

U.S. offshore wind power sector dynamics

Analyst Presentation

Shashi Barla | 4 April 2019





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About the Analyst



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Wood Mackenzie Power and Renewables

Shashi leads Wood Mackenzie's Global Wind Turbine Technology and Supply chain practice. He is responsible for global wind turbine technology trends, supply chain trends, turbine OEM market share developments and product positioning strategies, global wind operations and maintenance trends and strategies, and supports on due diligence projects. Additionally, Shashi is responsible for developing Wood Mackenzie's technology and supply-related databases. Shashi renders his knowledge and expertise to Wood Mackenzie's research and consulting clients.

Shashi has a decade of experience in the global wind industry market intelligence, research and consulting. Shashi joined Wood Mackenzie in 2017, prior to Wood Mackenzie, Shashi was a global key account manager at LM Wind Power, Denmark, and has worked in various roles, primarily in the global market intelligence and strategy function at LM Wind Power. Before LM Wind Power, Shashi was an analyst at GlobalData plc in the wind market intelligence, research and consulting division.



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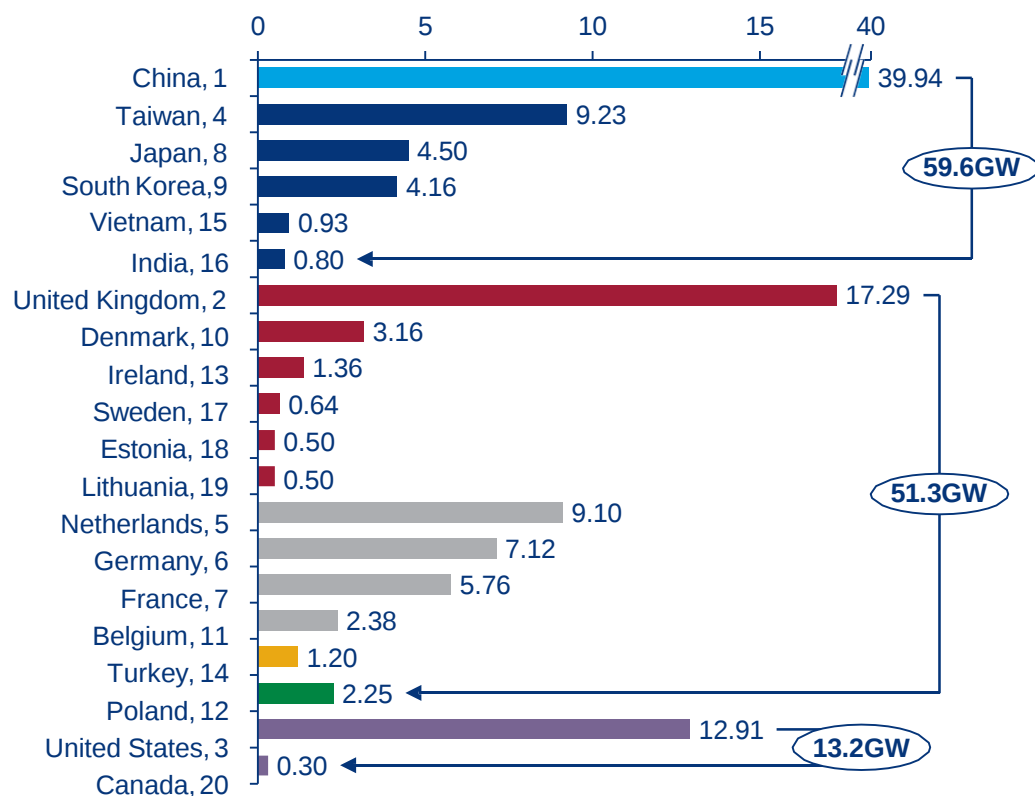
1. Sector forecast and overview



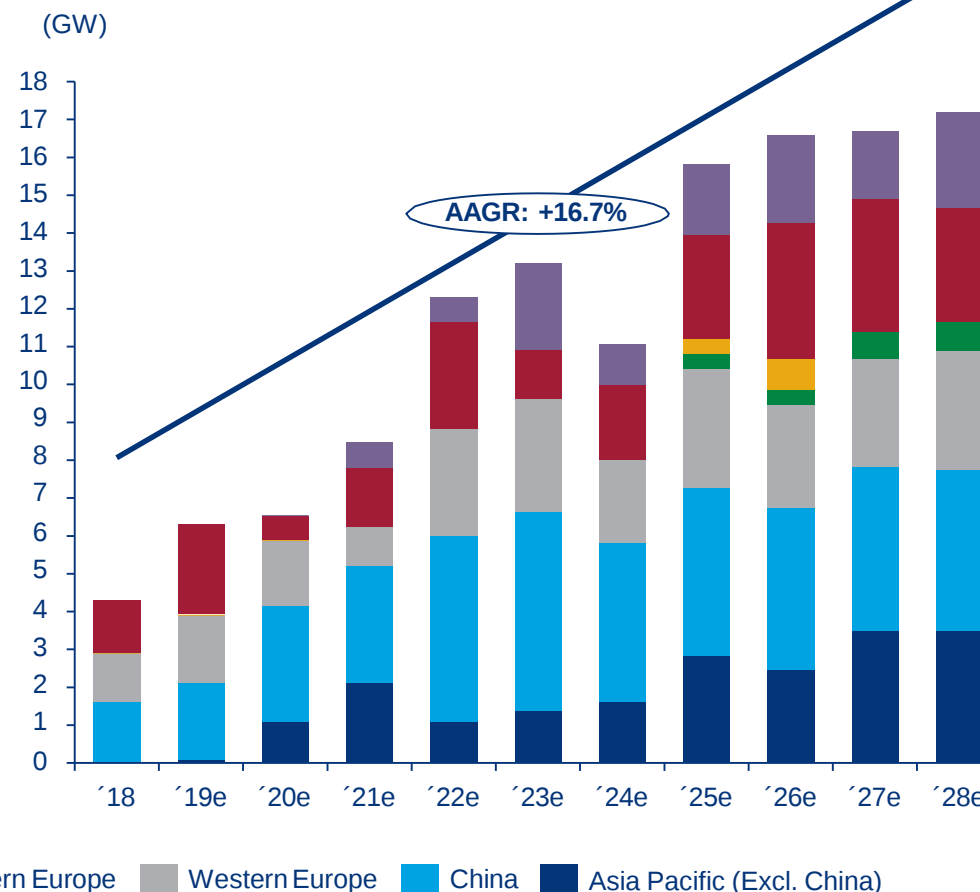
121GW of new offshore capacity or 18% of global total over the 10-year outlook

China more than tripled the amount of capacity it added YoY, contributing 38% of the record 4.3GW of offshore capacity grid-connected globally in 2018

Offshore top 20 markets: New capacity '19e-'28e

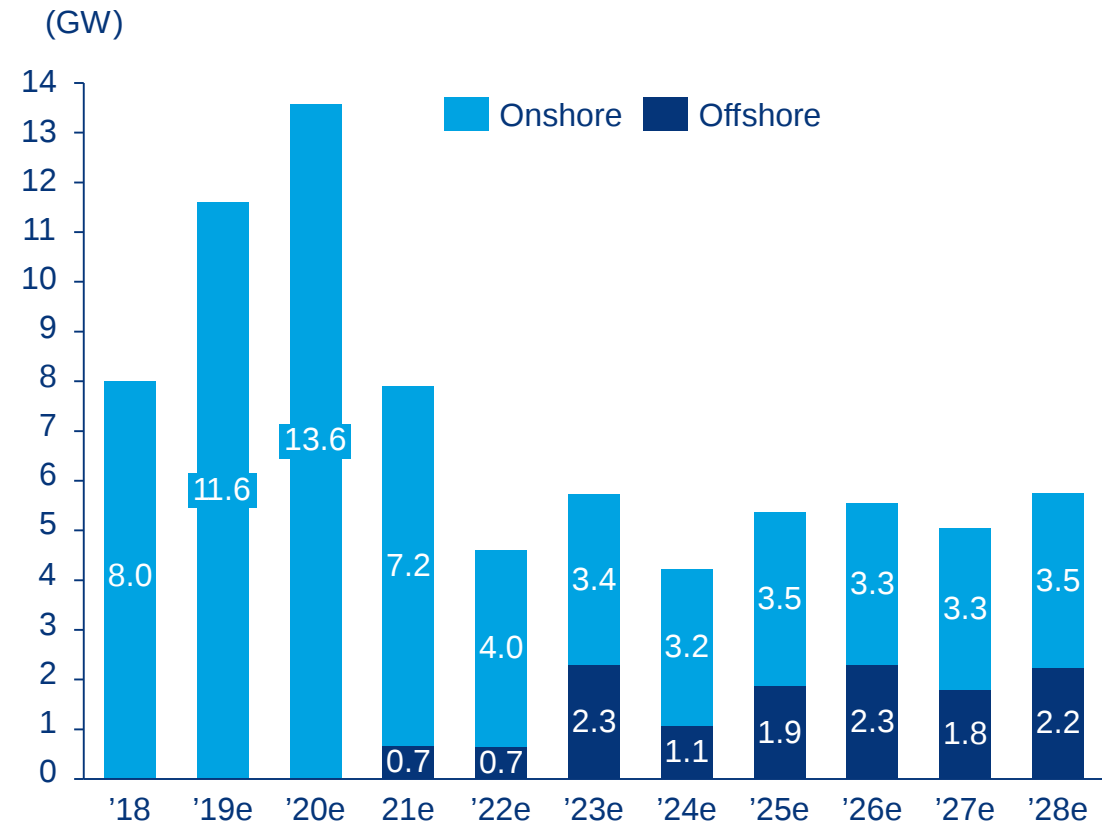
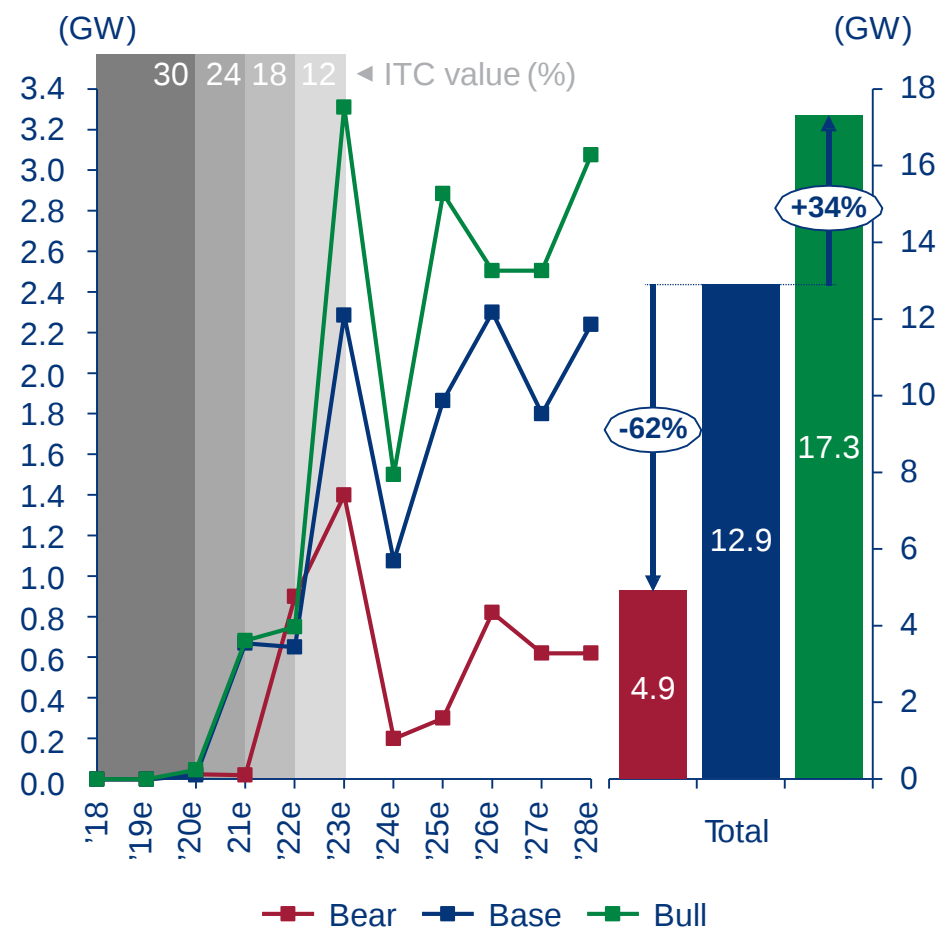


Offshore market forecasts: 2018-2028e

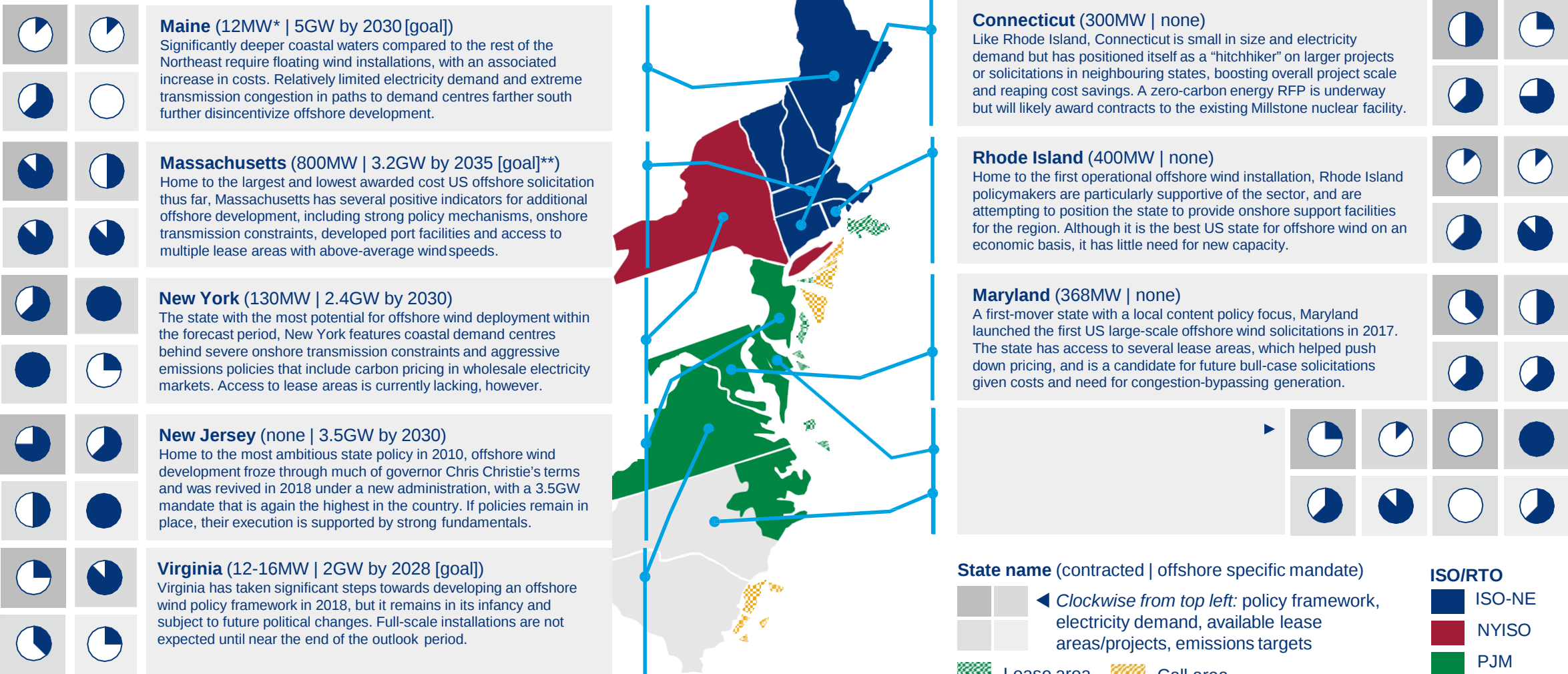


US offshore wind sector to install more than 12GW through 2028

Carbon policies, state initiatives and improving economics fuel an 82% sector CAGR over the forecast period



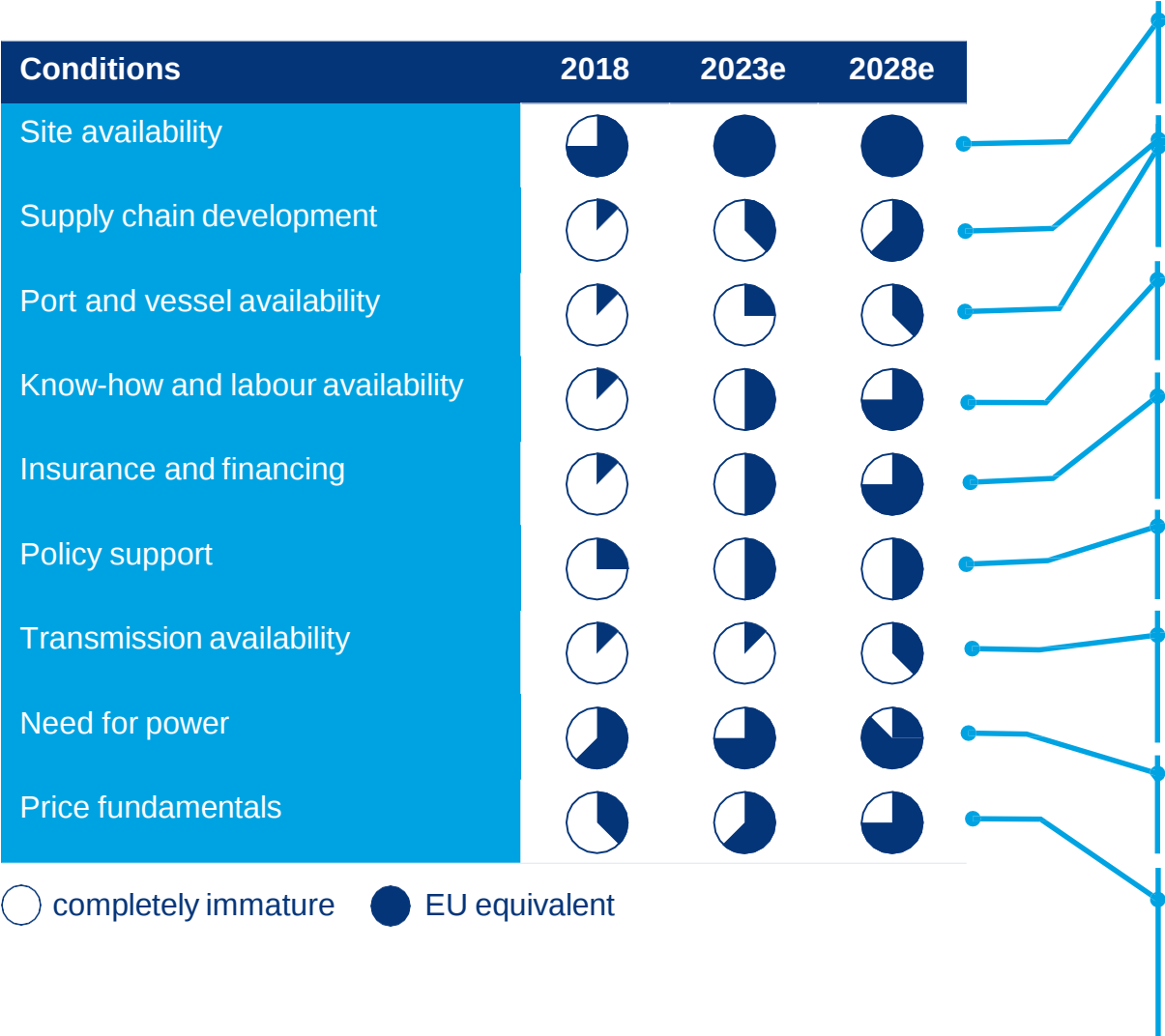
US offshore wind sector state-level overview (East Coast)



Note: Unless otherwise indicated, mandates are binding. *PPA under renegotiation. **1.6GW by 2027 remains the only mandate in Massachusetts; H.4857 set a non-binding goal.

Market maturity projections

Making up for 26 years of lost time, the US will rapidly ramp up its offshore wind capabilities in the next decade



An example of the benefits of federal leadership, the Bureau of Ocean Energy Management (BOEM) leases federal waters for wind energy development, sufficient to install dozens of gigawatts of offshore wind.

With virtually no offshore wind-specific stateside industry to speak of, the US will take the better part of a decade to even reach a fraction of Europe's capabilities. This is not necessarily a deal-breaker; the US can leverage European resources to a degree and can create unique, US-specific solutions to overcome obstacles, albeit often at cost.

One of the first elements of the sector to localize, aggressive state involvement in worker training and domestic hiring practices will quickly yield a trained US labour pool, with the exception of specialized roles for supply chain elements not localized.

While underwriters and financing entities will grow more comfortable with the sector and contingency costs will fall, US offshore wind projects will always hold the risk of catastrophic damage from Atlantic hurricanes, particularly given recent climate patterns.

Reliance on state-level policymaking will remain a crutch; on a federal level, popular opinion precludes the costliest European policies currently assisting offshore wind.

Balkanized policymaking is a particular impediment to the development of "backbone" infrastructure, especially RTO-led possibilities, with any new offshore transmission-specific policies from the Federal Energy Regulatory Commission (FERC) unlikely before 2021. Onshore interconnection upgrade requirements are also often extensive.

Despite relatively weak load growth in the Northeast, demand remains strong in nascent Mid-Atlantic and Southeast markets like Virginia and the Carolinas, and high retirement expectations in New York will require significant capacity additions to fill the supply gap.

While LCOE will compare positively to Europe by the end of the forecast term, the US will remain disadvantaged on a net cost of new entry (CONE) basis given the lower wholesale market prices in the US. Carbon policies, whether state-level or national, are likely to close this gap, but not fully. The gap is lowest in Northeast winters, when offshore generation is highest and power prices spike on natural gas supply constraints.

2. Key sector dynamics



Key sector drivers |

Investment tax credit

BOEM leasing

State initiatives

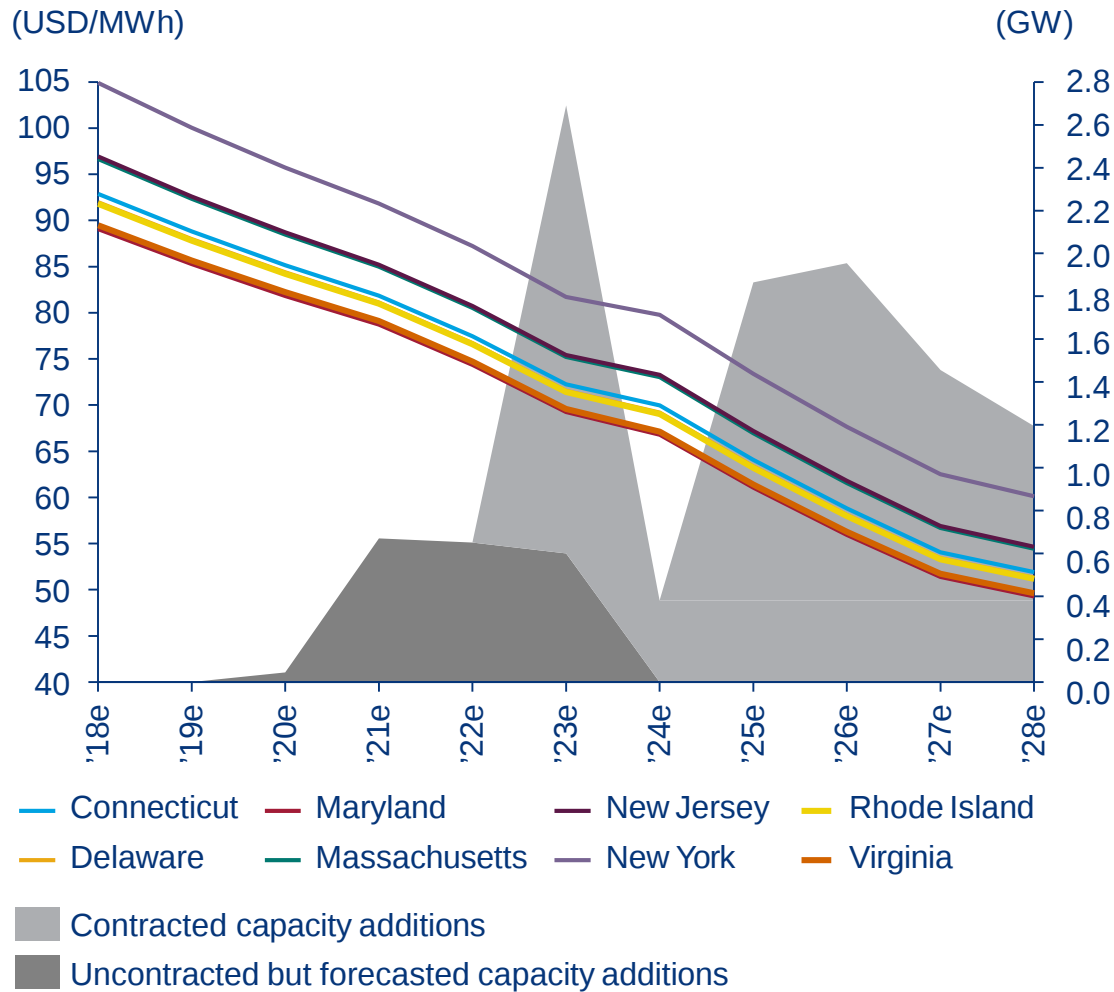
Global interest

Battery storage

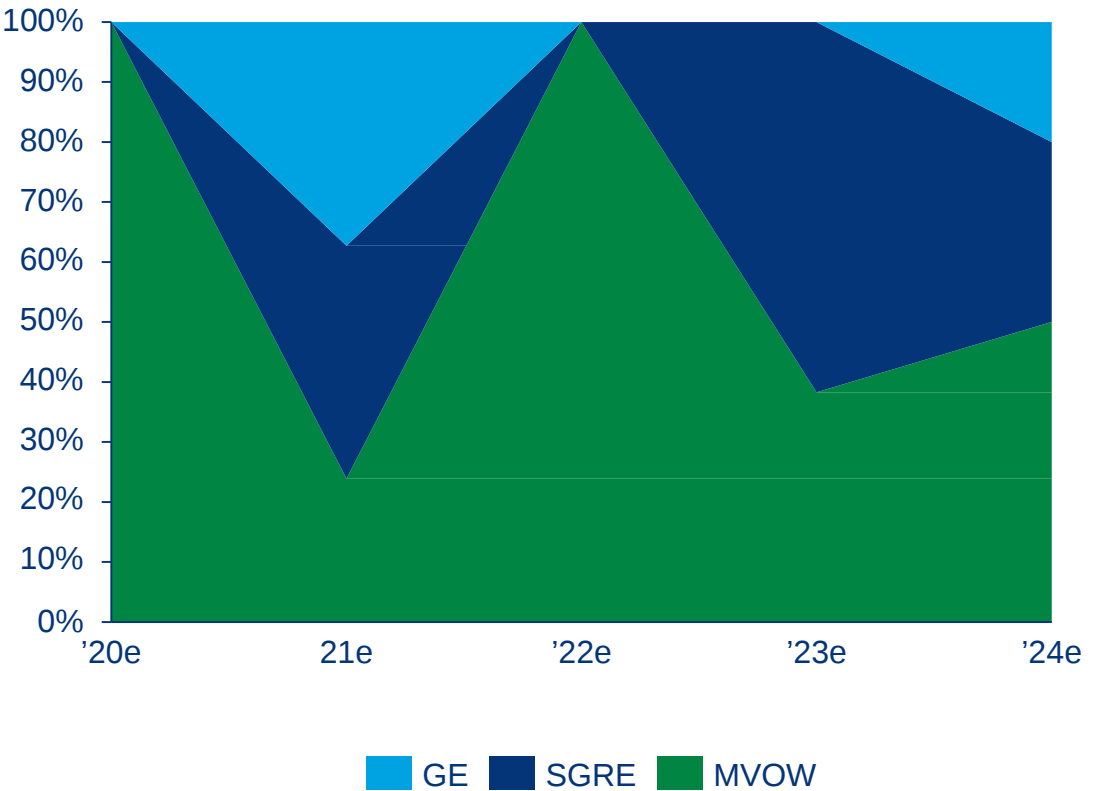
Key sector drivers | LCOE reductions

Current pricing counts on availability of EU resources; overreliance on them renders cost reductions unsustainable

Offshore wind LCOE by state, East Coast, 2018e to 2028e



US offshore turbine OEM market share forecasts 2020-2024e

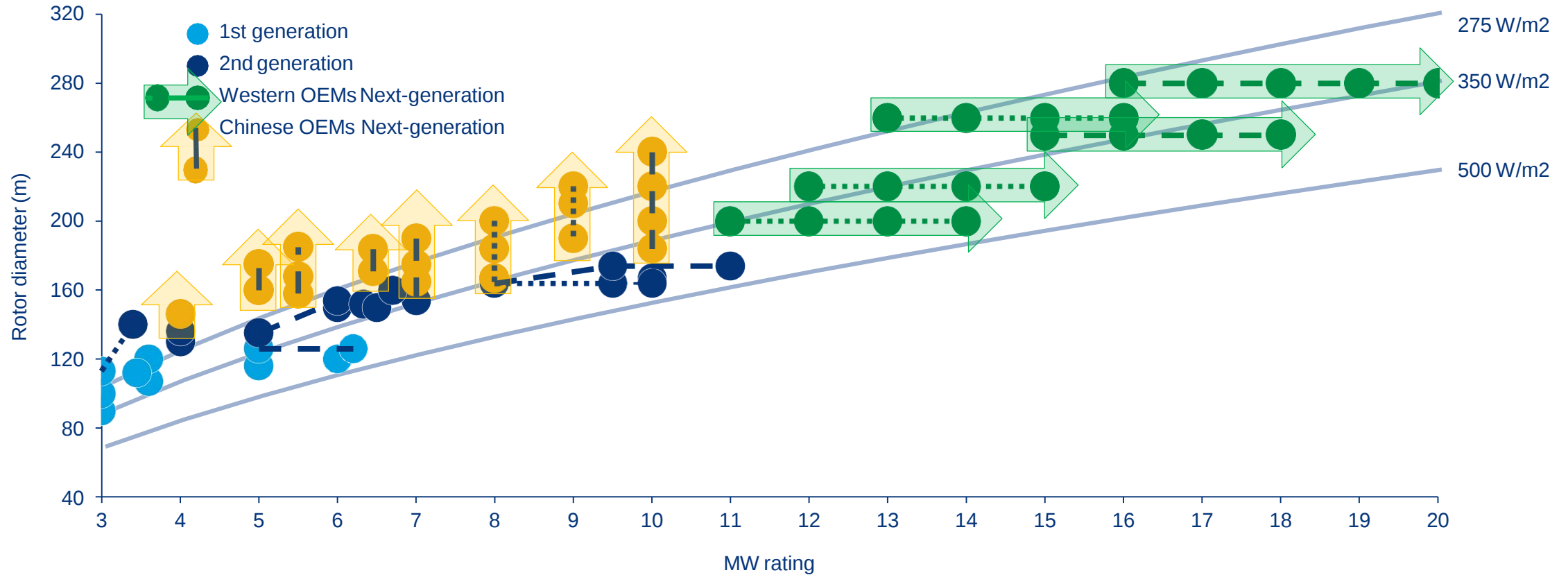




Contrasting product moves on next generation offshore platforms

Offshore Western turbine OEMs thrive on power uprates, while Chinese emphasise rotor upgrades

Next generation turbine projections for Western and Chinese turbine OEMs



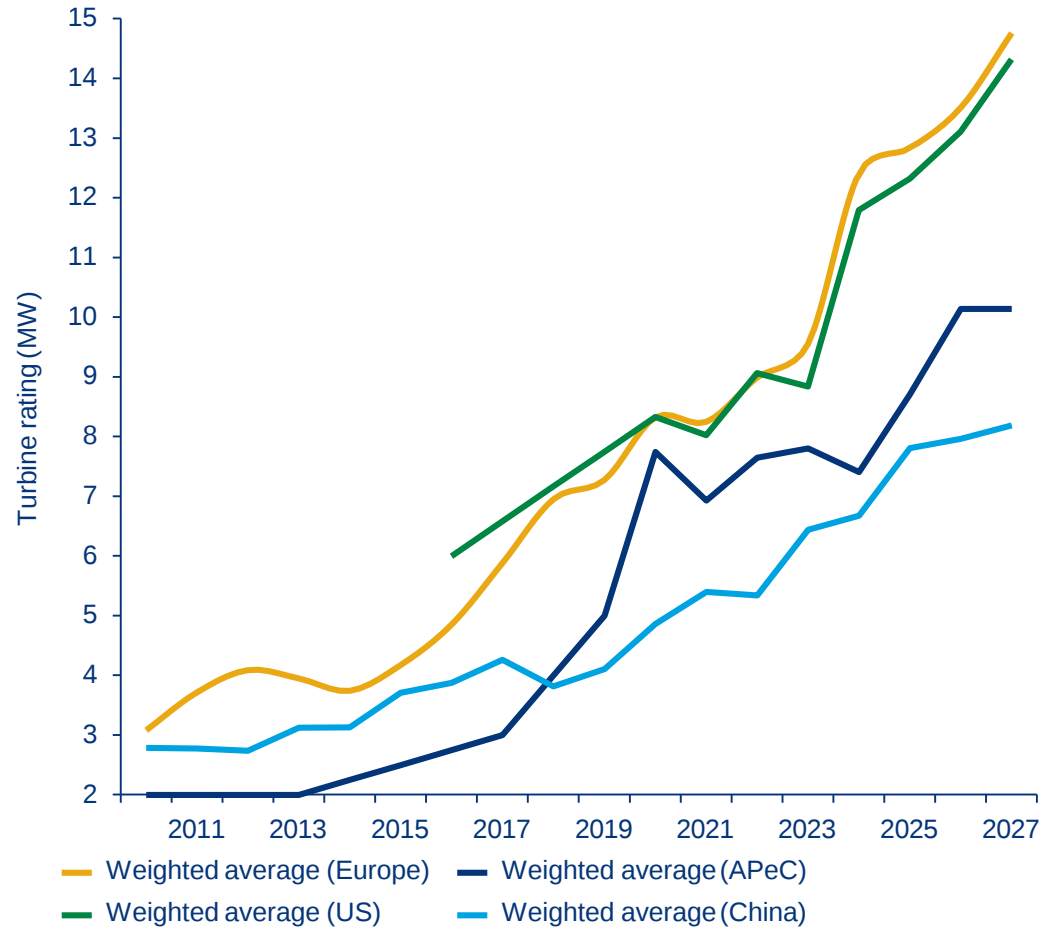
Source: Wood Mackenzie



US weighted average turbine rating will more than double in next 5 years

Turbine OEMs leverage the European platforms into the emerging US offshore market to benefit from economies

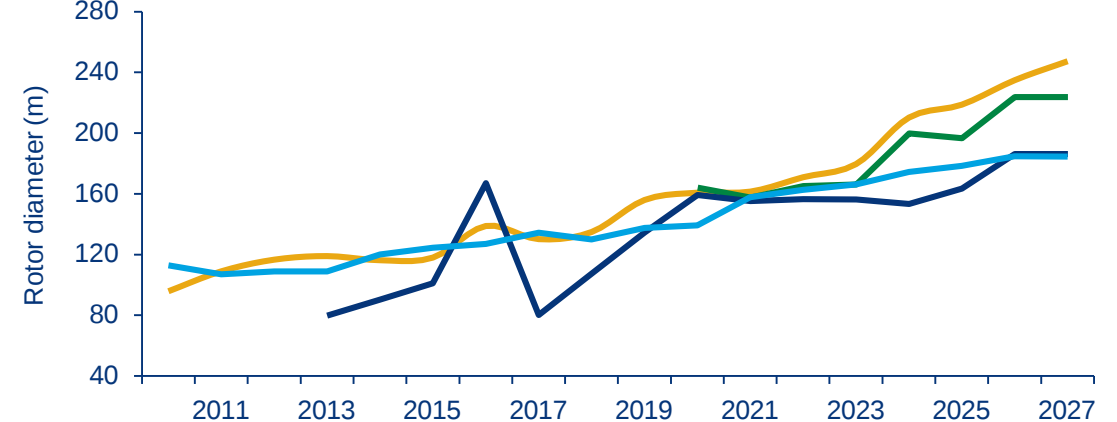
Turbine rating developments globally



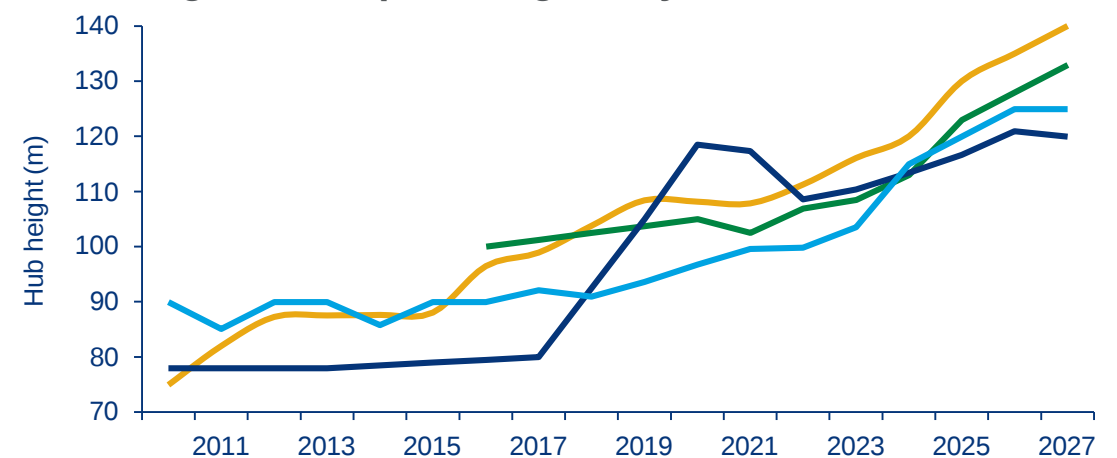
Note: Based on annual grid-connected capacity. Interpolated.

Source: Wood Mackenzie

Rotor diameter developments globally



Hub height developments globally





Key sector barriers | supply chain immaturity

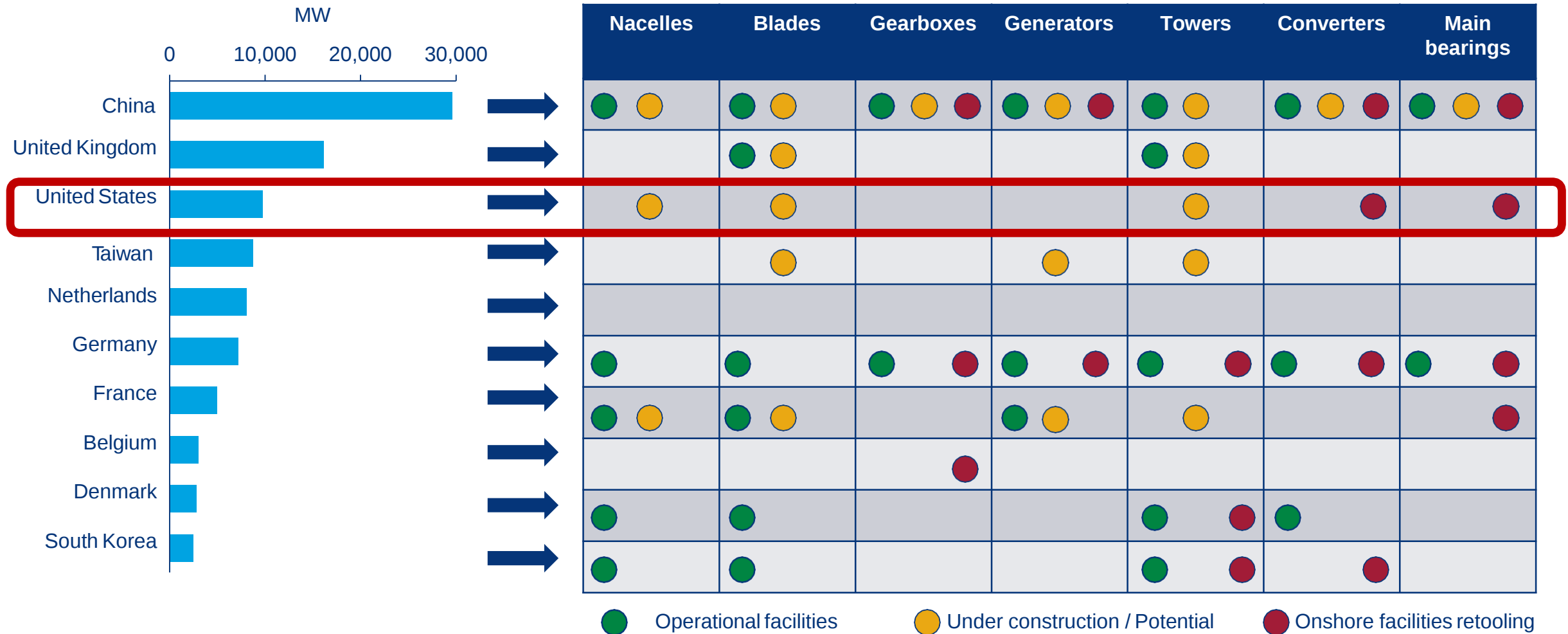
Supply to migrate as long-term demand visibility solidifies and state-funded port upgrades break ground



China, UK and Germany will be large offshore manufacturing hubs due to market size

Onshore facilities will be leveraged for components not challenged by expensive logistics

Offshore market cumulative installs 2018-2027e



Key sector barriers | solving the supply chain challenge

A durable and capable supply chain is key to leveraging EU technological innovations and facilitating cost-out

US local content potential by main component





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