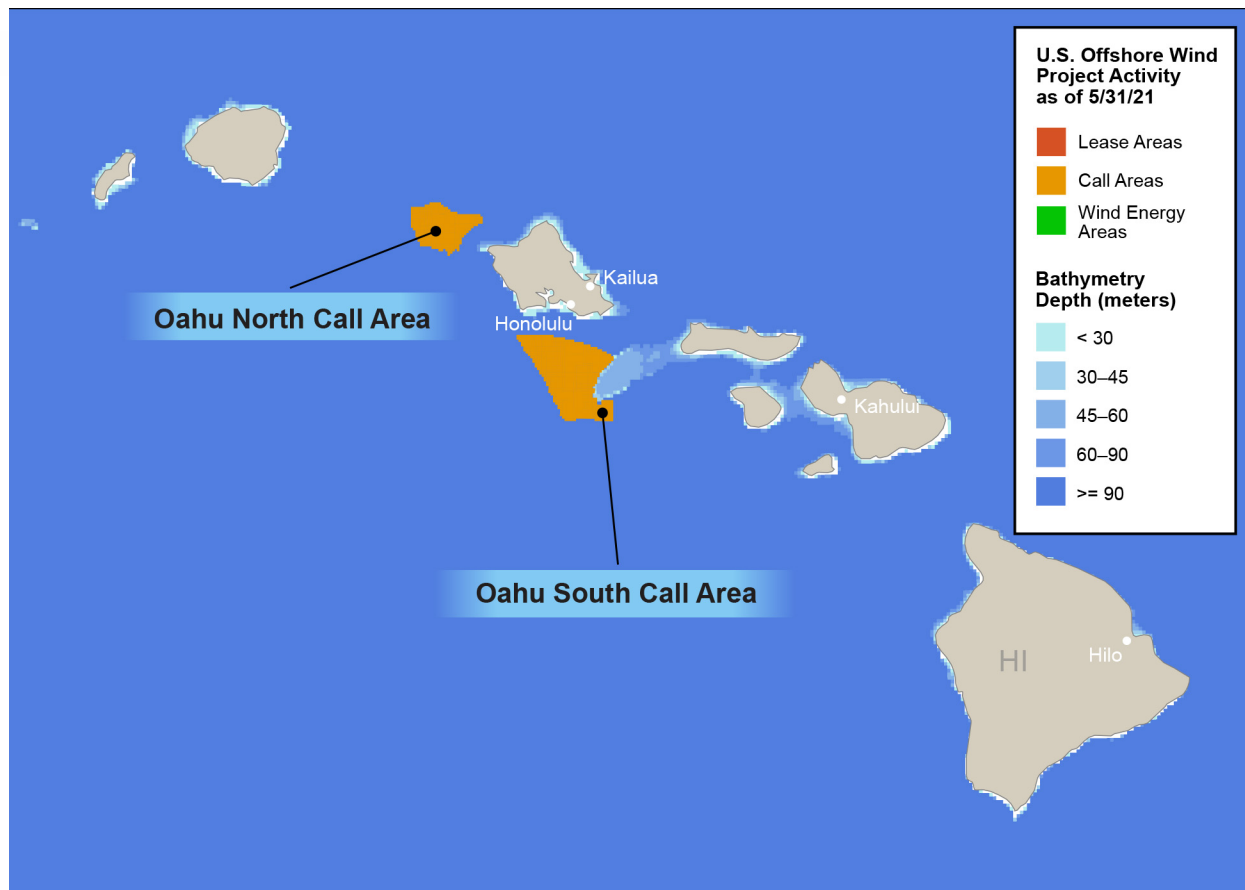
Map created by the National Renewable Energy Laboratory (NREL)

# U.S. West Coast Offshore Wind Call Areas



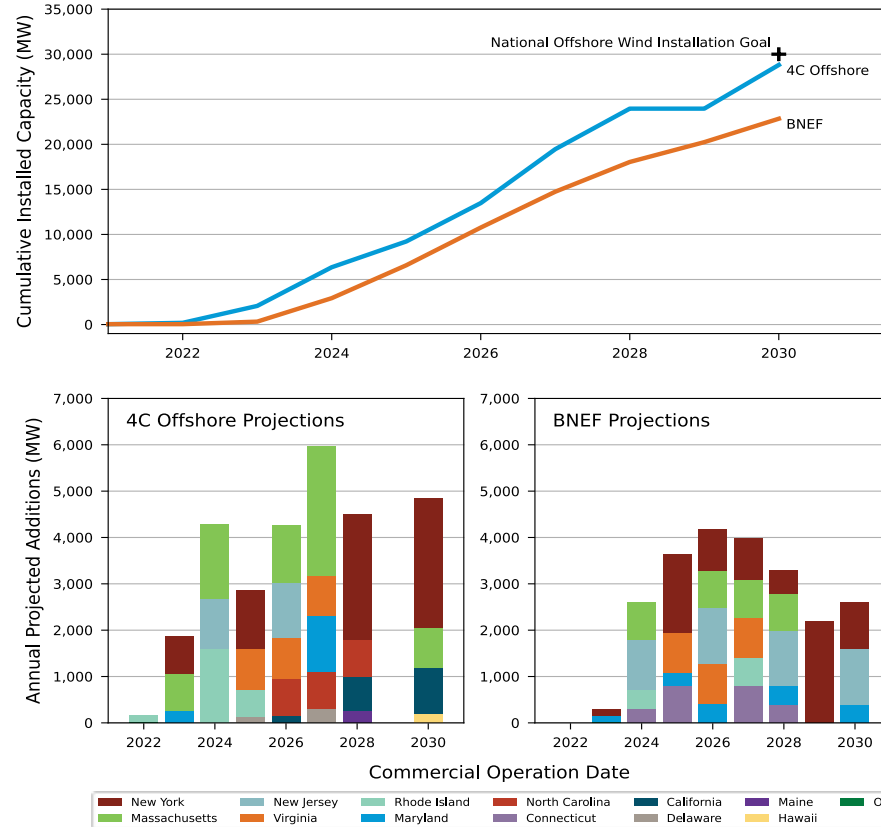
Map created by NREL

# Hawaiian Offshore Wind Call Areas

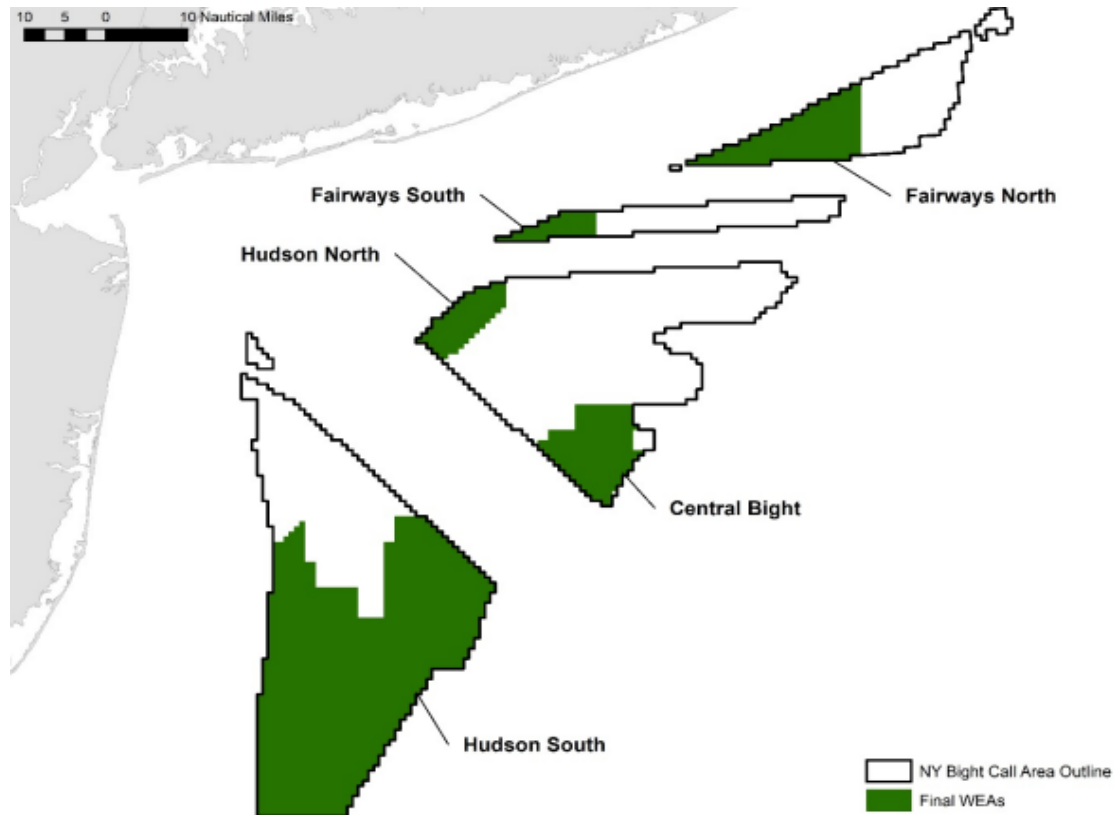


Map created by NREL

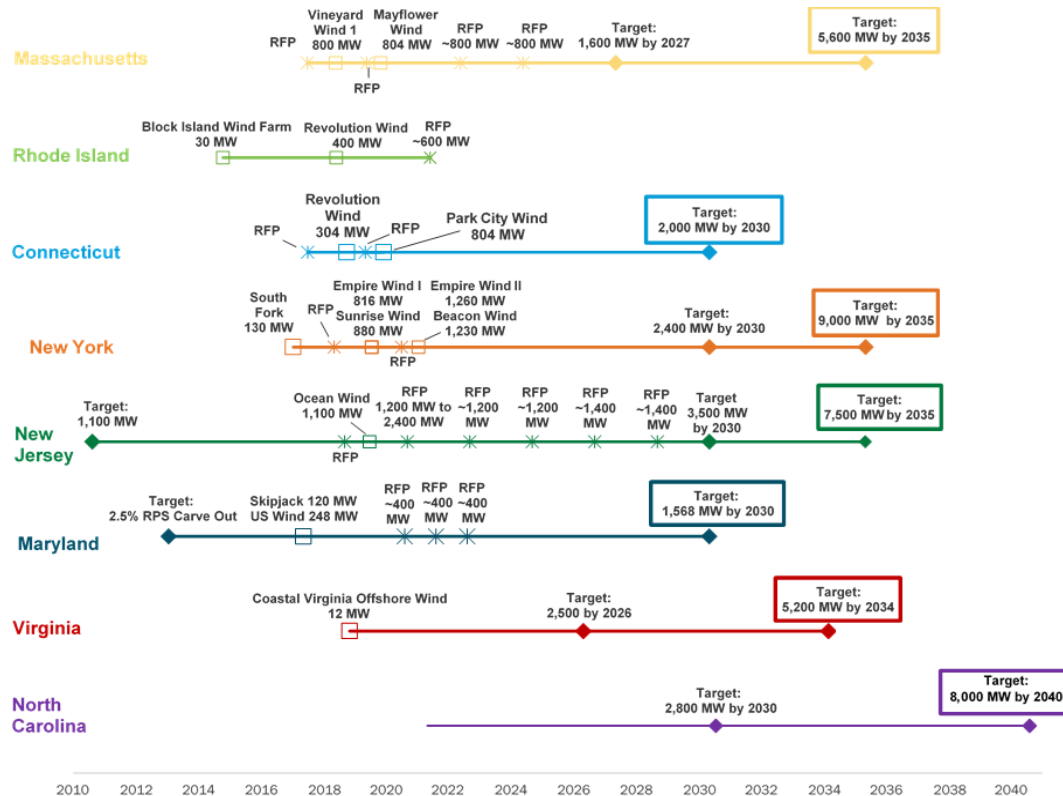
# Industry Forecasts for U.S. Offshore Wind Energy Deployment to 2030 Including the National Goal



# New York Bight Wind Energy Areas (WEAs)



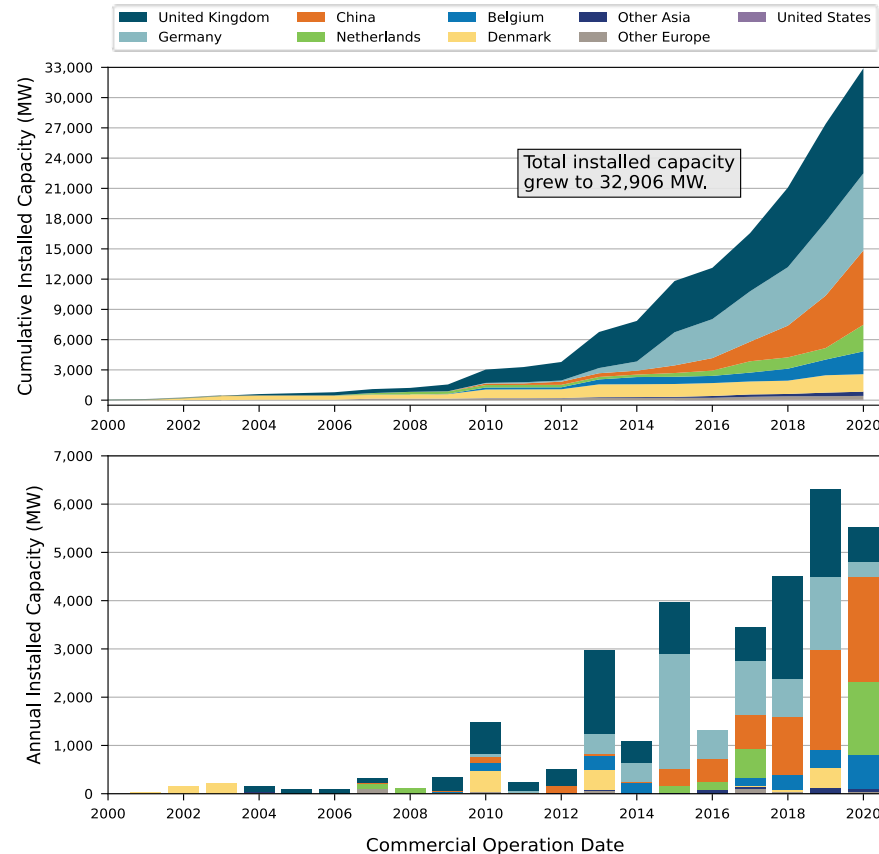
# U.S. Offshore Wind State Procurement Targets and Timelines



RFP=request for proposals

# Global Offshore Wind Data

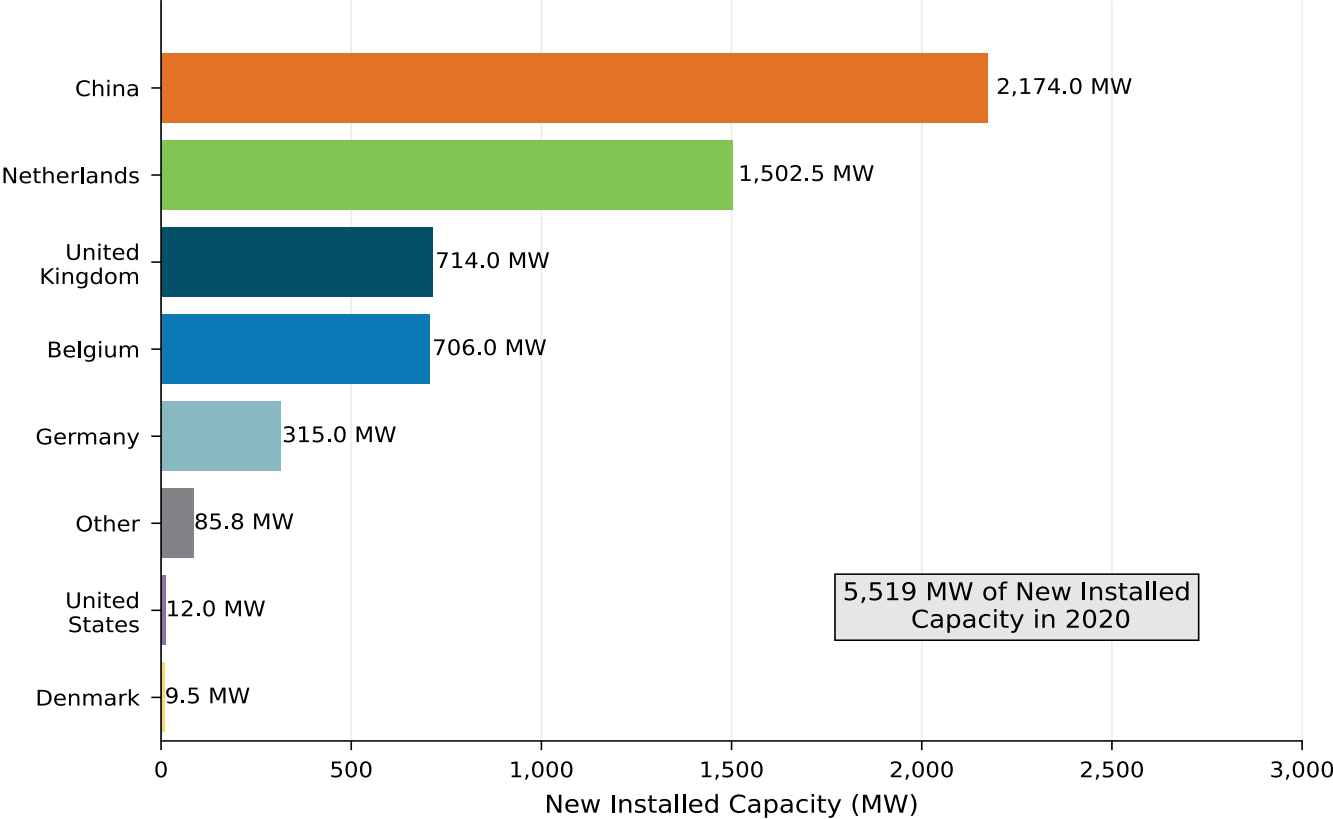
# Global Cumulative Offshore Wind Deployment and Annual Capacity Additions in 2020



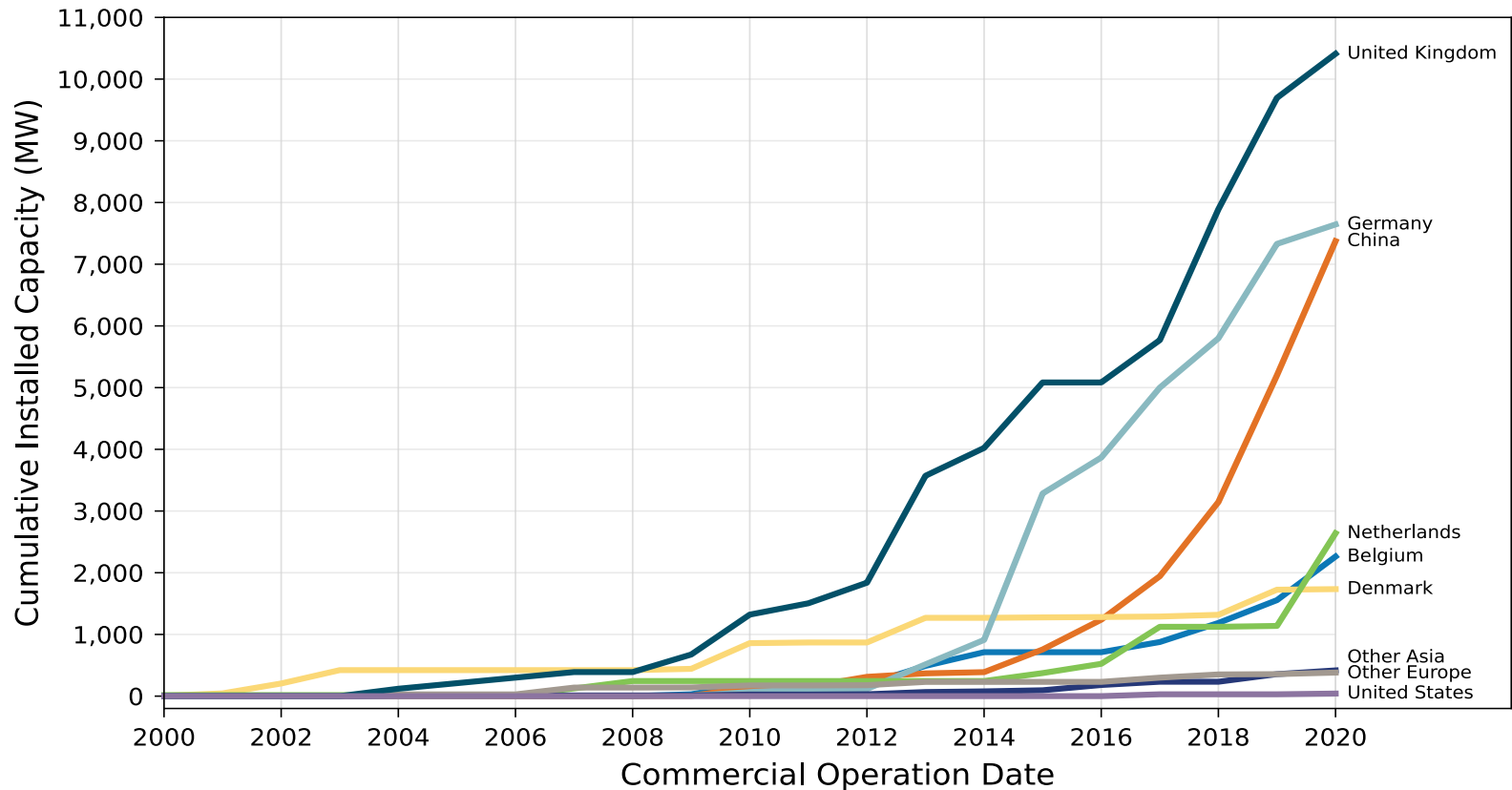
Global Cumulative  
Offshore Wind  
Deployment

Annual Capacity  
Additions

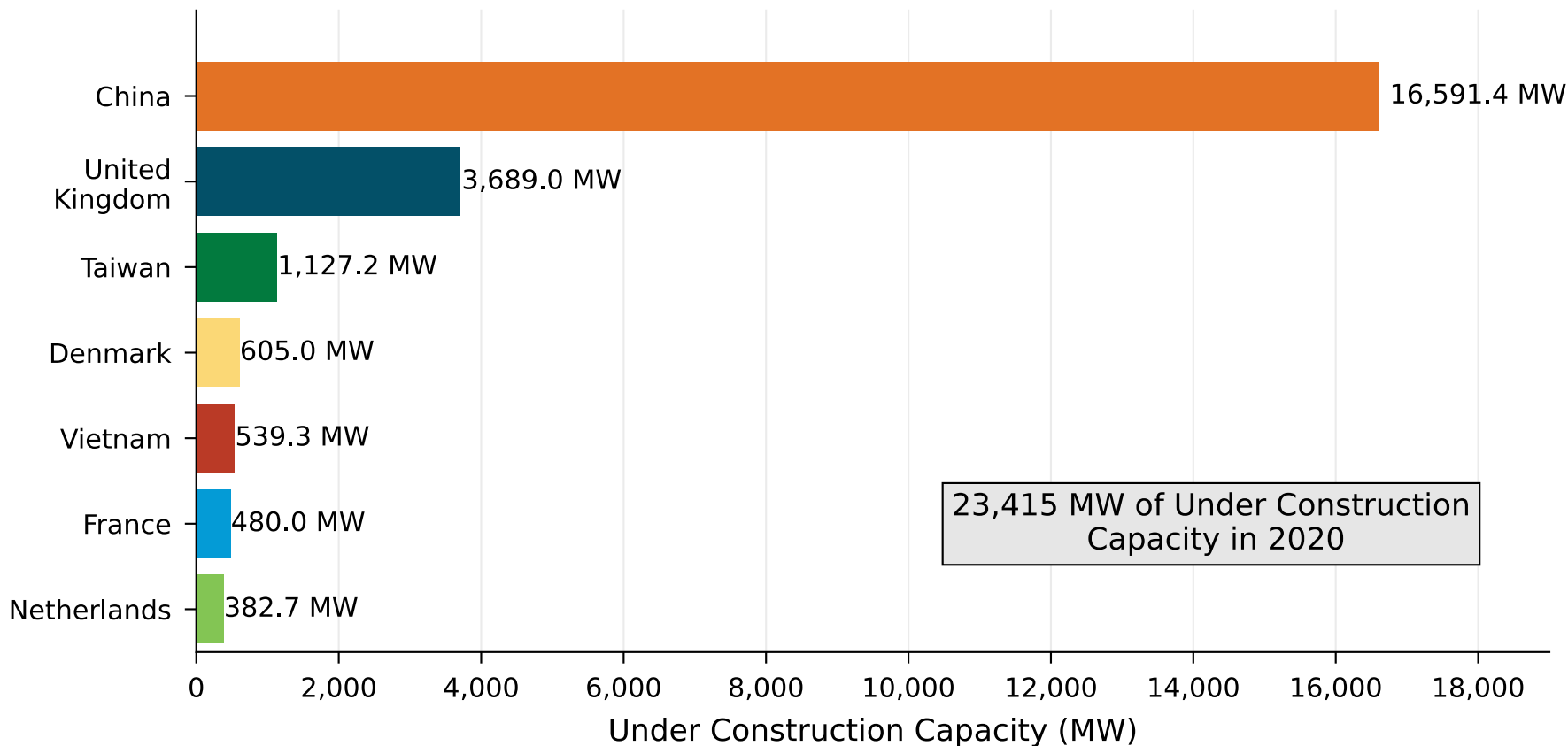
# Global Offshore Wind Installations in 2020



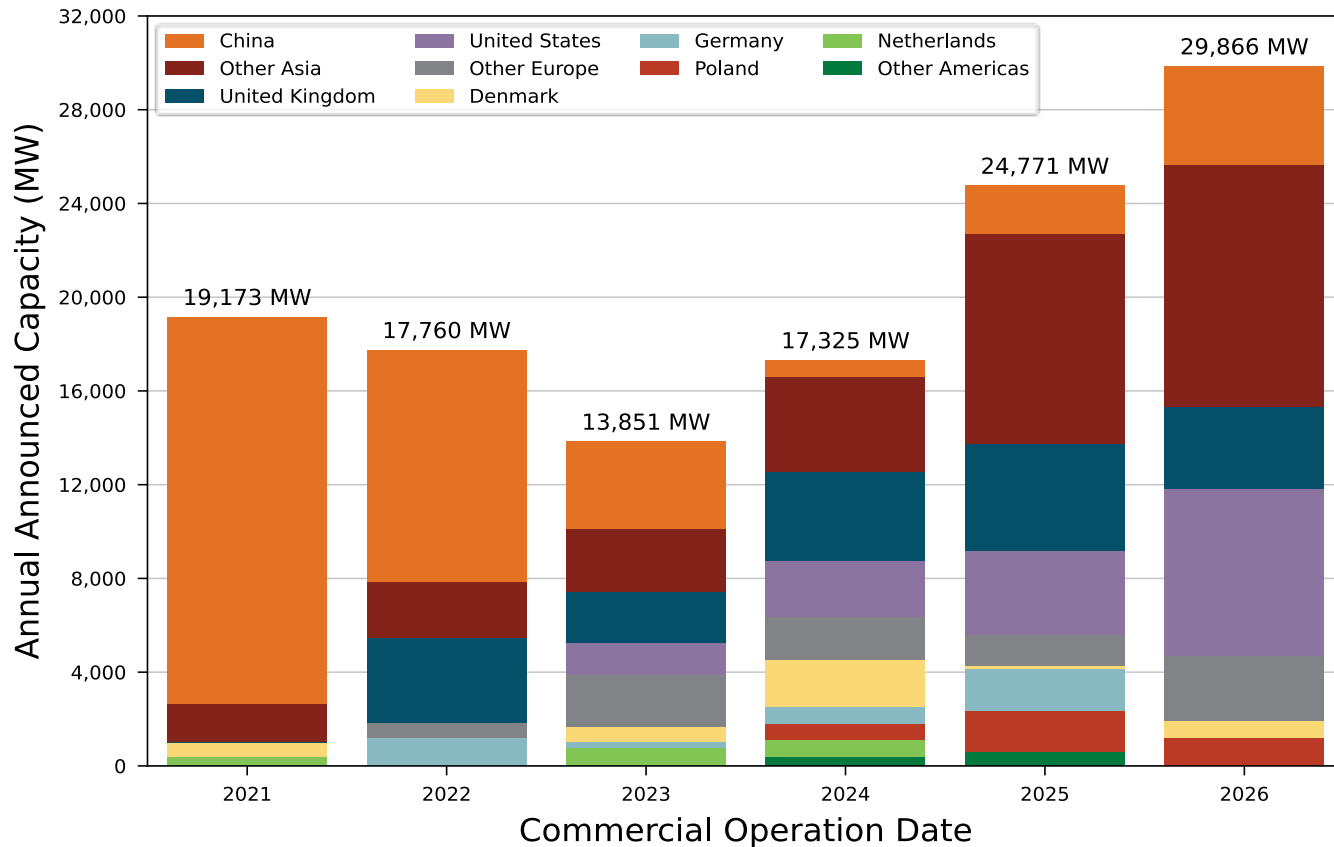
# Global Cumulative Offshore Wind Installation by Country



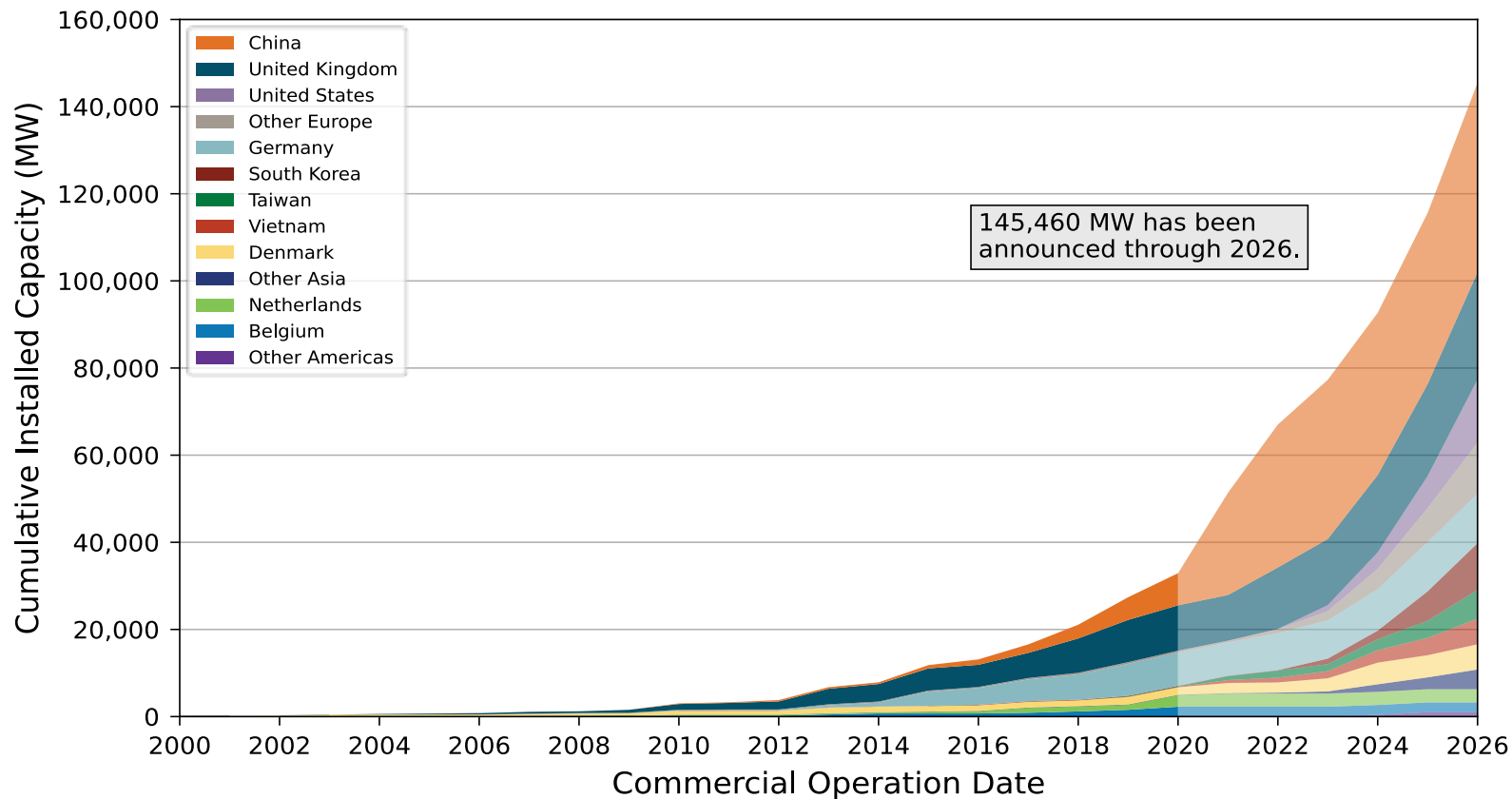
# Offshore Wind Capacity Under Construction by Country as of 2020



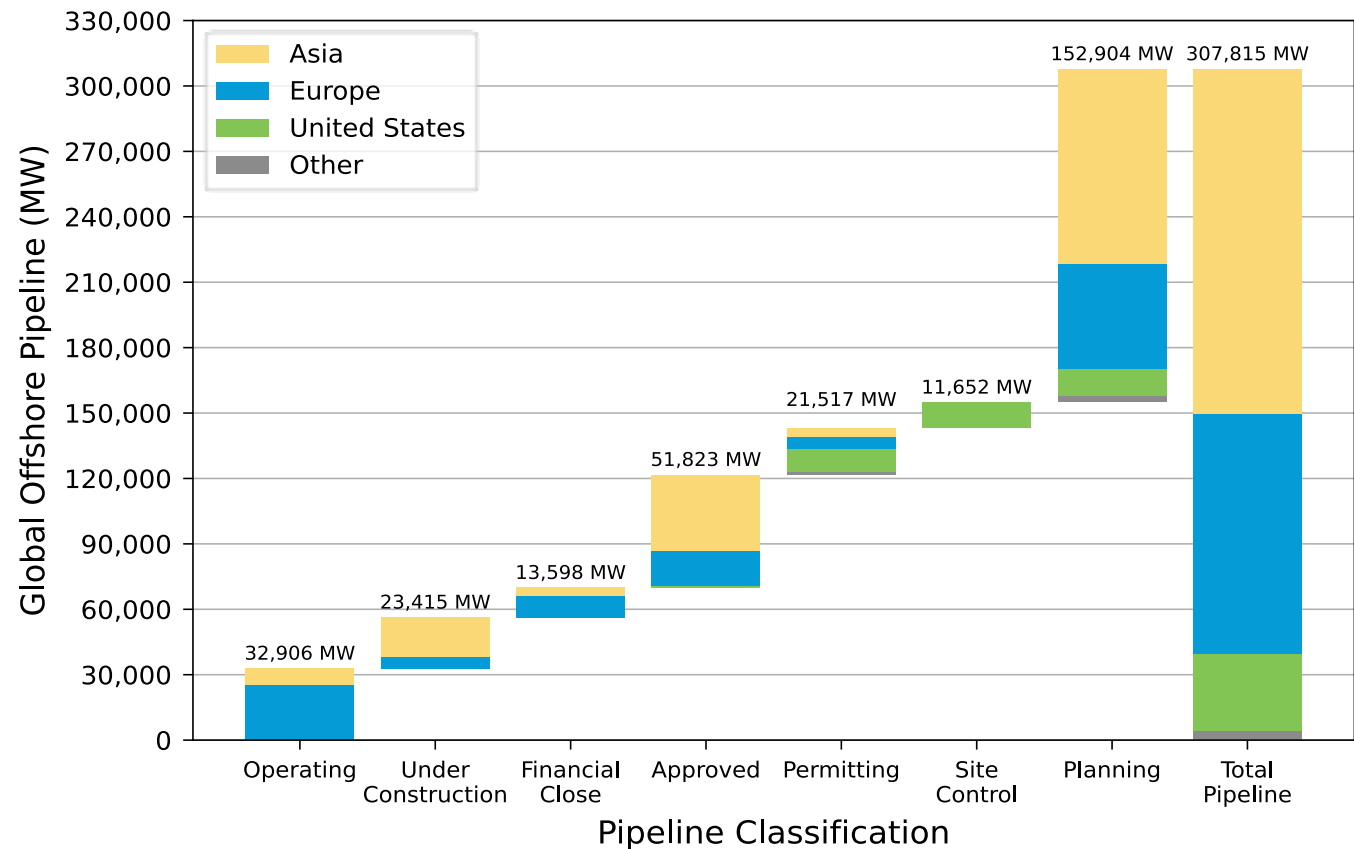
# Developer-Announced Offshore Wind Capacity through 2026 for Projects with Financial Closure



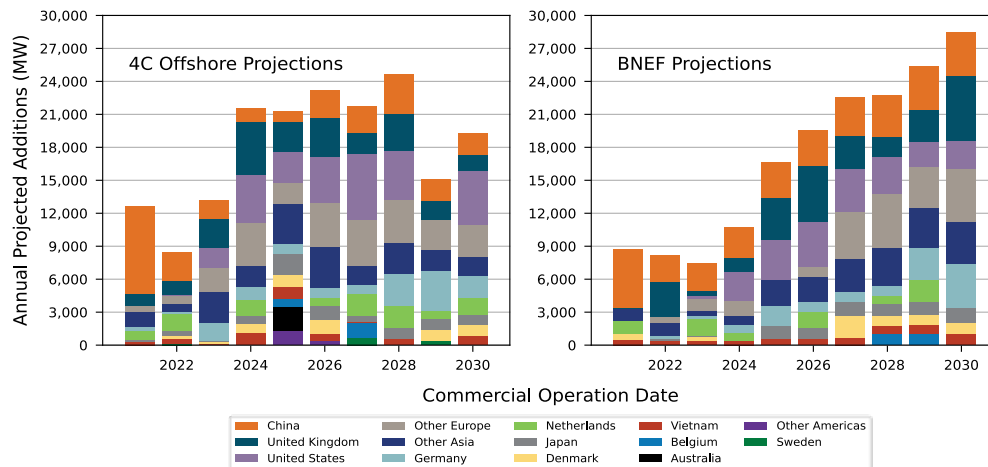
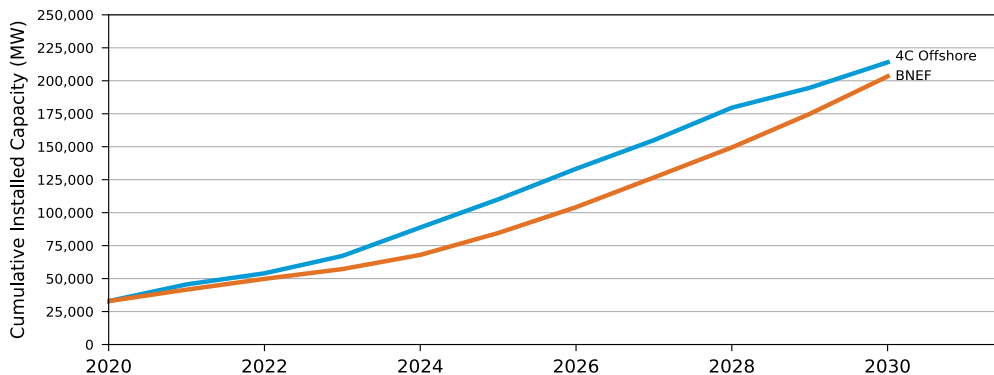
# Estimated 2026 Cumulative Offshore Wind Capacity by Country Based on a Developer-Announced Commercial Operation Date



# Total Global Pipeline by Status

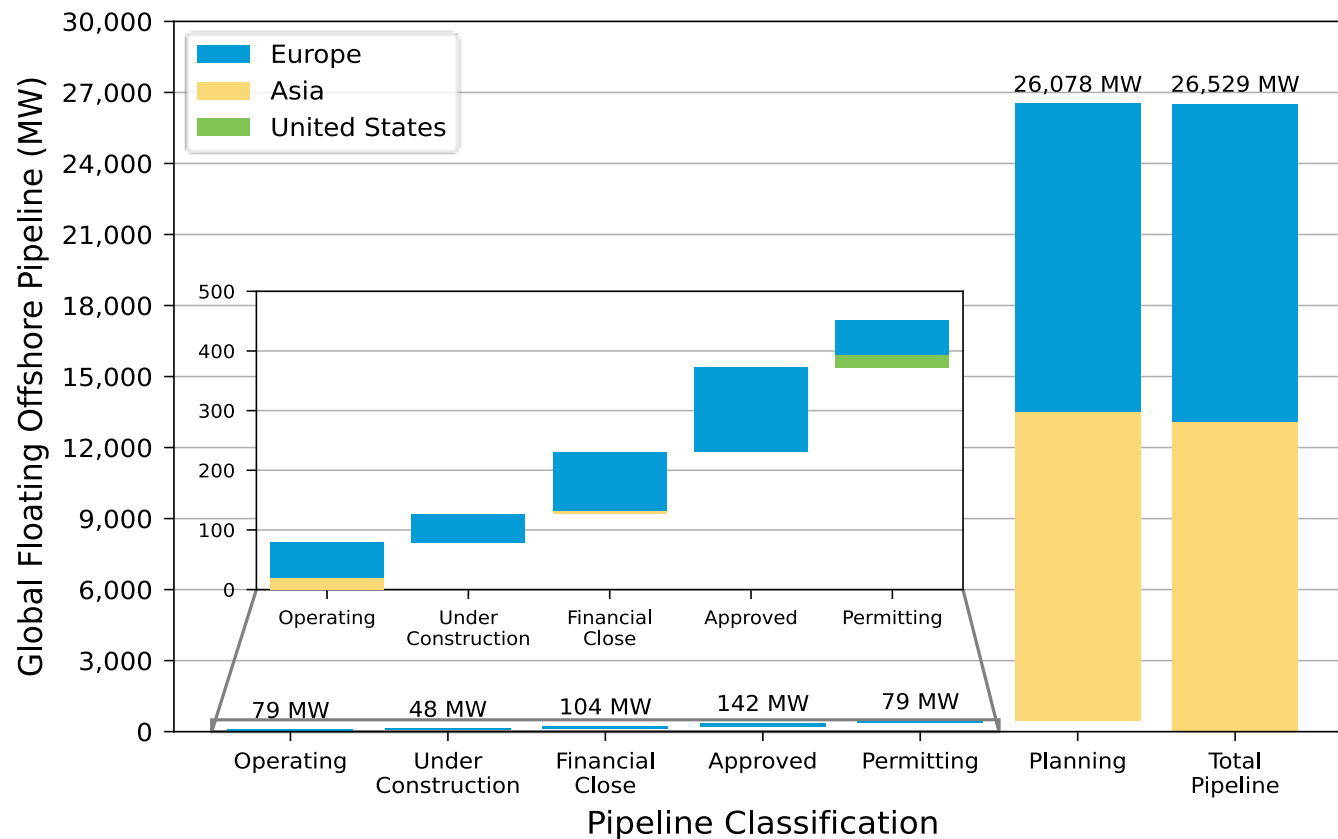


# Industry Forecasts for Global Offshore Wind Energy Deployment to 2030

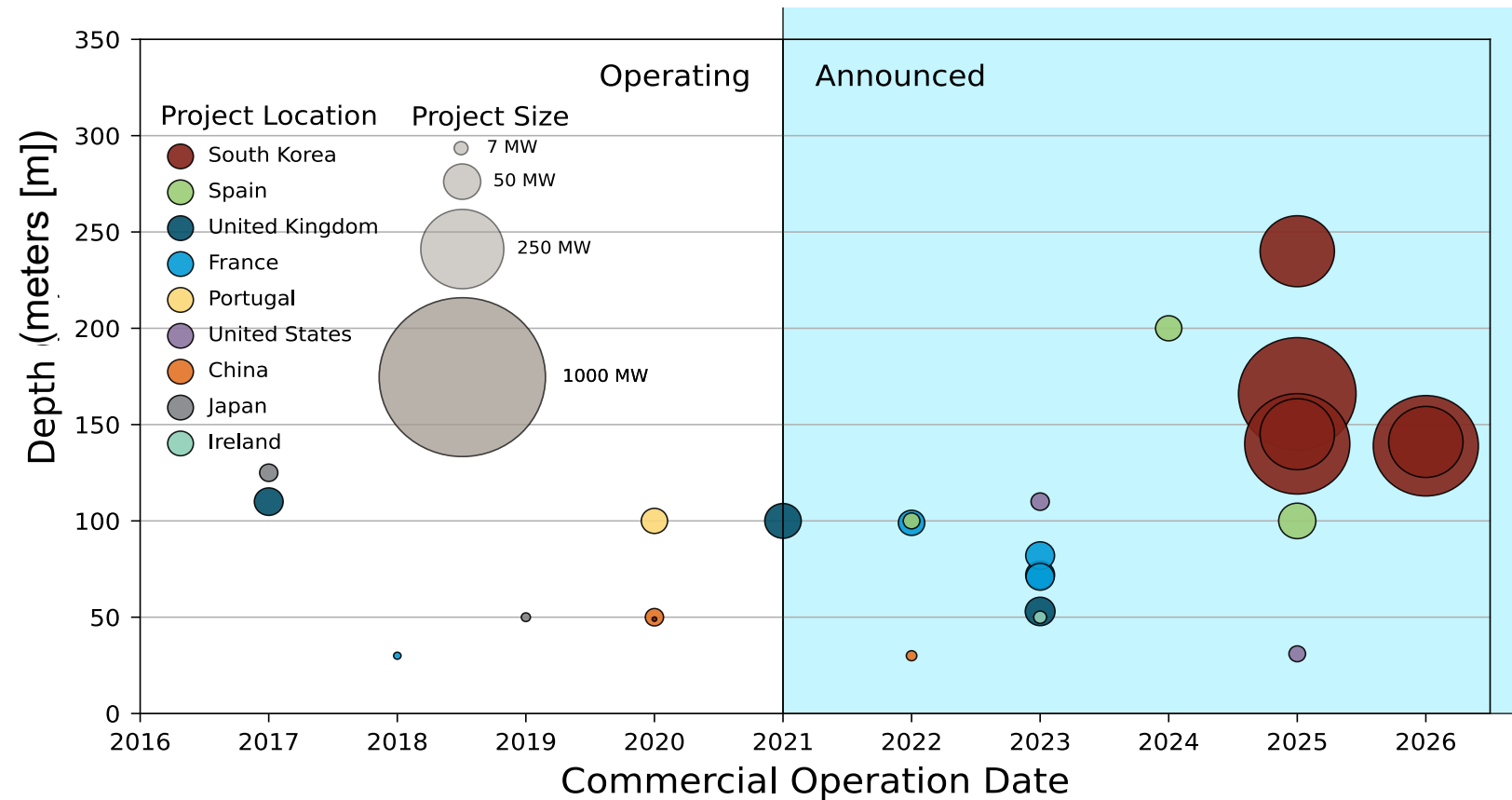


# Global Floating Offshore Wind Data

# Total Global Floating Offshore Wind Energy Pipeline

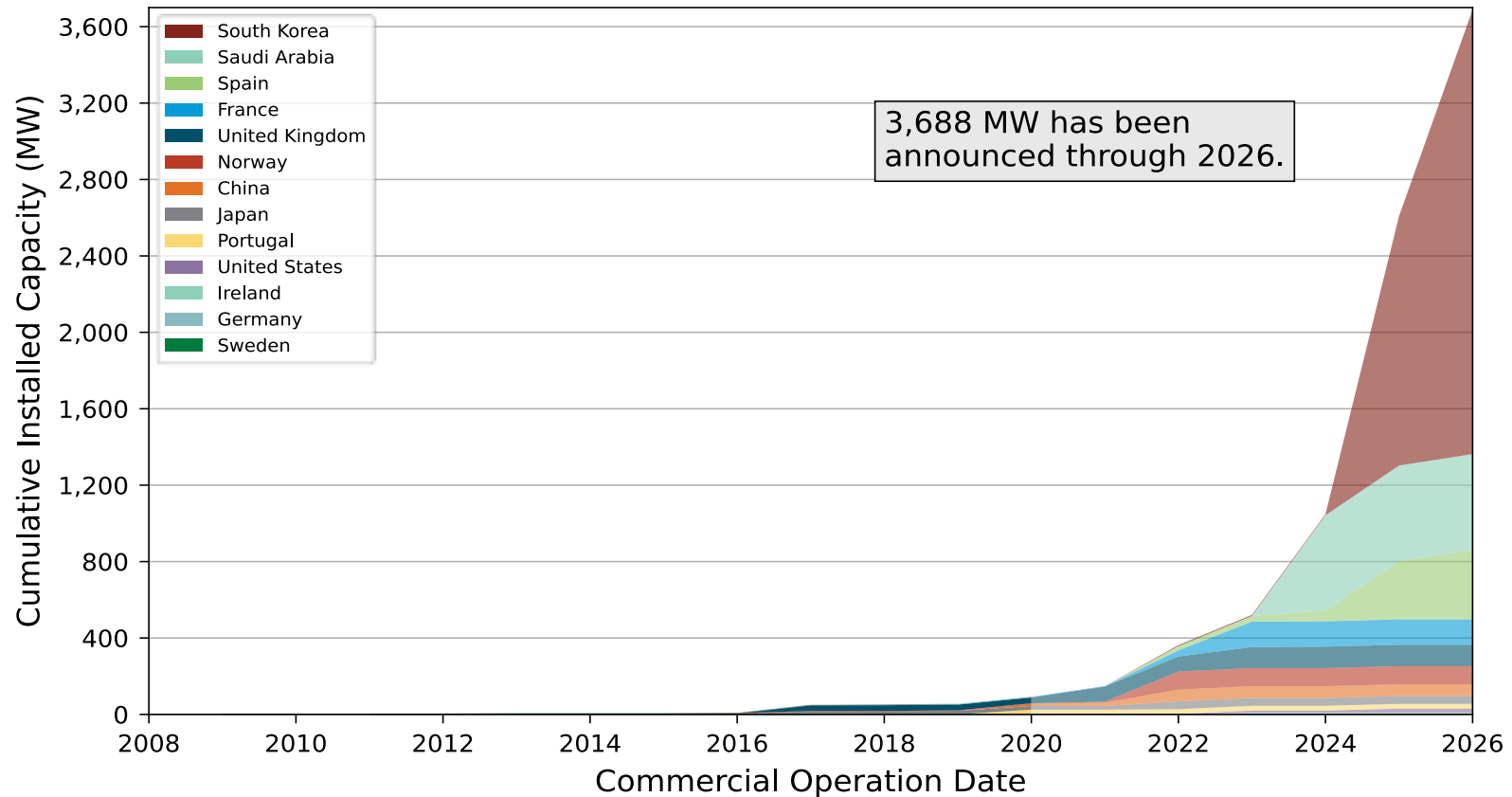


# Global Floating Offshore Wind Energy Projects by Depth, Country, and Project Size



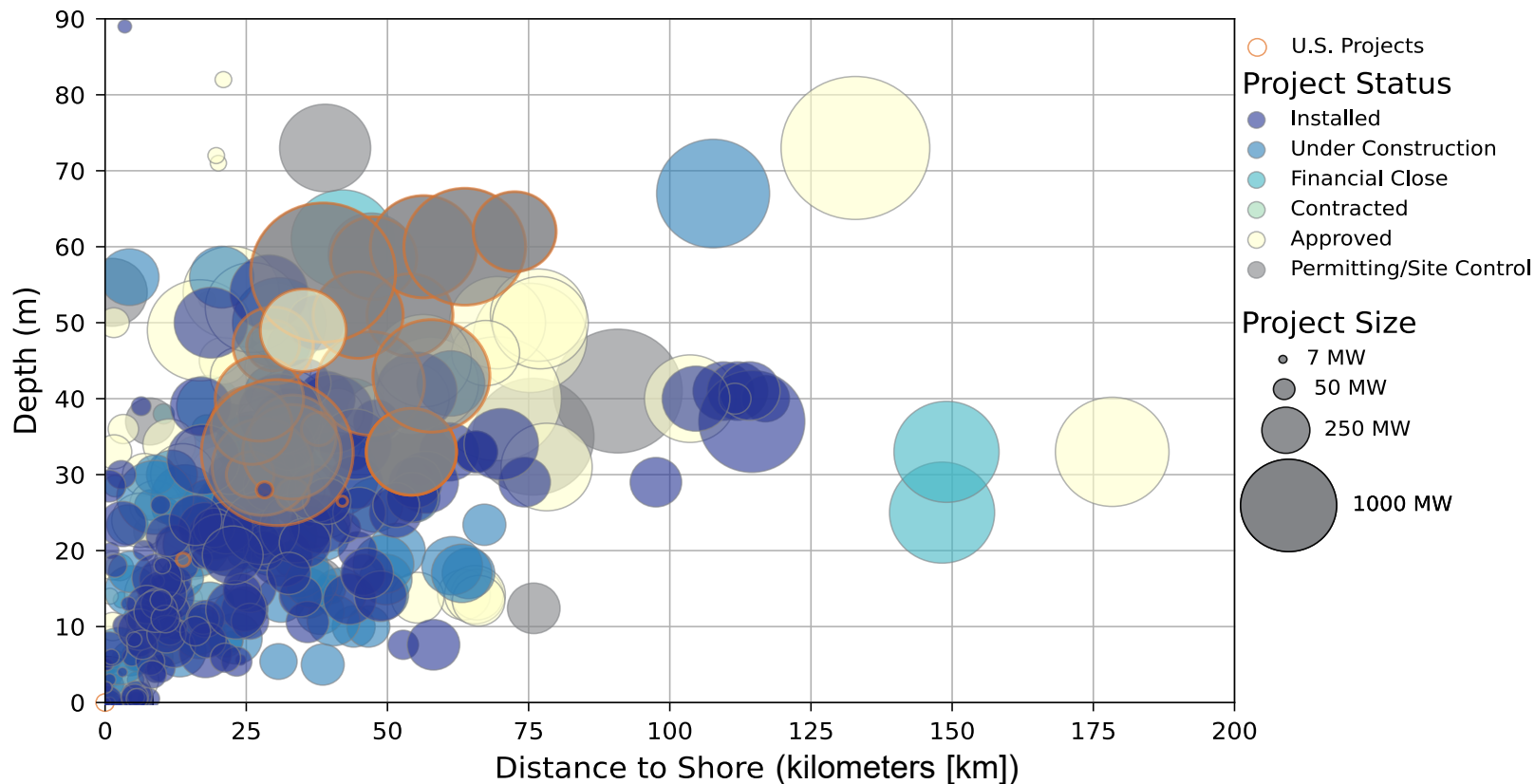
# Cumulative Floating Offshore Wind Capacity by Country

## Based on Announced Commercial Operation Date through 2026

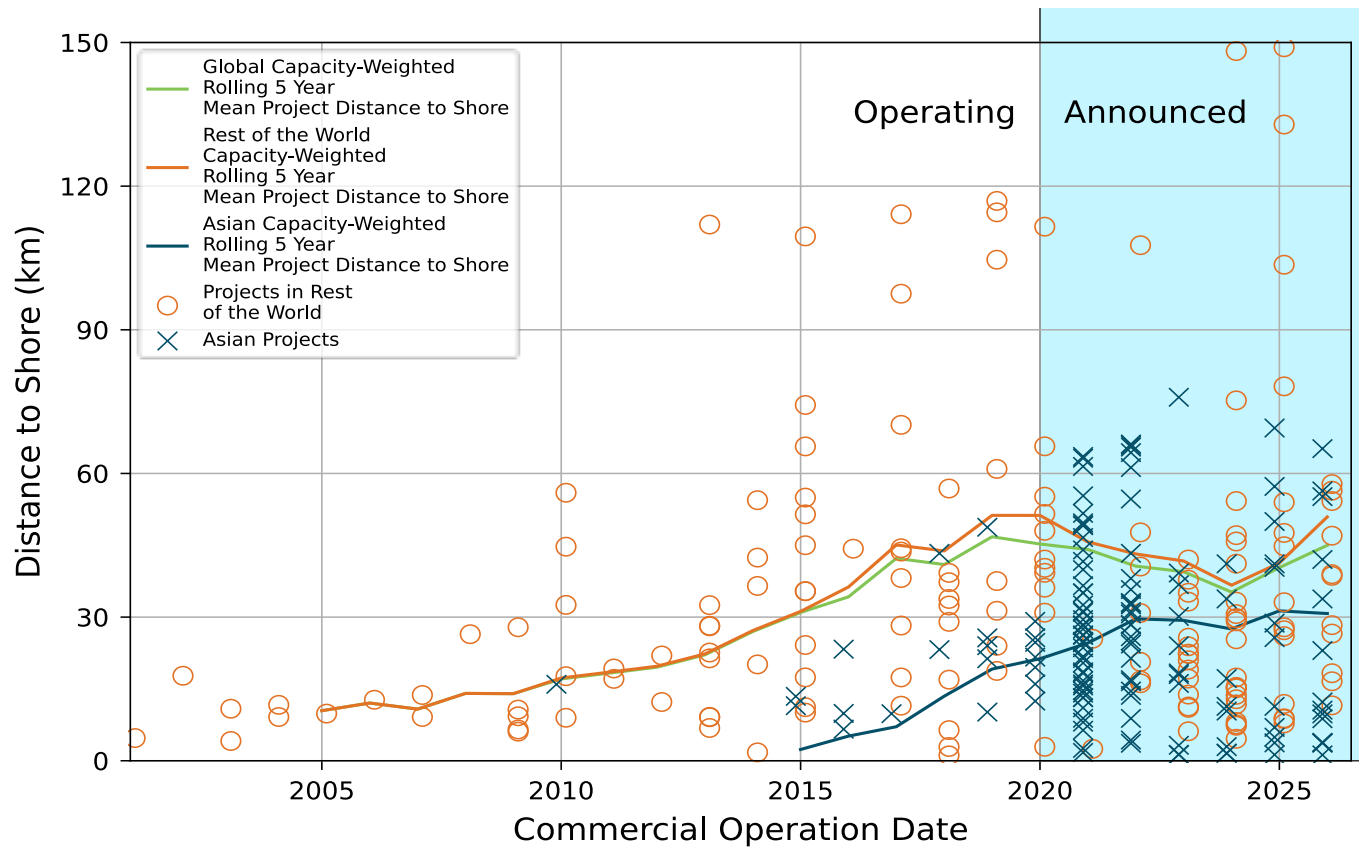


# 2020 Offshore Wind Technology Trends

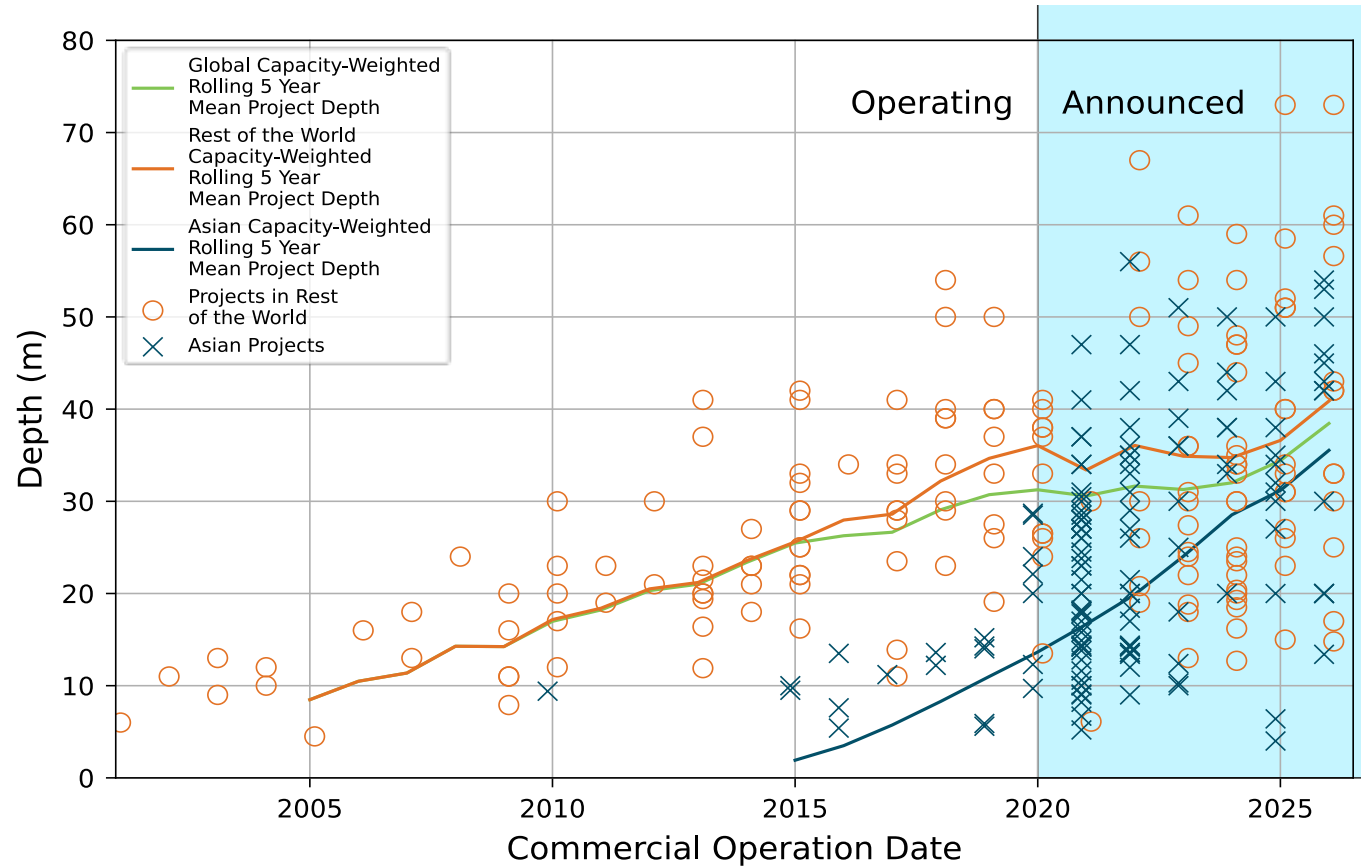
# Fixed-Bottom Offshore Wind Energy Project Depths and Distances to Shore



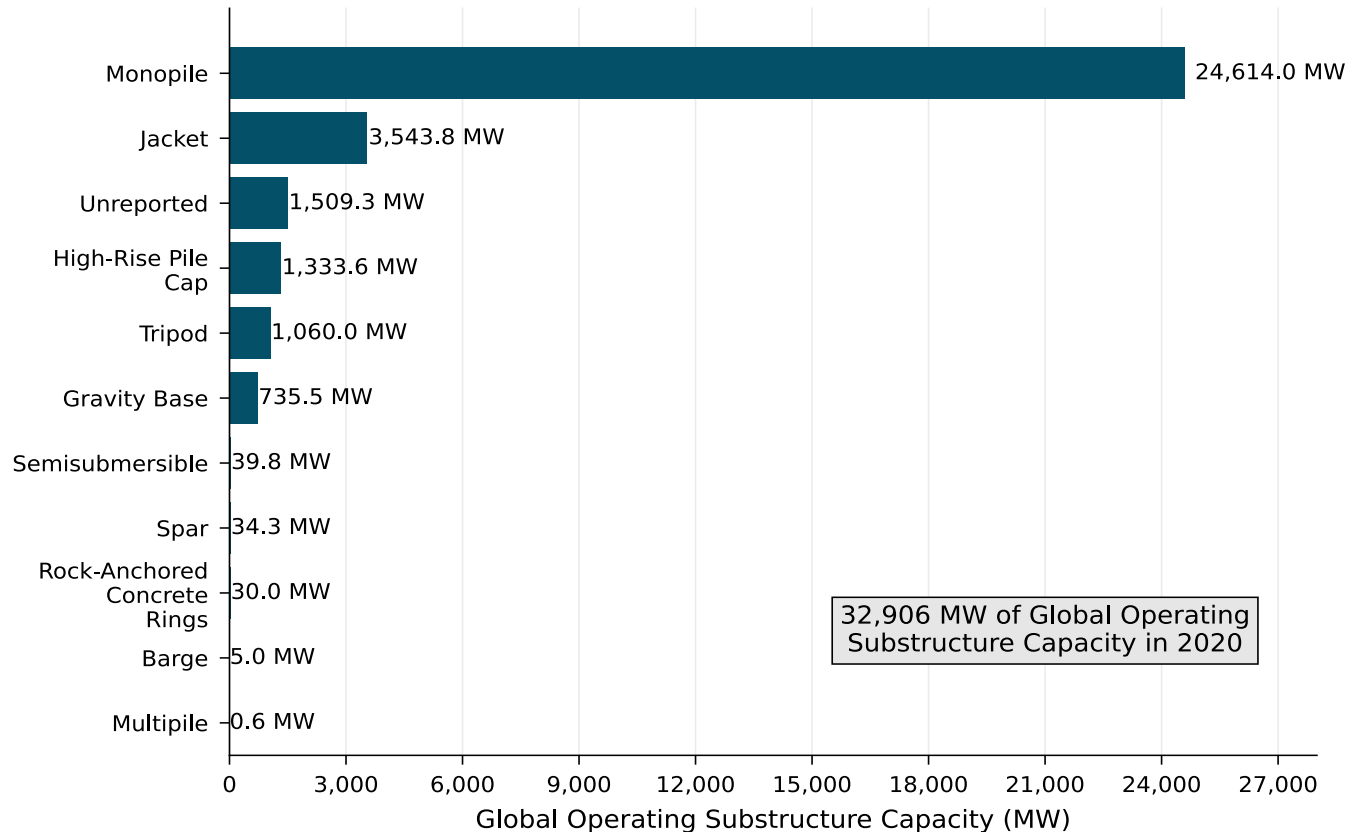
# Distance From Shore for Global Operating and Future Offshore Wind Energy Projects



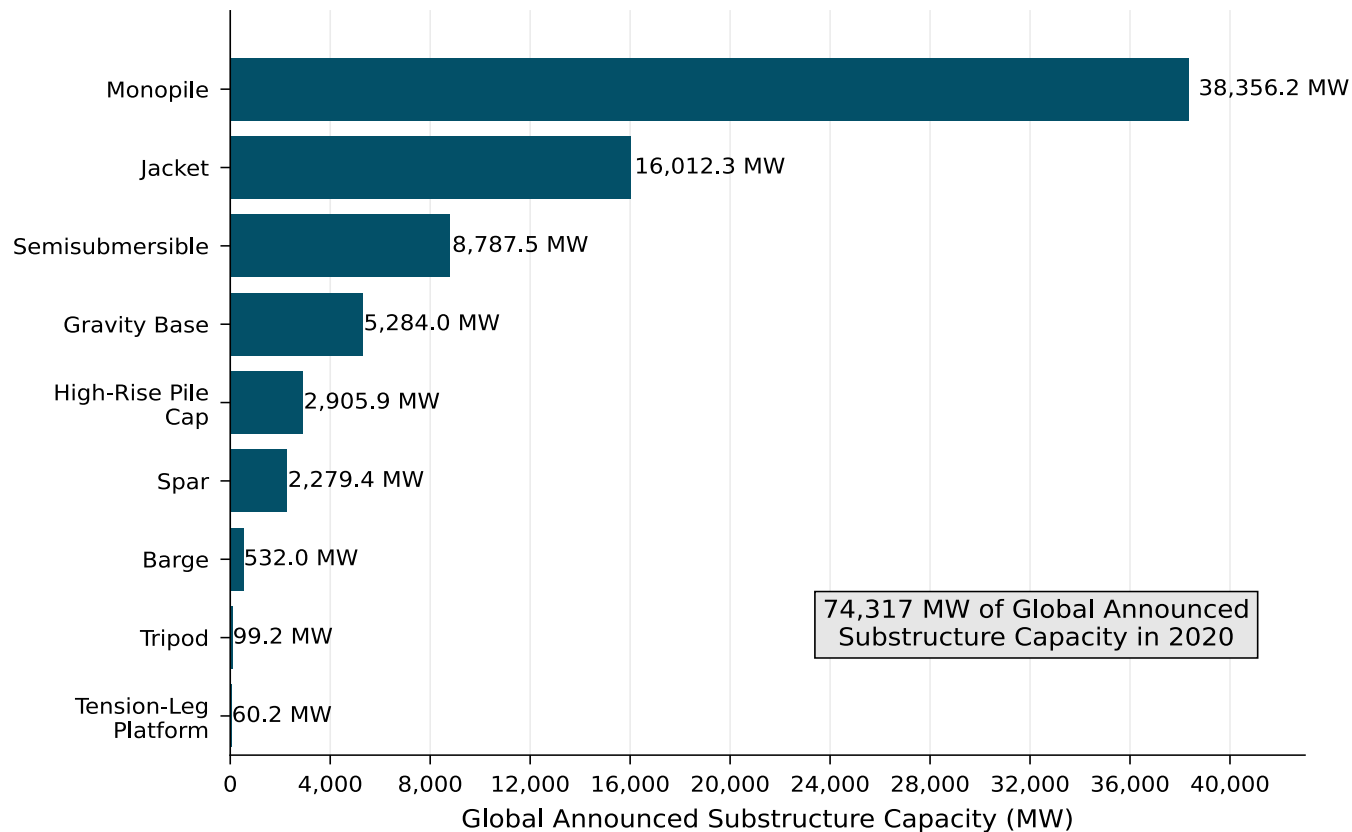
# Water Depth for Global Operating and Future Projects



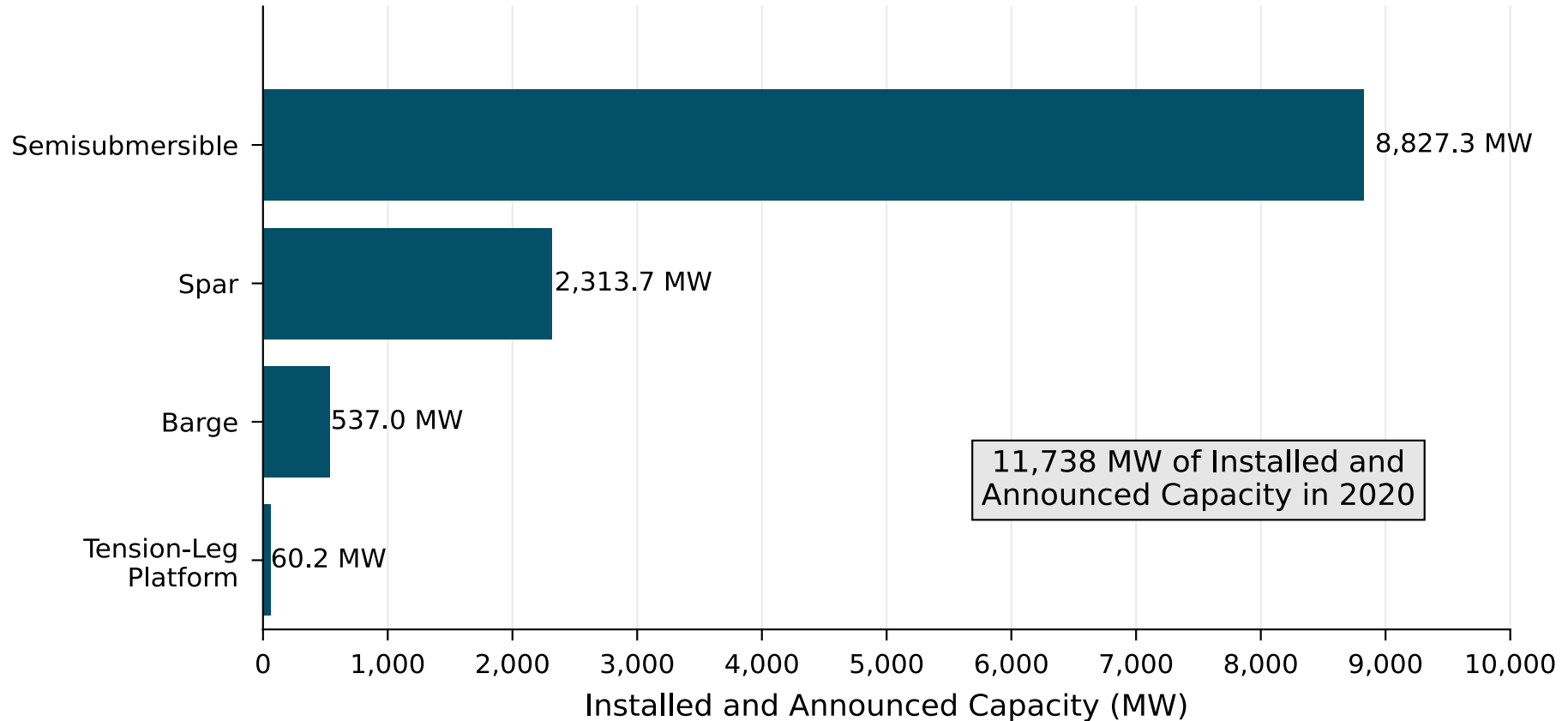
# Offshore Wind Substructure Technology Used in Operating Projects



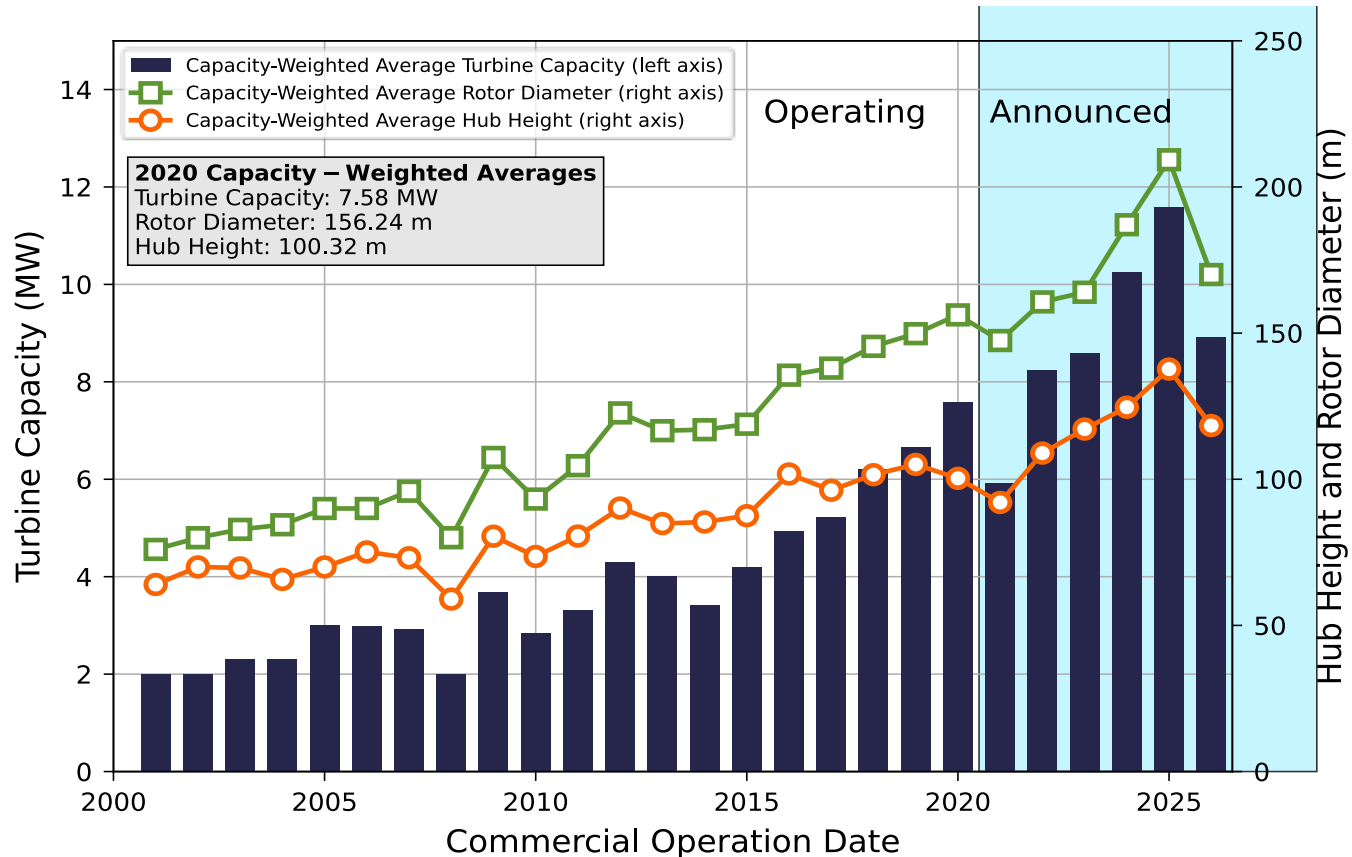
# Announced Offshore Wind Substructure Technology Market Share



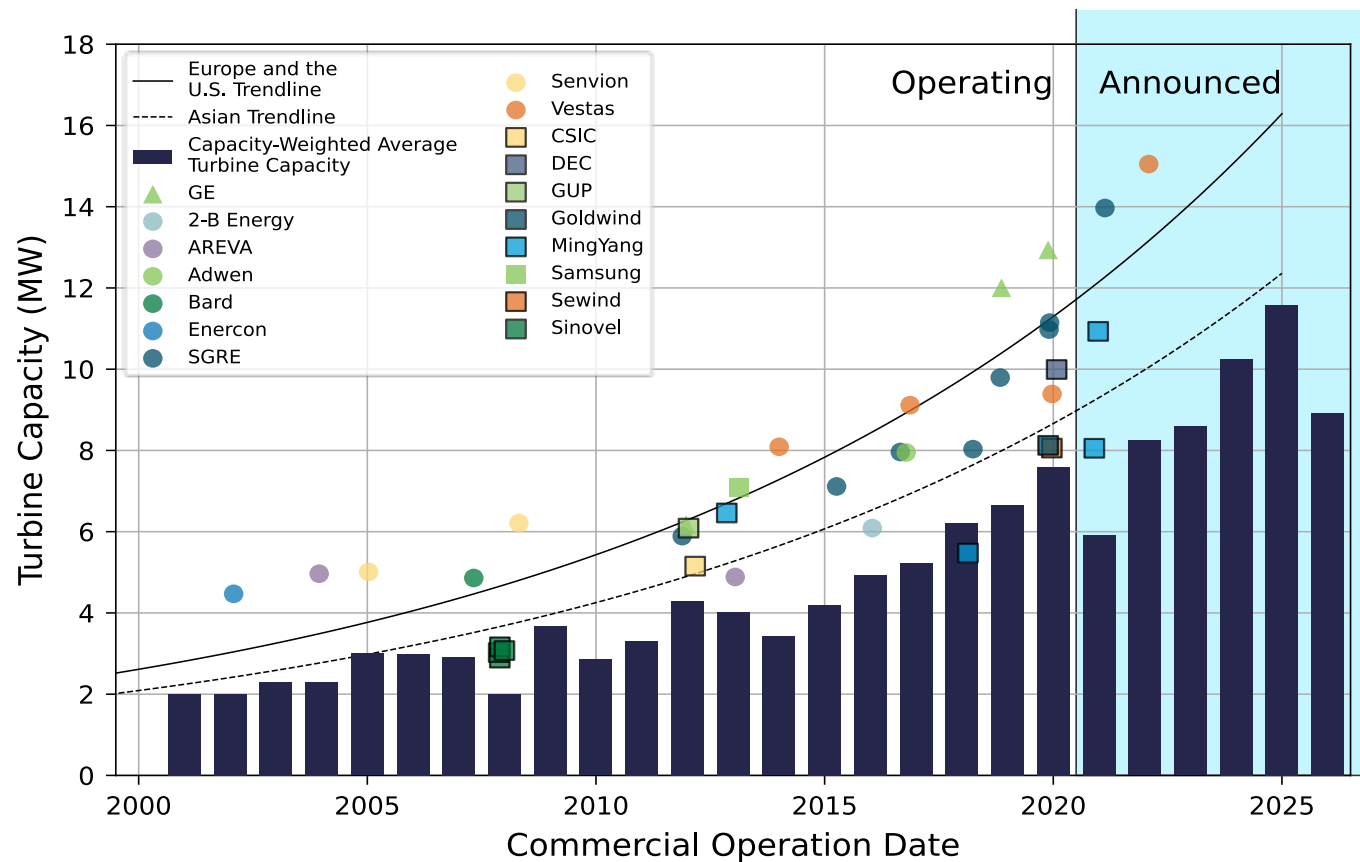
# Global Floating Substructure Market Share



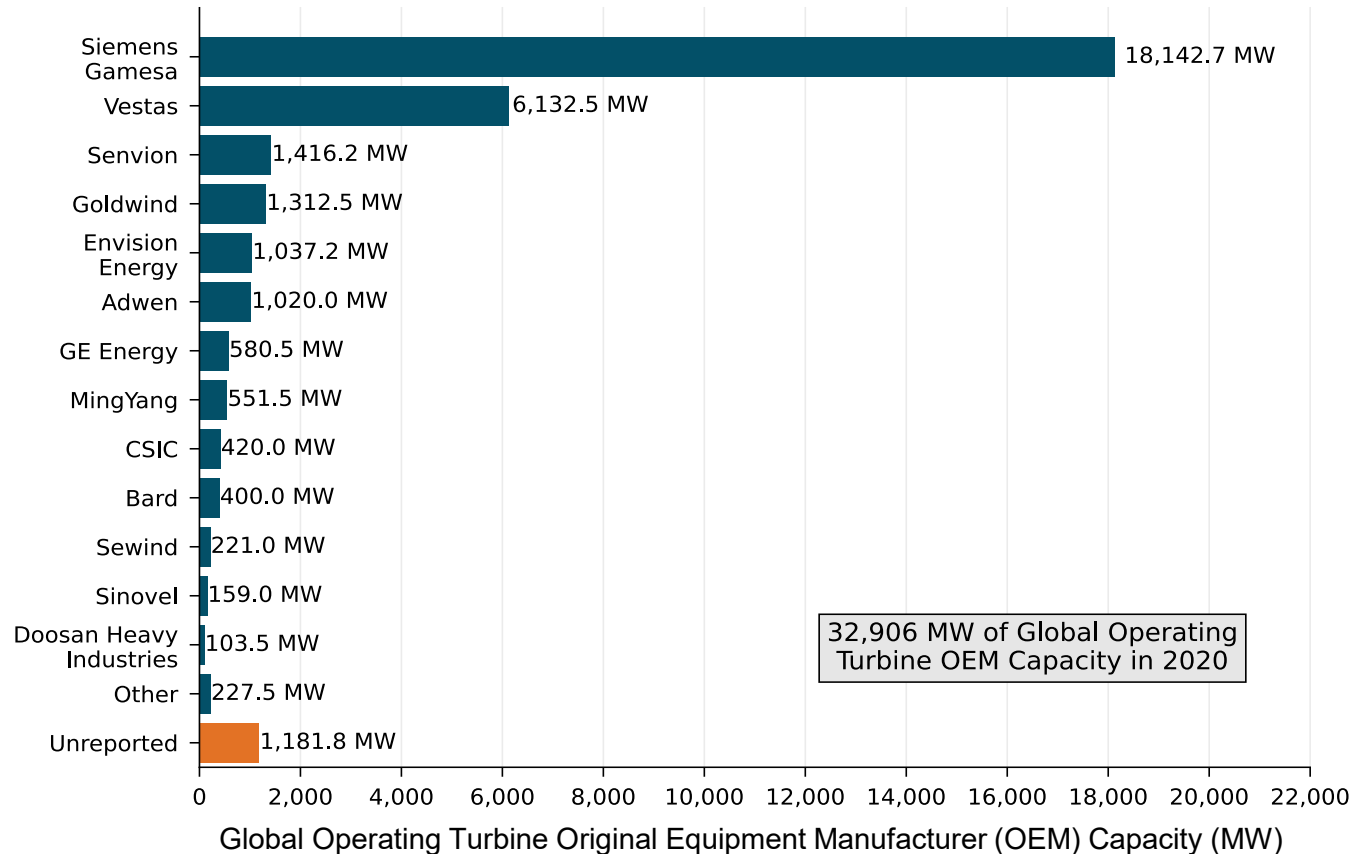
# Average Offshore Wind Turbine Capacity, Hub Heights, and Rotor Diameters



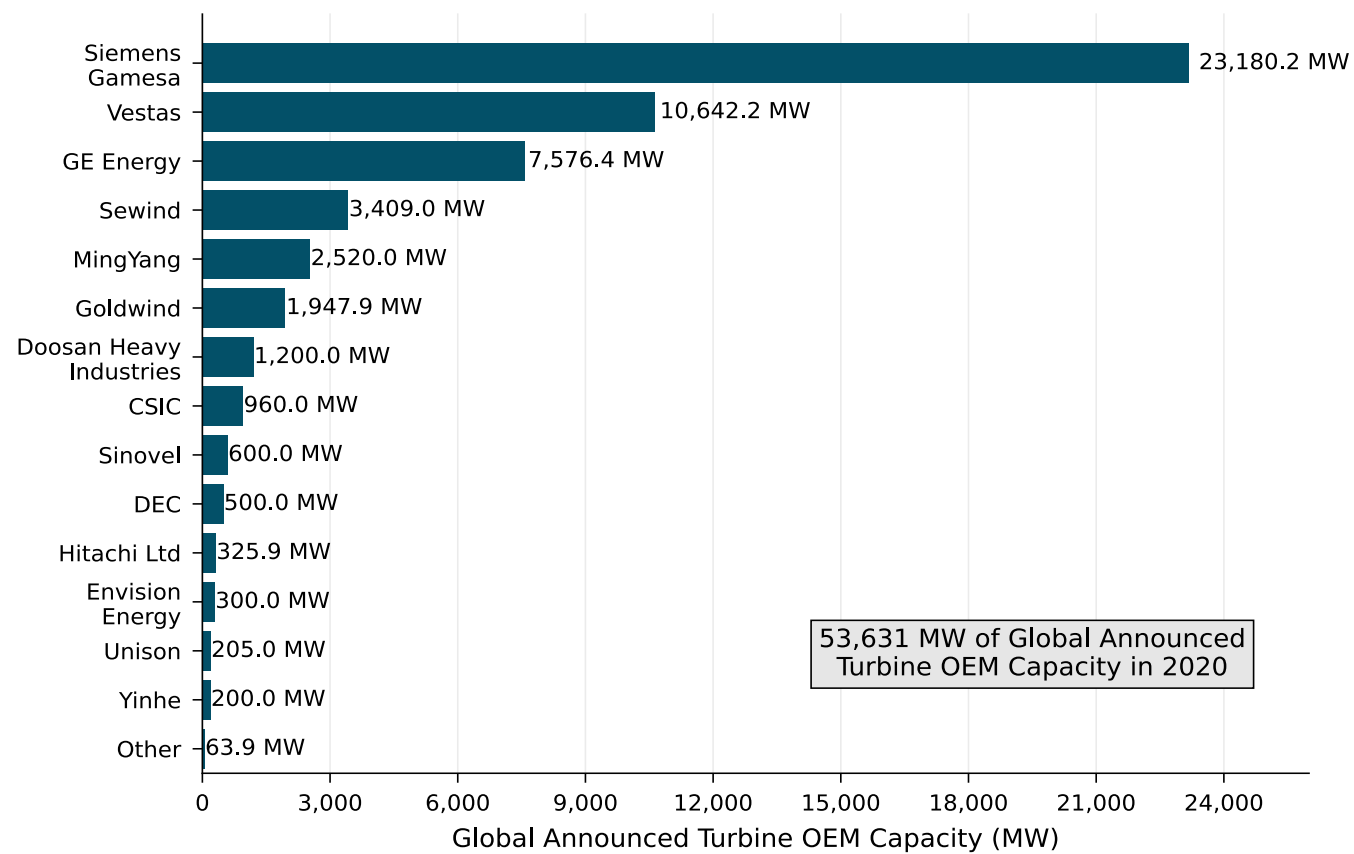
# Comparison of Offshore Wind Turbine Prototypes with Commercial Offshore Turbine Growth



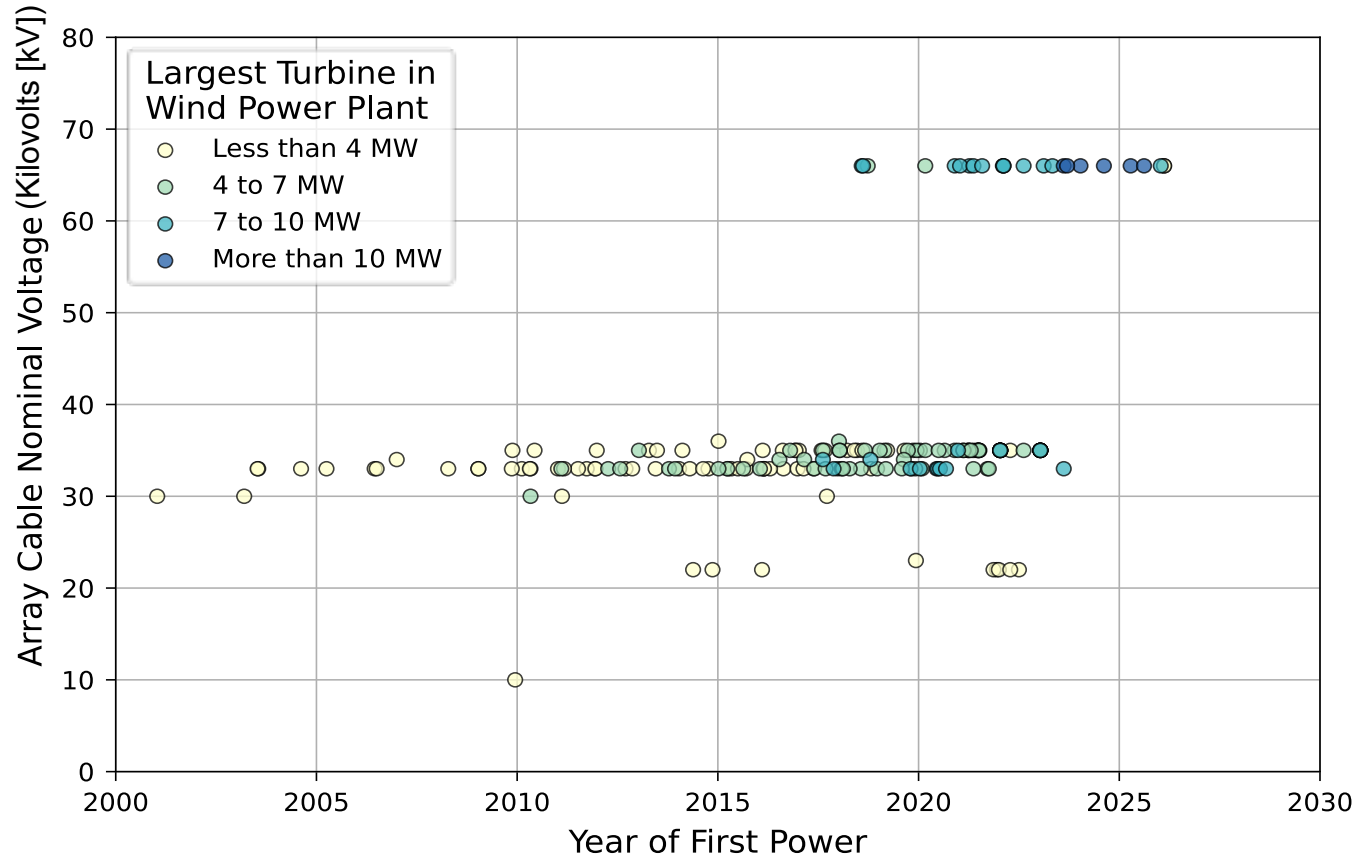
# Offshore Wind Turbine Manufacturer Market Share in Operating Projects



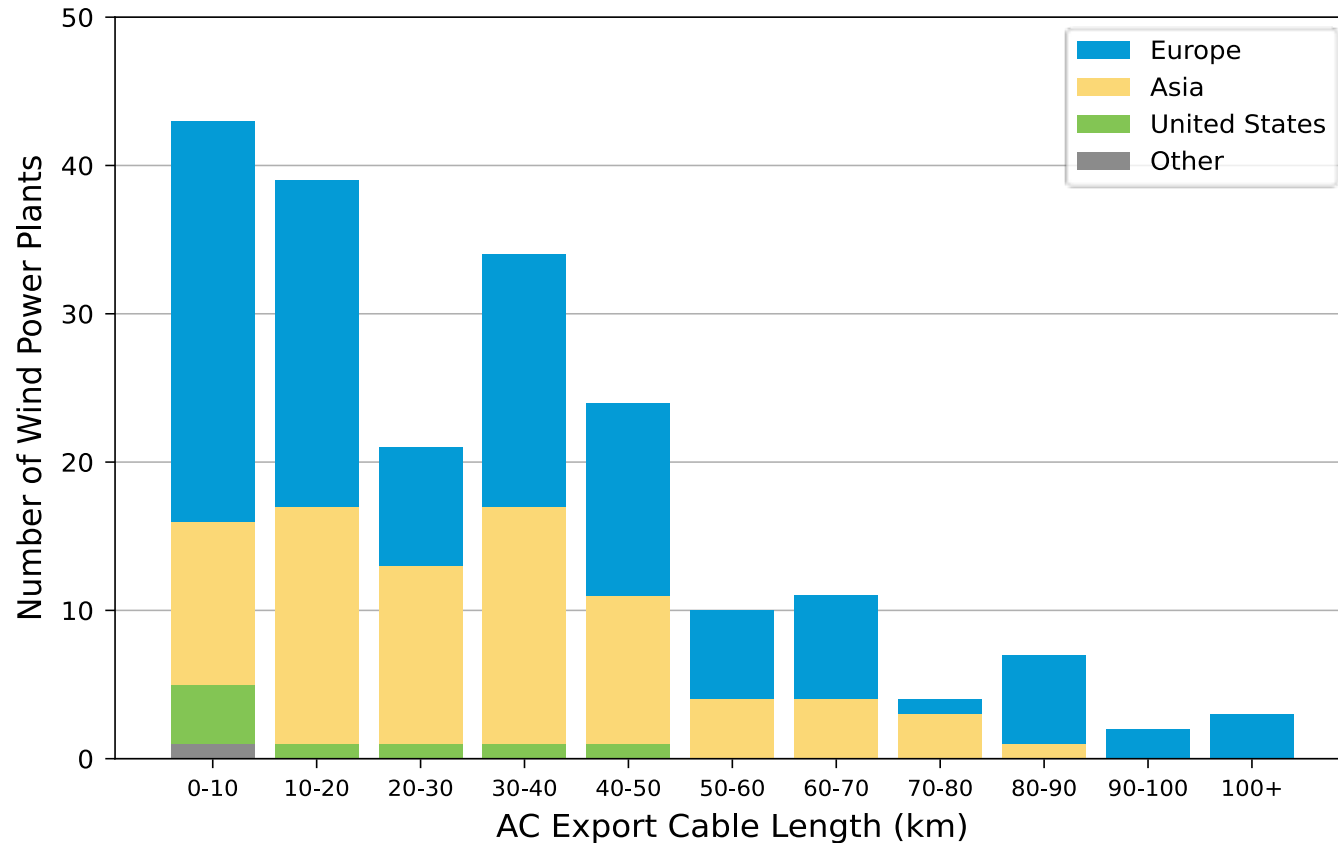
# Offshore Wind Turbine Manufacturer Market Share for Announced Projects



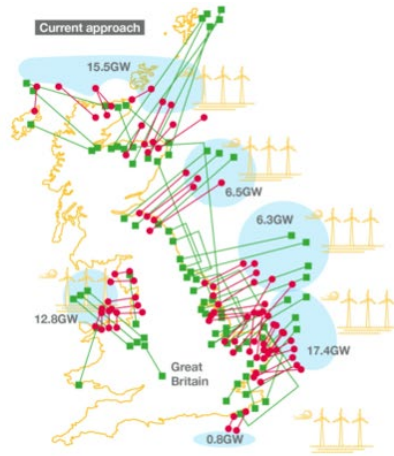
# Distribution Voltage of Array Cable Versus Year of First Power



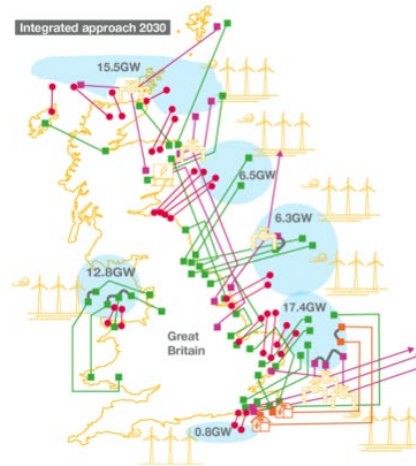
# Number of Wind Farms Versus Length of AC Export Cable Length



# Status Quo and Future Potential Integrated U.K. Network Designs



Capex Cost: £29 billion  
Total Assets: 330  
Total Landing points: 105



Capex Cost: £27 billion (-8%)  
Total Assets: 40% reduction  
Total Landing points: 60



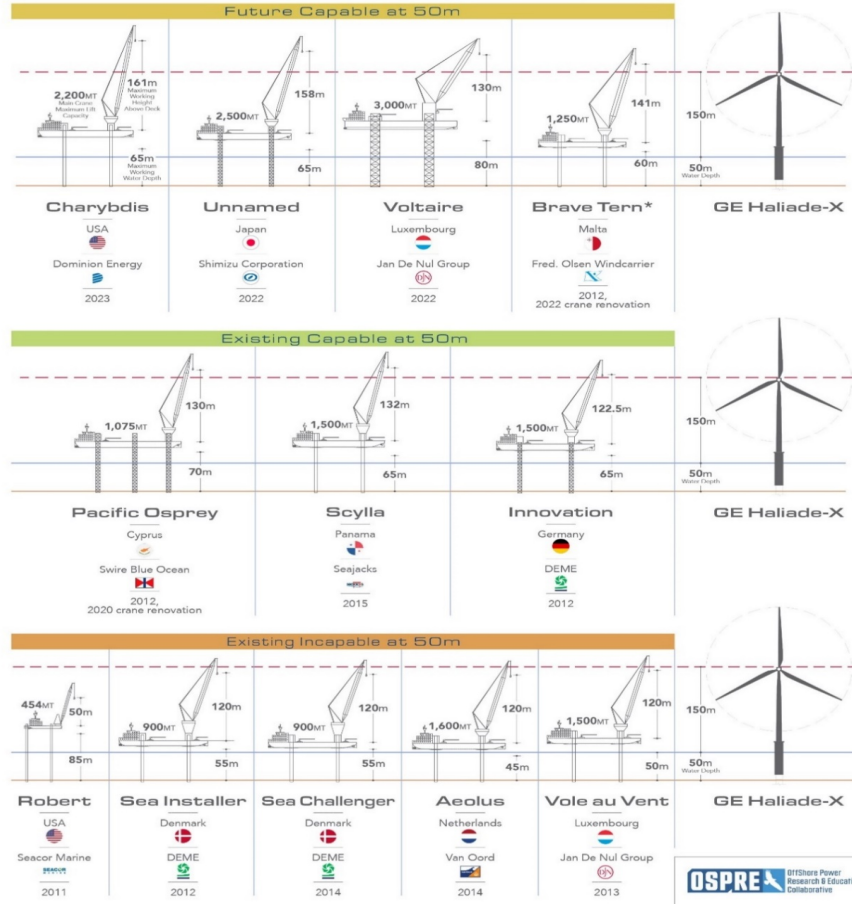
Capex Cost: £23 billion (-18%)  
Total Assets: 70% reduction  
Total Landing points: 30

*Image from* National Grid Electricity System Operator, Offshore Coordination Project

**Status Quo**

**Future Potential Integrated**

## Analyzing Global WTIV Fleet for Haliade-X Turbine Installation at 50m Water Depth

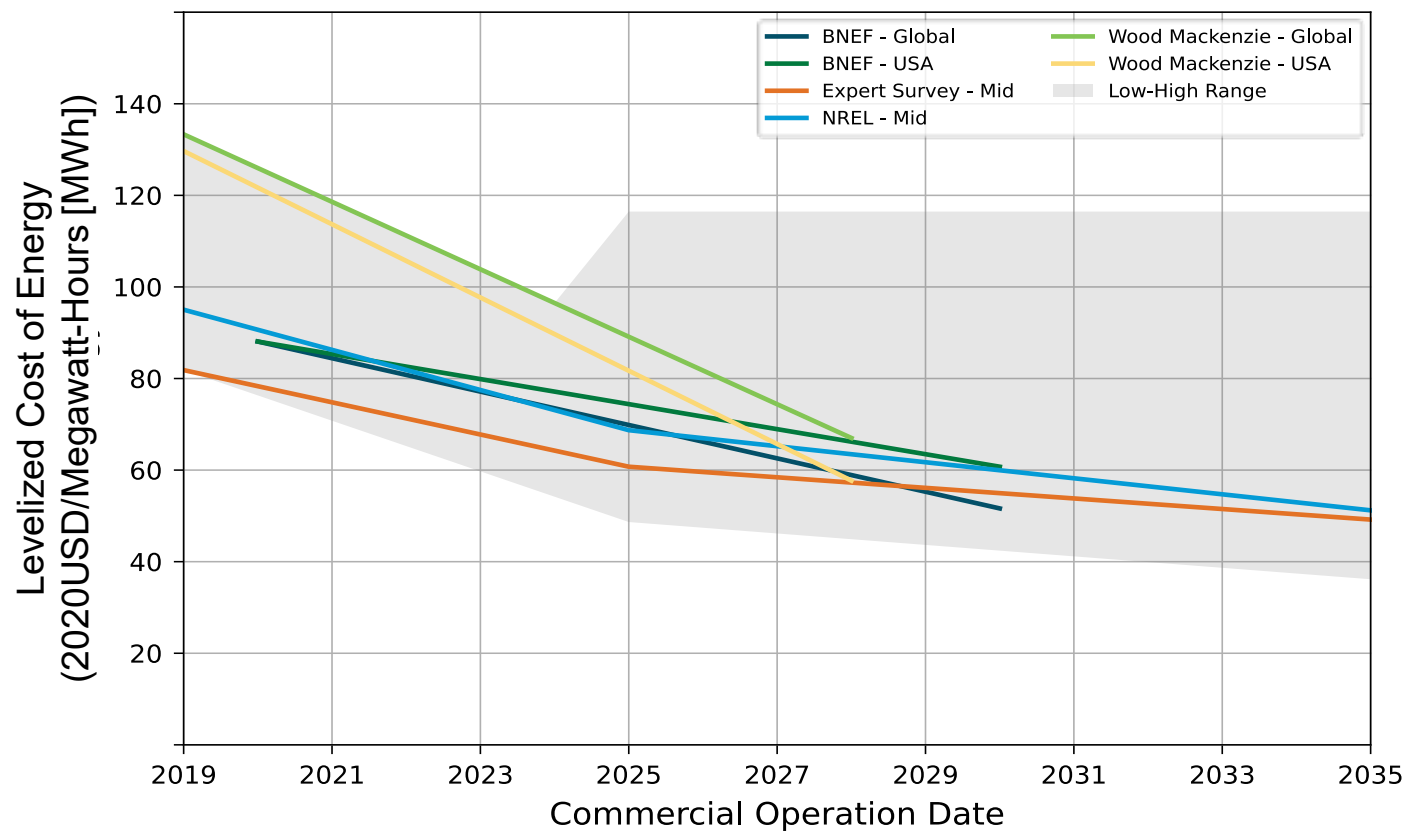


## Analysis of Global Wind Turbine Installation Vessel (WTIV) Capabilities

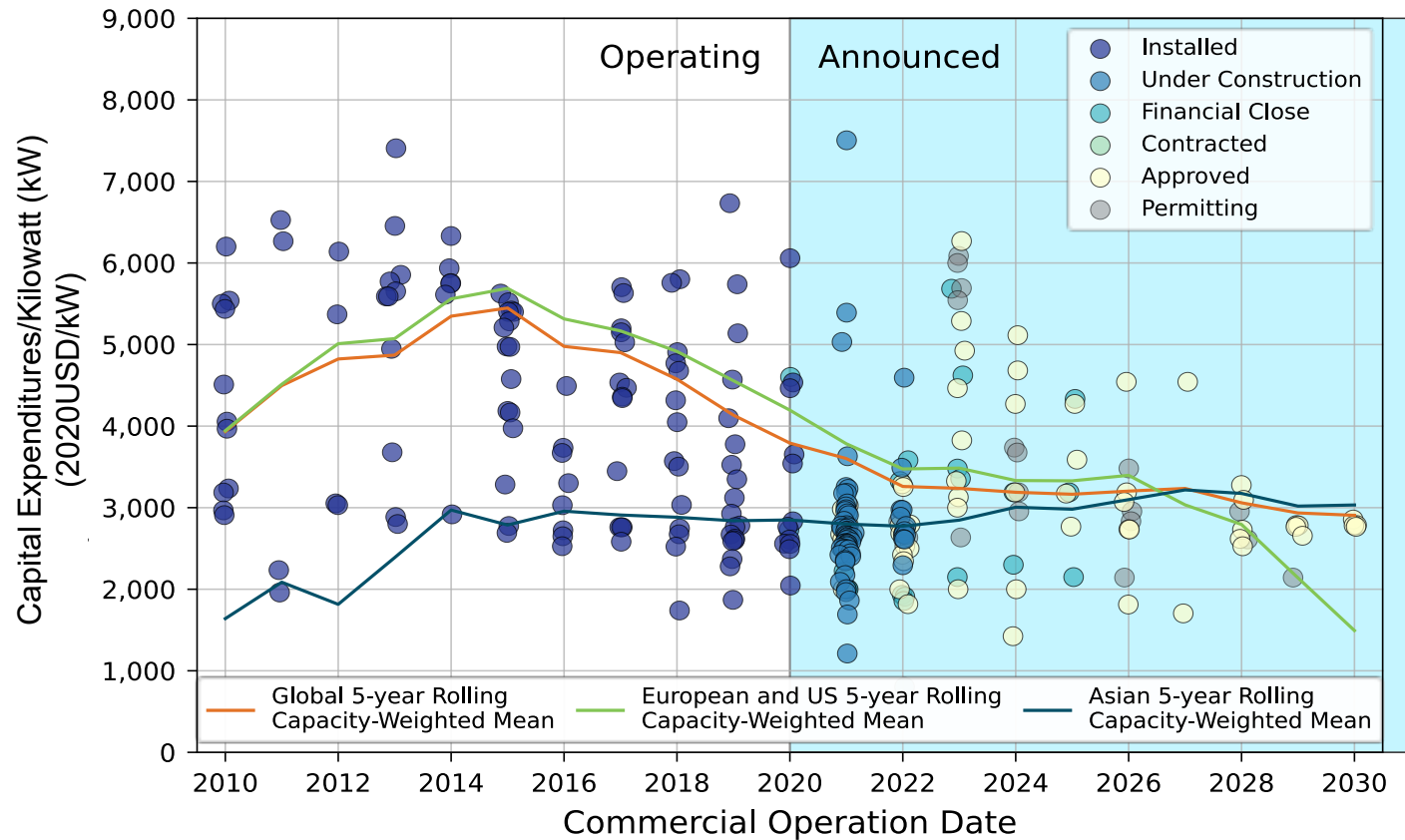
Image from Bocklet et al. (2021)

# 2020 Offshore Wind Cost Trends

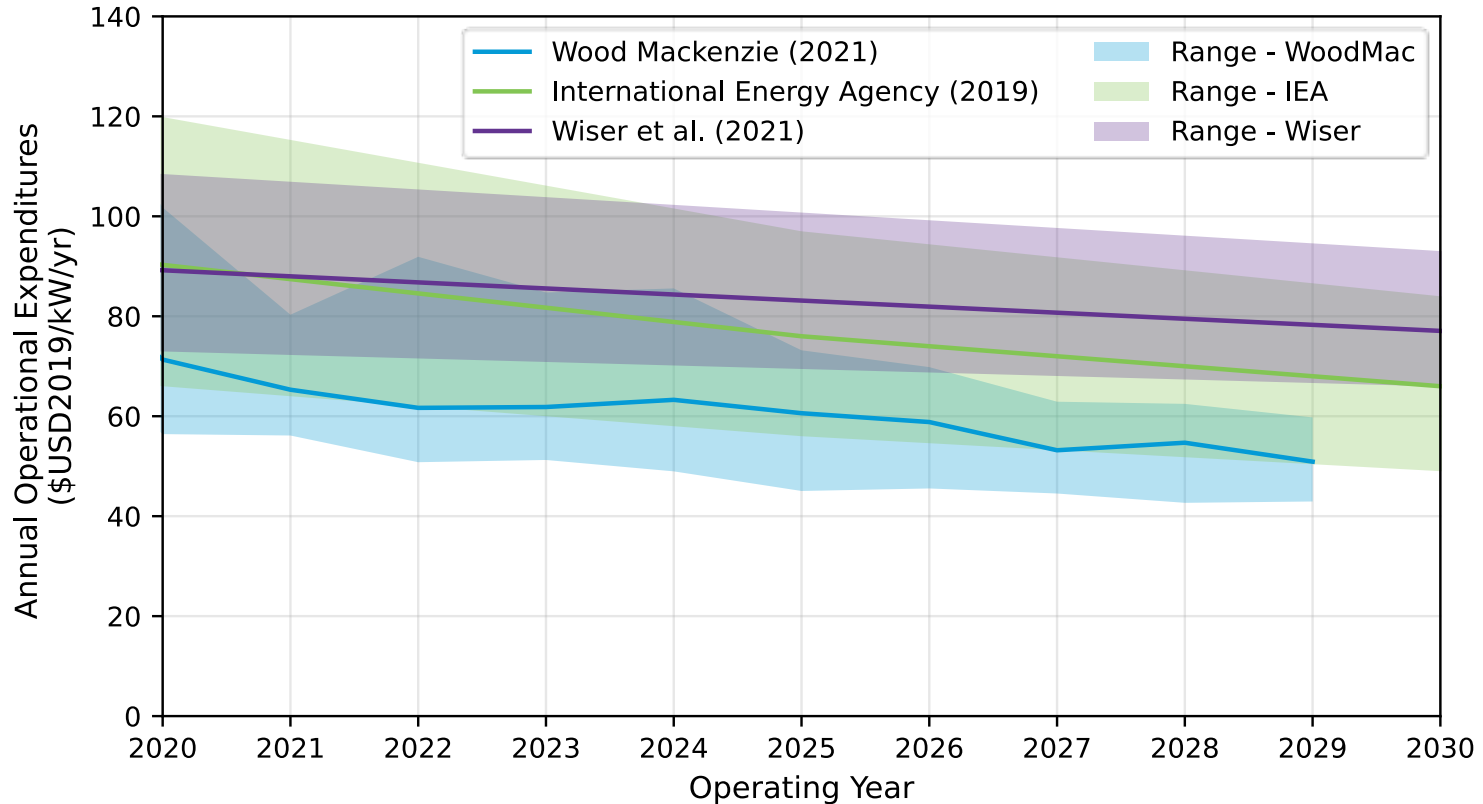
# Global Levelized Cost of Energy Estimates for Fixed-Bottom Offshore Wind



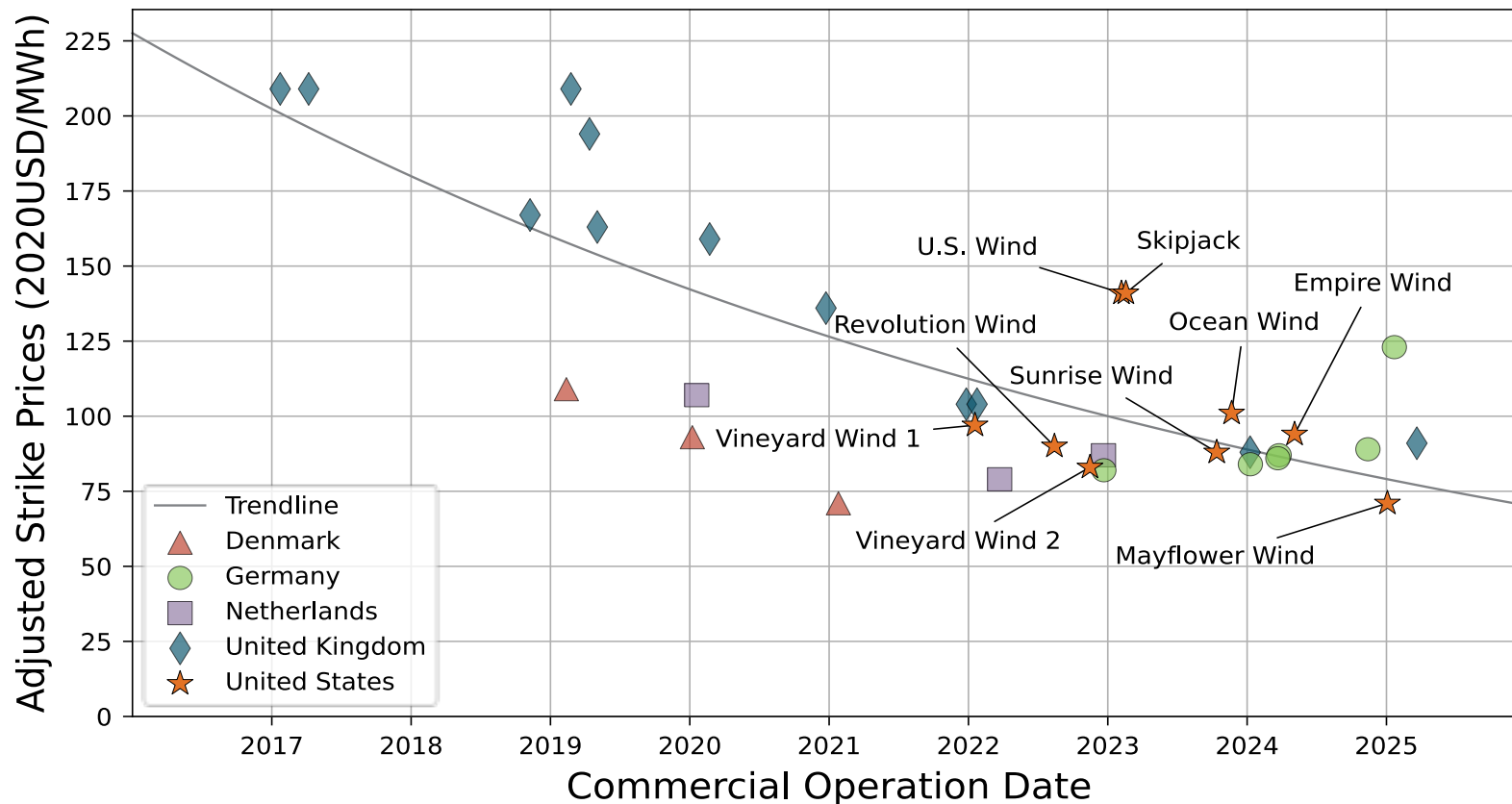
# Capital Expenditures for Global Offshore Wind Energy Projects



# Global Offshore Wind Power Plant Operational Expenditures

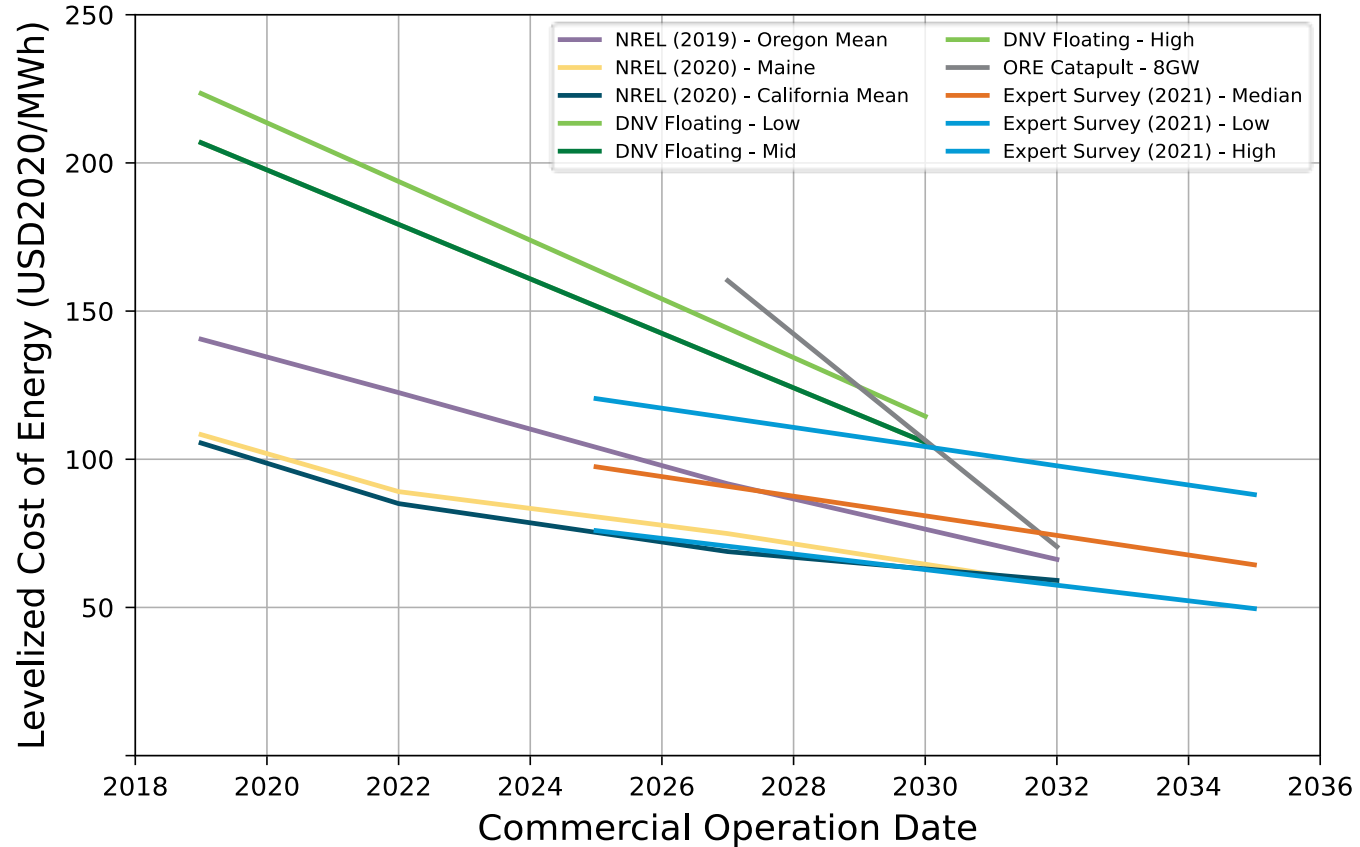


# Adjusted Strike Prices from U.S. and European Offshore Wind Procurements



Beiter et al. (2021) for U.S. projects

# Global Levelized Cost of Energy Estimates for Floating Technology



# Notice

# Notice

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