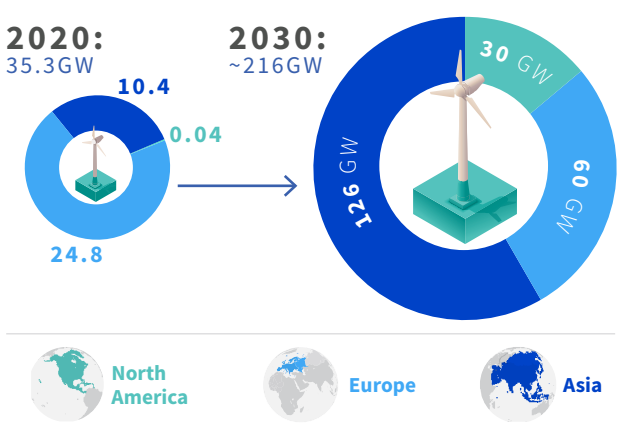
OFFSHORE WIND
A Global Perspective

EPRI

DEPLOYMENT PROJECTIONS



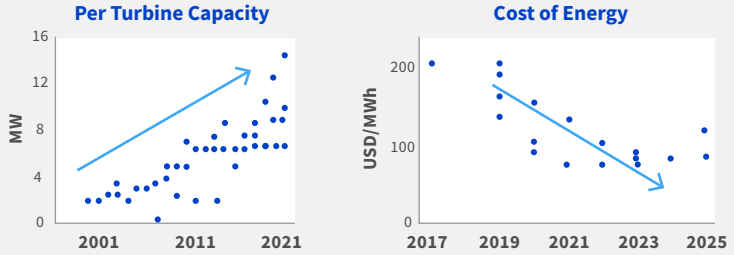
Source: IRENA Future of Wind, GWEC – Global Wind Report 2020

Since 2010, offshore wind has grown tenfold to more than 30 GW by the end of 2020.

The United Kingdom and Germany were the first countries with significant offshore wind capacity and Europe was the dominant market, representing 75% of the total global offshore wind capacity until 2019. Now China is emerging as a key market, accounting for the majority of the new global capacity installed in 2020.

Looking forward, offshore wind is expected to continue rapid global deployment, with projections for 2030 cumulative capacity in the 200GW range.

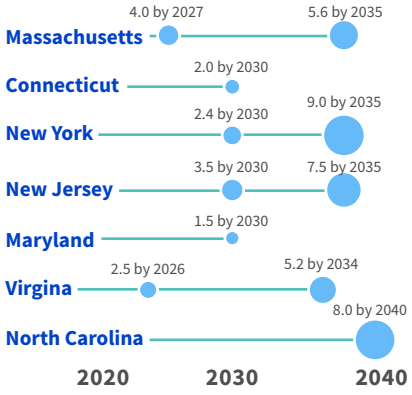
TECHNOLOGY SCALING & COSTS



Source: GWEC, Global Offshore Wind Report 2020 (August 2020). U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, 2018 Offshore Wind Market Report. (August 2019)

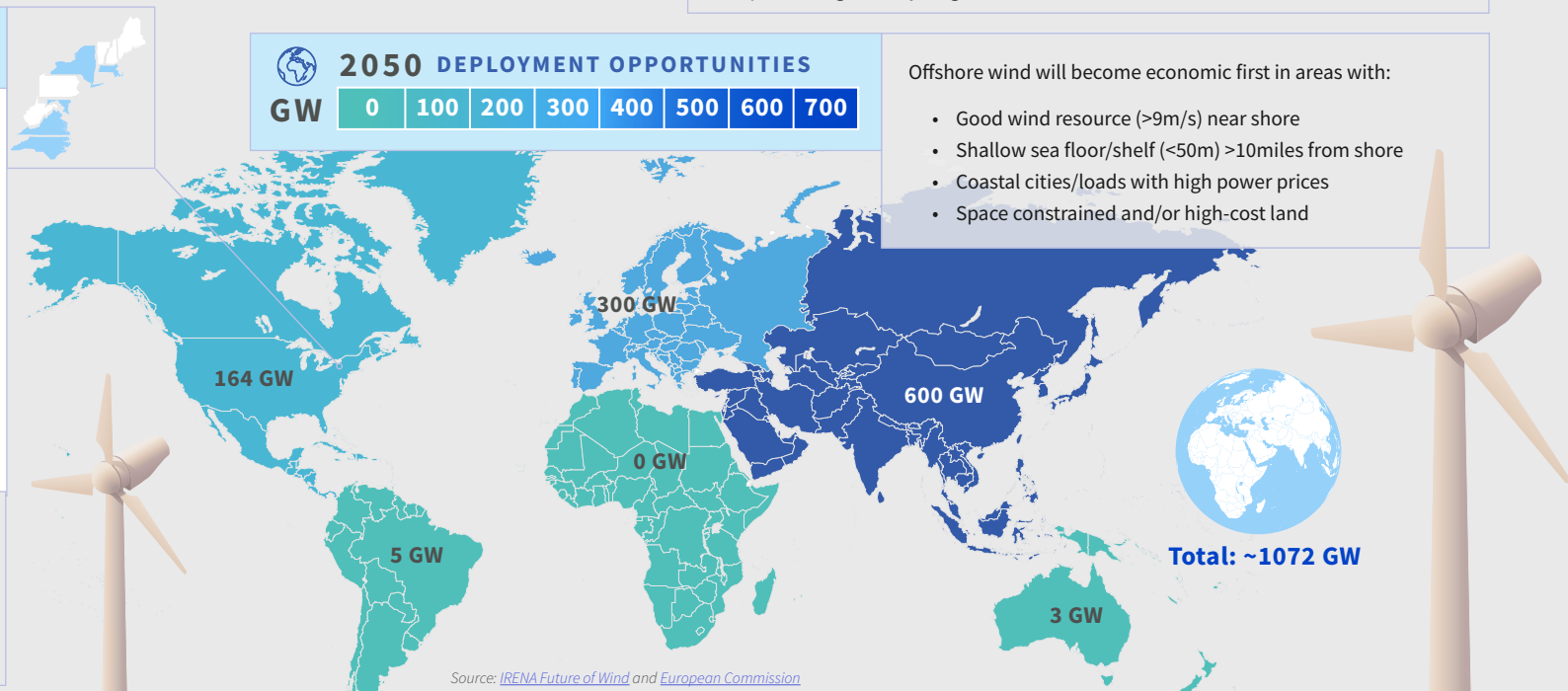
As deployment of offshore wind has increased, the cost of electricity has quickly decreased from more than $200/MWh in the 2010s to as low as $50/MWh for plants planned for the mid 2020s. Coupling with battery storage will become more common in the near term and some planned demonstration projects will produce "green" hydrogen.

U.S. STATE TARGETS (GW)



The Biden Administration announced offshore wind goal of 30 GW in the United States by 2030. Currently, individual states' non-binding goals already combine to reach that level by about 2035.

2050 DEPLOYMENT OPPORTUNITIES

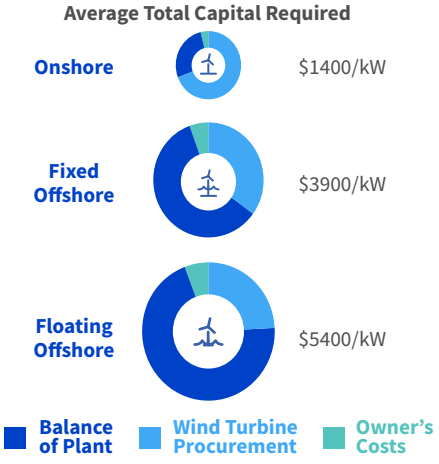


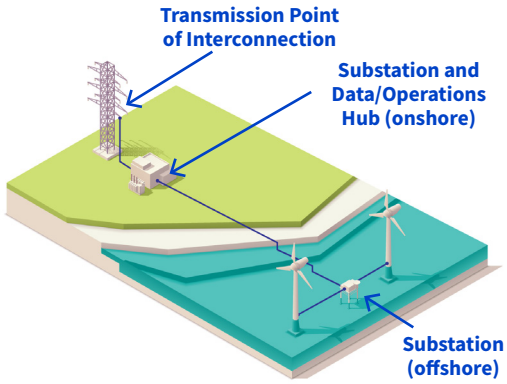
Source: IRENA Future of Wind and European Commission

Offshore wind will become economic first in areas with:

- Good wind resource (>9m/s) near shore
- Shallow sea floor/shelf (<50m) >10miles from shore
- Coastal cities/loads with high power prices
- Space constrained and/or high-cost land

OPPORTUNITIES AND CHALLENGES



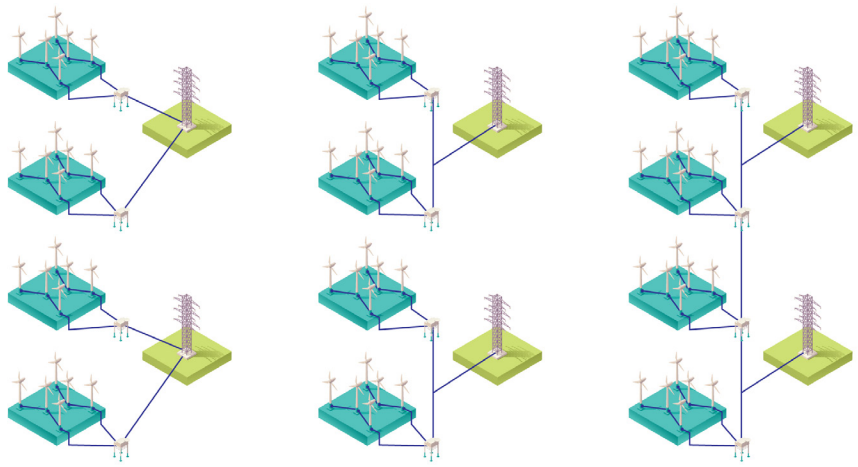


Major cost reduction opportunities include:

- Construction – logistics, mass production, purposed ports, high/heavy lift vessels
- BOP – electrical, foundations
- O&M – production efficiency, condition-based and proactive maintenance

The components of an offshore wind farm must include corrosion resistant materials and coatings, in addition to better ambient environment control inside the nacelle and substations. Fixed foundations extending to the seabed also mean taller overall heights than onshore wind. Combined with storms, waves, and currents, this can mean much greater forces on the foundation.

HOW TO CONNECT OFFSHORE WIND PLANTS



There are several key options for interconnection configurations, ranging from a radial connection, where a single wind farm is connected to a single point of interconnection (POI), to several wind farms on an offshore transmission backbone with multiple POIs onshore.

While the majority of offshore wind is radially connected, a more optimized combination of radial and meshed connections could reduce landing points and total costs while improving reliability.

FLOATING OFFSHORE WIND

For some coastlines with near shore water much deeper than 50m, floating offshore wind may become viable in the next decade and the technologies are still rapidly advancing. Currently, there are only 72 MW of pilot floating offshore wind projects. Major offshore wind market players and oil and gas (O&G) companies are investing into this fast-emerging segment. Europe, Asia, and North America, respectively, are all expected to deploy floating wind turbines by the 2030s or earlier. According to GWEC, 6GW of floating wind could be grid-connected by 2030, with the potential to disrupt the market into the 2030s.

Source: U.S. Department of Energy

EPRI R&D AREAS AND EXPERTISE

Wind Generation	Environmental Aspects of Wind	Bulk System Integration
Renewable Economics	Offshore Wind Interest Group	Substations
Cross-Cutting R&D	Transmission Planning	Distribution Systems

- Grid Integration
- Offshore networks design and stability
- Voltage control and coordination
- HVDC
- Data driven wind turbine O&M
- Performance efficiency
- Economics
- Offshore cables
- Converter stations
- Environmental aspects of wind

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