EXHIBIT C

Offshore wind supply chain constraints

Prepared for Empire Offshore Wind LLC, and Beacon Wind LLC

June 2023

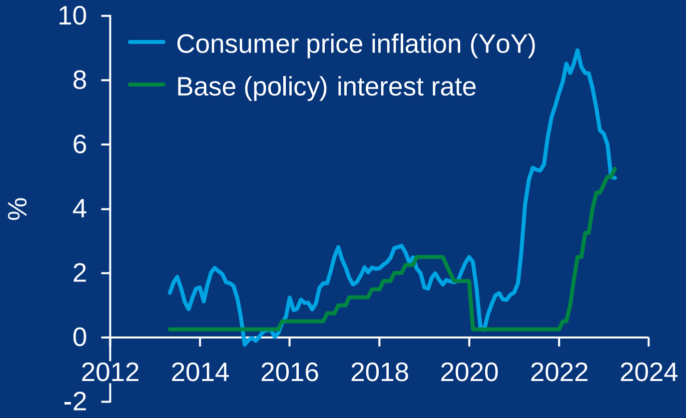
Executive summary: Macroeconomic context

Shorter-term macro-economic challenges will be superseded by longer-lasting supply chain constraints which will be the focus of this report

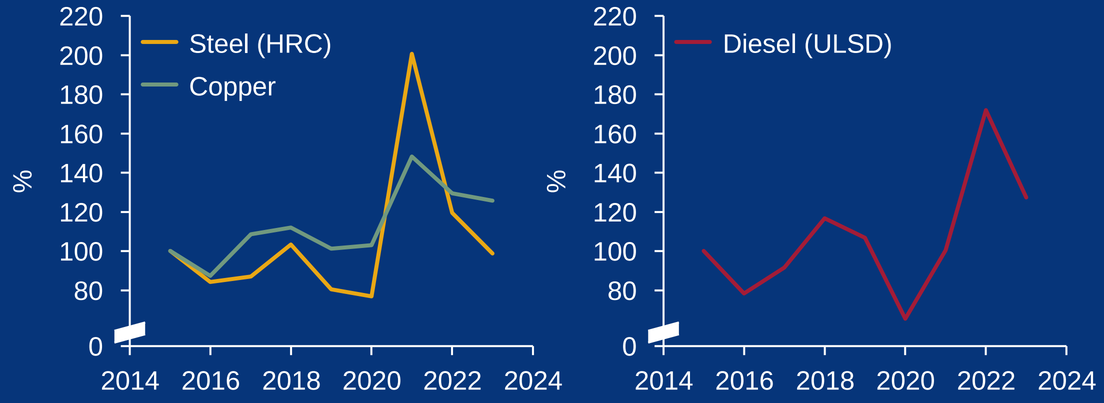
Since 2018, the global economy has suffered a series of shocks. The COVID-19 pandemic and then the war in Ukraine resulted in major shifts in macroeconomic fundamentals, including sharp rises in inflation, interest rates and commodity prices. Since offshore wind projects are capex intensive, these developments have translated into upward price pressures that have had a direct and detrimental impact on project economics.

On top of challenging macroeconomics, the offshore wind sector is approaching a longer lasting challenge of ramping up significantly to match both government and developer ambitions for offshore wind. Meeting the demand for offshore wind will expose the sector to longer-lasting supply chain constraints. The objective of the report therefore is to detail these supply chain constraints and discuss their implications.

US Inflation & Policy interest rates



Commodity prices - indexed to 2015



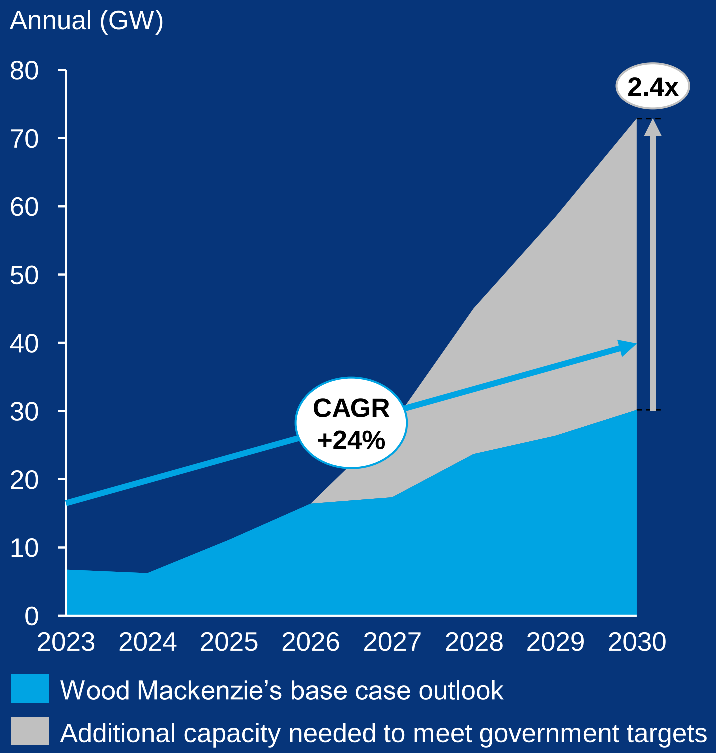
Source: Factset, Wood Mackenzie

Executive summary: Demand

Ambitious government targets and long lead times result in soaring offshore wind demand at the end of the decade

- The offshore wind sector is largely globalised. The exception is the Chinese market, which has different supply chain than the rest of the world. For the purpose of this study, projects and facilities in China are therefore excluded, unless otherwise specified.
- Even without China, Wood Mackenzie forecasts the offshore wind sector to grow at a 24% CAGR from 2023 to 2030, with the annual connected capacity being over ten times greater in 2030 compared to 2020.
- Government targets for offshore wind far exceed what Wood Mackenzie forecast will come online. If all 2030 government targets outside China were to be met, the annual grid-connected capacity in 2030 would be more than double what Wood Mackenzie forecast. Consequently, the supply chain constraints identified in this study would be even more demanding in a scenario where global offshore wind targets are achieved.
- The growth in demand for offshore wind is fueled by its improving cost competitiveness, technological maturity, potential for rapid deployment at scale and strong public policy support.
- The offshore wind sector offers high visibility out to 2027 as projects must go through government tenders to secure offtake. The fact that projects have already been awarded support schemes also means that they have locked in a large part of their revenue streams. This leaves the projects exposed and vulnerable to rises in project capex.
- The rising cost pressures since 2020 have had a detrimental impact on project returns, thereby putting them at risk of delays and even cancellations. However, as government targets are heavily concentrated towards the end of the 2020s, delaying a project towards the end of the decade would only worsen supply chain constraints and reduce supply chain revenues in the mid-2020s. This, in turn, would hinder supply chain investments.

Wood Mackenzie's base case offshore wind outlook Vis-à-Vis government targets*



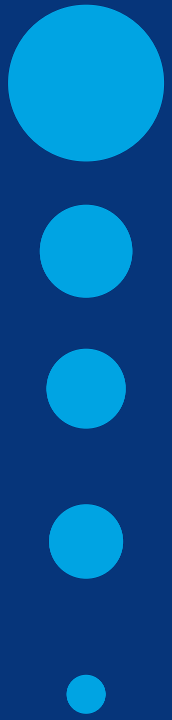
Note: *Excluding China.
Source: Wood Mackenzie

Executive summary: Supply constraints

The sizeable gap in supply by 2030 will subdue offshore wind build-out and introduce longer-lasting risks

- USD 25 billion investments are required over the next 4-5 years to meet demand peaks in 2029-2030. Supply ramp up is particularly crucial for vessels, where 80% of the 2030 required capacity is yet to be brought online, requiring USD 13.1 billion to compensate for the limits of todays operational fleet.
- Whilst increasing turbine ratings will continue to offer cost out for developers by reducing resources required per MW, this trend also pushes the supply chain to evolve and invest to handle increasing component sizes.
- The tight supply demand balance brings a multitude of risks to the sector:
  - » The globalisation of the supply chain, combined with the proliferation of local content policies, brings inefficiencies, new risks and supply chain constraints.
  - » EBITDA margins across the offshore wind supply chain have been squeezed since 2015. The low margins, combined with macroeconomic dynamics that drive up cost of capital, facility and vessel capex, challenge new investments into the sector.
  - » Most of the operational supply capacity needed in 2030 is yet to be built. As the supply is already tight, delays and cancellations of the announced facility would have a sizeable impact on the supply and demand balances and build out of offshore wind.
  - » The tight supply balance also reduces supply chain flexibility. That means that if a project is delayed or issues arise on the supply side, it is now more challenging to find the spare capacity needed to close the gap.
  - » The offshore wind supply chain is concentrated, with a limited number of experienced suppliers making it a sellers' market. This has pushed buyers to procure earlier, sign longer slot agreements and allow for increases in supplier margins to secure the right supply capacity at the right quality to realise projects and reduce schedule risk.

Investment in new supply capacity required to meet 2030 demand



Installation
USD 13 billion
investment secured by 2026
19 new vessels*

Foundations
USD 5 billion
investment secured by 2025
5 new facilities*

Blades
USD 3 billion
investment secured by 2026
5 new facilities*

Towers
USD 3 billion
investment secured by 2025
6 new facilities*

Nacelles
USD 1 billion
investment secured by 2027
2 new facilities*

Note: *USD figures represent total Capex including announcements, facility level only indicates investments yet to be finalised. Source: Wood Mackenzie

Contents

Approach

Sector wide analysis

Offshore wind demand

The section presents Wood Mackenzie's base case GW capacity outlook for the offshore wind sector that will form the basis of the supply and demand analyses. The section includes reflections on the certainties and uncertainties and compares the outlook with government targets. At the end, the parameters of the study are identified and the conversion from GW demand to component-level demand is outlined.

Offshore wind supply chain constraints

The section discusses the overarching implications of supply chain constraints that cuts across the analysed offshore wind components.

Scope

Geographical coverage:

- Global excl. China and Vietnam

Forecast period:

- 2015-2030

Supply vs. demand by major offshore wind component

Each component will be analysed in separate sections. Each section will section will include:

- Section summary
- Supply vs. demand analysis
- Methodology for calculating supply
- Methodology for calculating demand
- Analysis of how the component demand scales with the megawatt (MW) outlook

Installation
(turbine and foundation installation)

Foundation supply
(primary steel for monopiles and transition pieces)

Turbine blades

Turbine towers

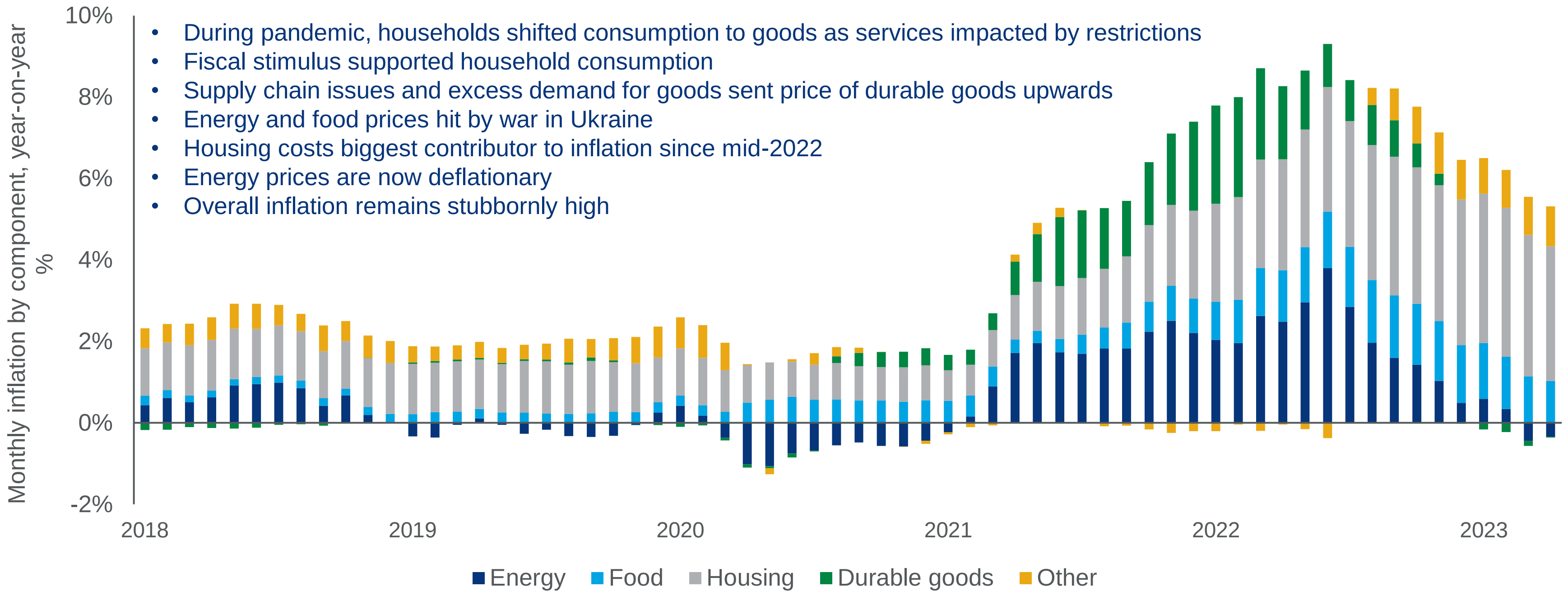
Turbine nacelles

1. Changes to the macroeconomic context

US inflation has hit a 40-year high in the wake of the COVID-19 pandemic and war in Ukraine

Supply chains, food, energy and housing costs pushed inflation to peak of 8.9% in June ‘22

US consumer price inflation

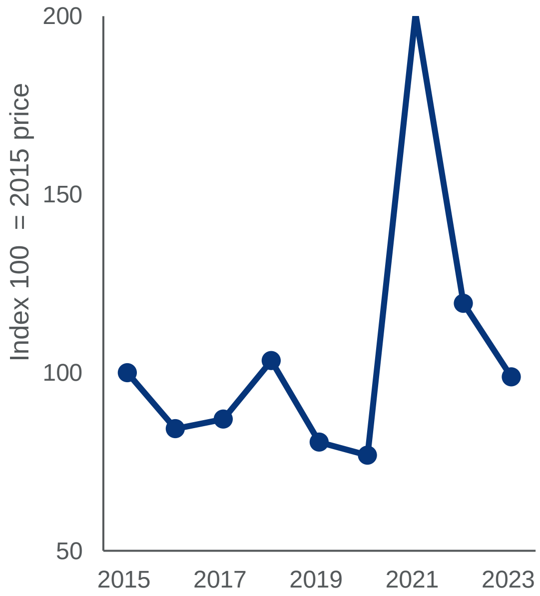


Source: Wood Mackenzie, Factset

Recent inflationary trends can be clearly seen in price spikes for key offshore wind inputs like steel, copper and diesel

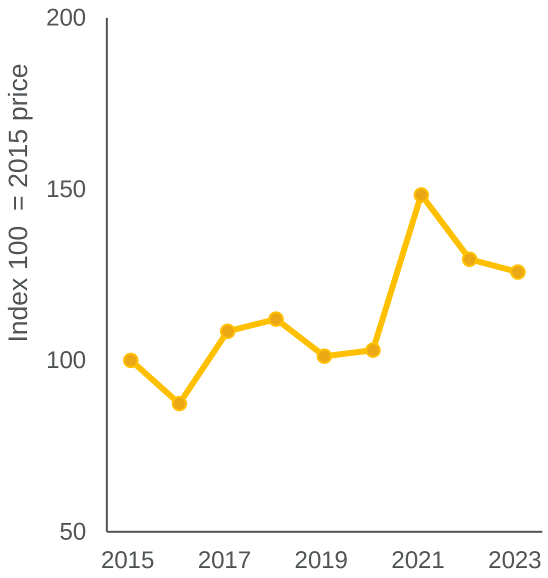
Steel prices suffered the largest shock followed by diesel and then copper – although prices have come down most of these indexes remain stubbornly inflated

Steel prices



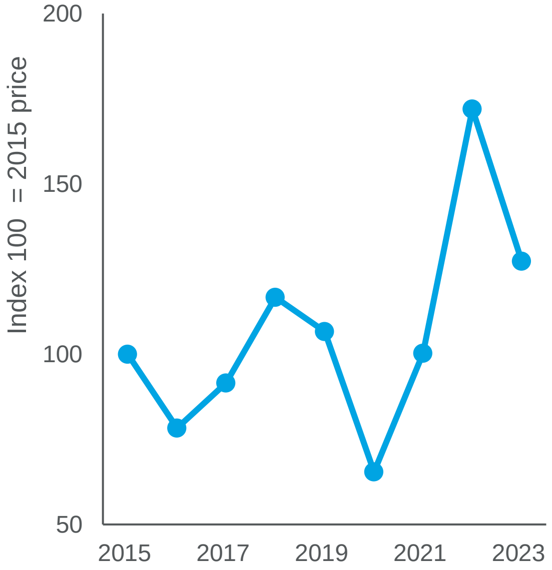
Source: Wood Mackenzie
Note: Hot rolled coiled steel US Midwest ex-mill US$/tonne

Copper prices



Source: Wood Mackenzie
Note: London Metal Exchange Cash Copper Price Real 2023 $/tonne

Diesel prices

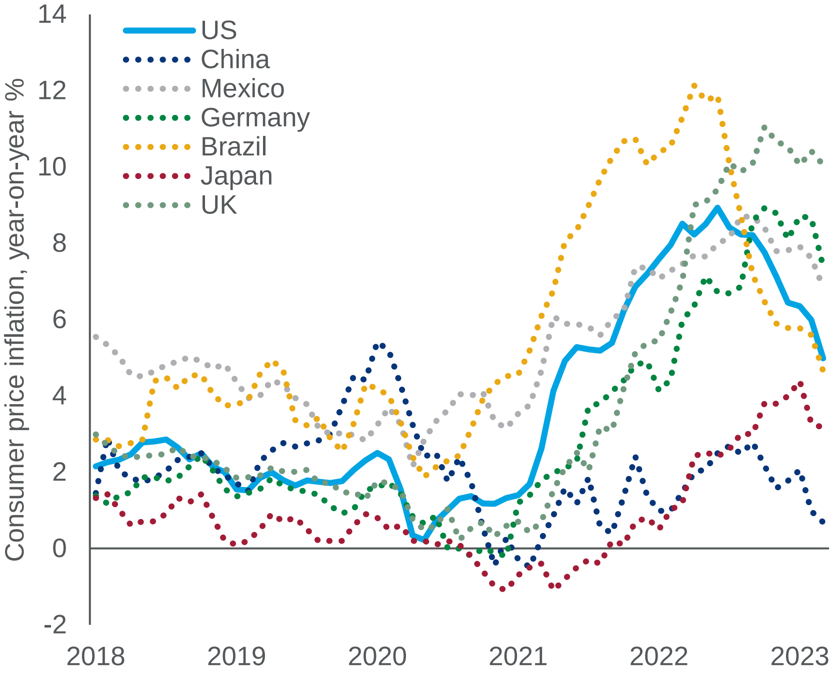


Source: Wood Mackenzie
Note: New York ultra low sulphur diesel Real 2023 US$/barrel FOB barges

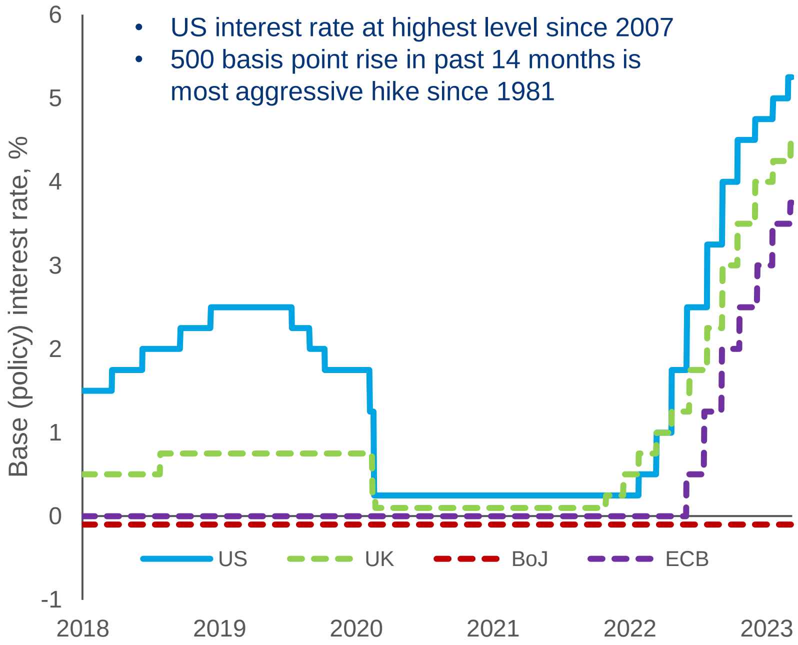
Soaring inflation has prompted a cycle of aggressive interest rate tightening

US inflation is in retreat but remains elevated above the Federal Reserve's 2% target putting upward pressure on typical offshore wind project borrowing costs

US inflation versus peers



Monetary policy of major central banks



Source: Wood Mackenzie, Factset

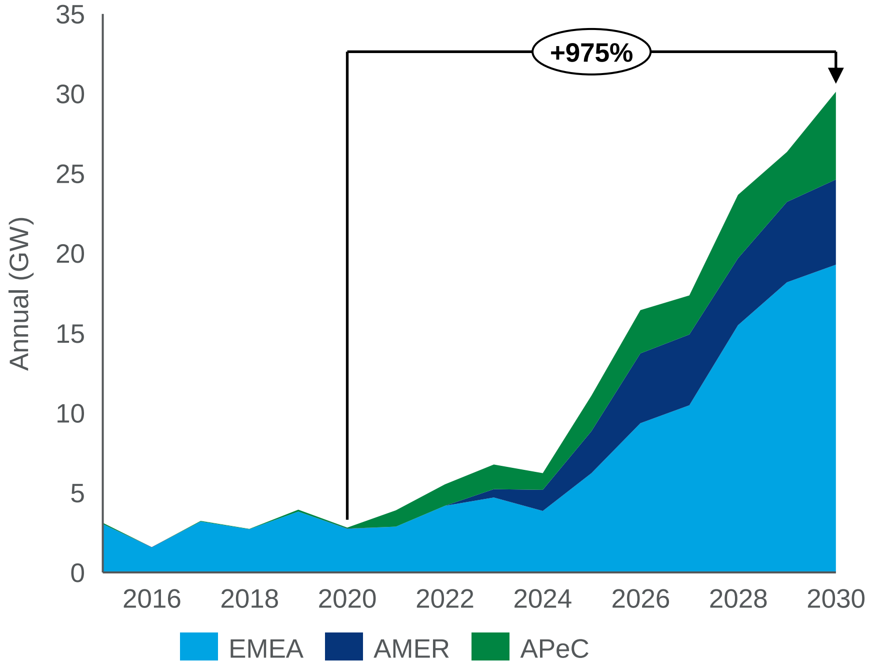
2. Offshore wind demand

2.1 Wood Mackenzie’s base case outlook

The opportunities are vast in the offshore wind sector

Outside of China, the annual GW demand in 2030 will be over ten times greater than in 2020

Annual offshore wind grid-connected capacity



Key drivers of the offshore wind opportunity

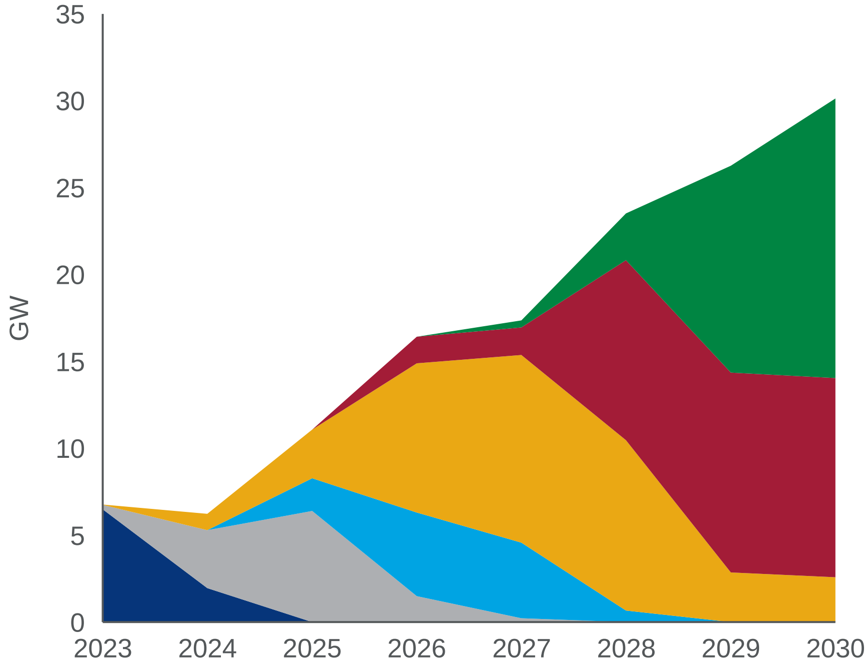
- **Rapid deployment at scale** Offshore wind's technical potential is very large and GW scale projects make offshore wind attractive as pressures mount to decarbonise power production
- **Maturing technology** The offshore industry has moved beyond its infancy and the level of technical risk associated with projects has been reduced
- **Improving cost competitiveness** The LCOE of offshore wind has nearly halved between 2015 and 2020
- **Strong public policy support** The need for carbon-free generation in land constrained regions or regions with less attractive irradiance and onshore wind resources has led to strong support for offshore wind. The importance of energy security and green jobs also boost offshore wind support.
- **Linked to green hydrogen** High-capacity factors make offshore wind an attractive option for powering the production of green hydrogen.

Note: EMEA: Europe, Middle East and Africa. AMER: Americas. APeC: Asia Pacific excluding China.
Source: Wood Mackenzie

Government subsidies offer long-term visibility on projects

89% of the capacity expected through 2027 has at least been awarded a support scheme, offering high visibility

Offshore outlook by project status



Note: Outlook excludes China
Source: Wood Mackenzie

Risks of not getting build or delayed based on project-status

Offshore construction started
There is a risk of project delays primarily caused by weather and seabed equipment failure. The risk of cancellations is very low here and the risk of delays after construction has started is considered limited.

Final investment decision (FID)
Similar to 'Offshore construction started', except here the risk from delays also includes the wider suppliers and quality issues. The risks of delays and cancellations are also low here.

Support scheme awarded and permits in place
Once the support scheme and permits are secured, the risk of cancellations drops significantly. More certainty is also provided on the timing of the project, especially for those with a grid-connection deadline. As FID is not provided, projects are susceptible to macroeconomic changes which can shift FID decisions.

Advanced planning (support scheme awarded but no permit)
Variations exist across support schemes, especially in relation to whether or not permitting is signed before or after the contract. The lack of a permit puts the timeline of the project at risk.

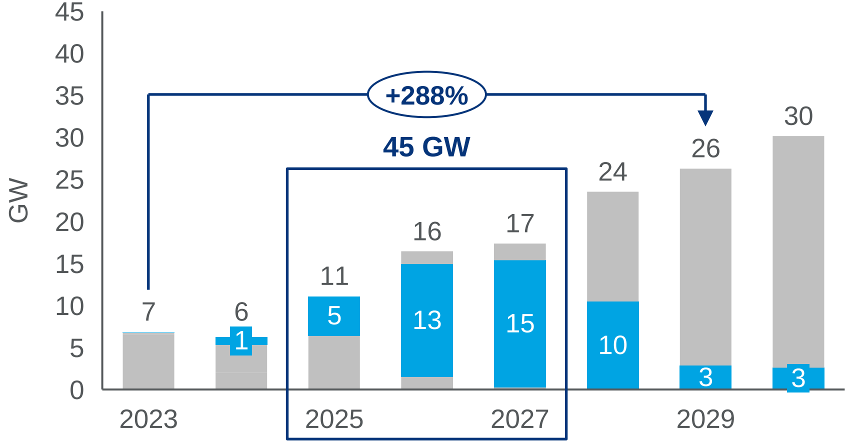
Early site development
The milestones of these projects are more uncertain as the projects have yet to identify a route to market and are therefore more likely to be cancelled.

Pre-project
As there is no identified site or route to market, the risk of cancellation and delays are high for these projects.

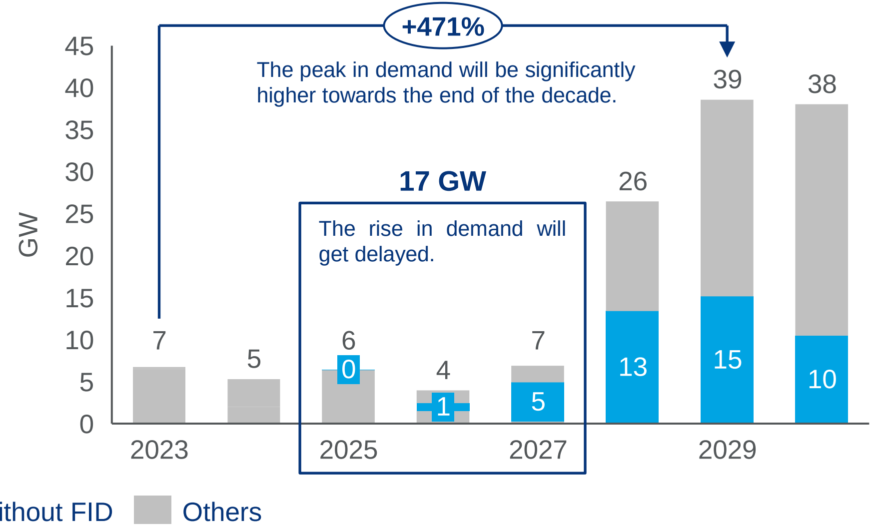
Delaying FID would impede mid-term buildout and exacerbate bottlenecks

Without securing FIDs, the developers will be unable to firm up supply chain orders which would restrict supply chain investments and in turn subdue the deployment of offshore wind

Wood Mackenzie base case offshore wind capacity outlook



Base case outlook assuming two years delay of secured pipeline without FID



No FIDs → No supply chain orders → No supply chain investments → Subdued offshore wind growth

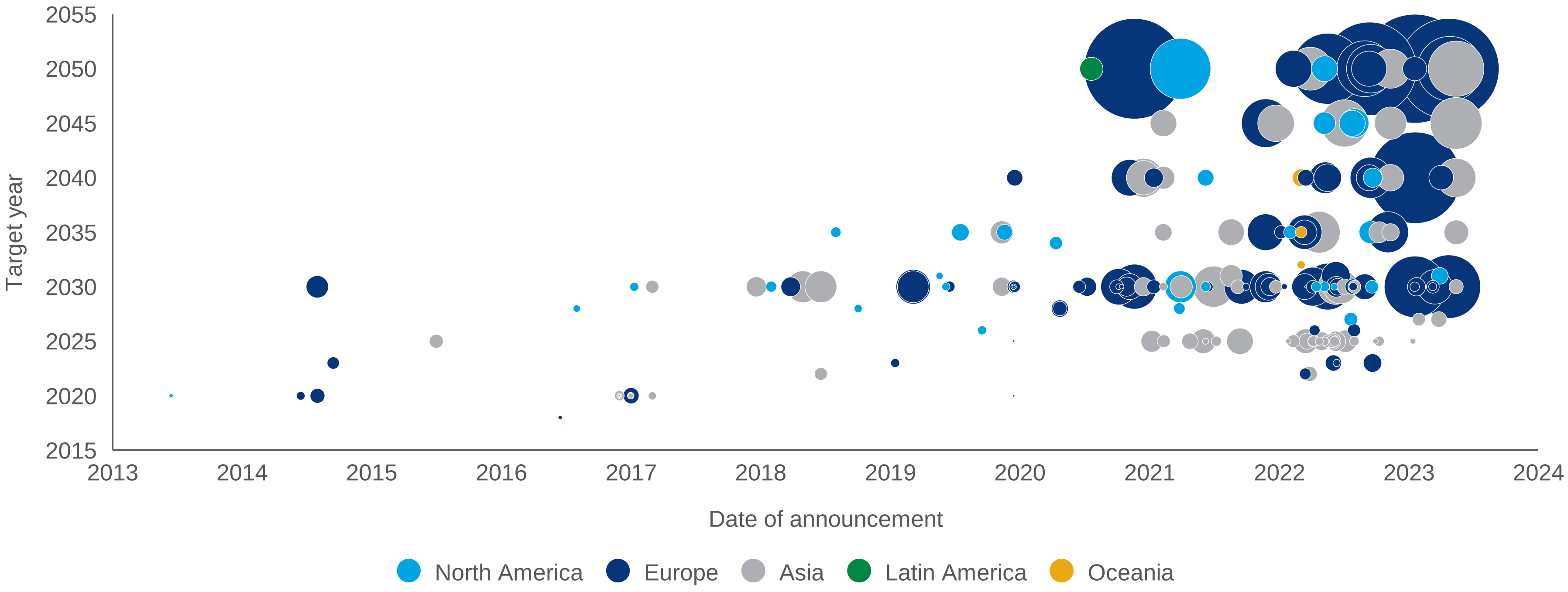
Note: Secured pipeline is defined as projects which have been awarded a subsidy or a route to market. FID: Final investment decision. Data excludes China
Source: Wood Mackenzie

2.2 Government targets for offshore wind

Government targets for offshore wind have been accelerating since 2021

This trend encapsulates the momentum of the energy transition, and it illustrates how policy-makers confidence in offshore wind as a central tool for decarbonisation

Global offshore wind targets announcements by region

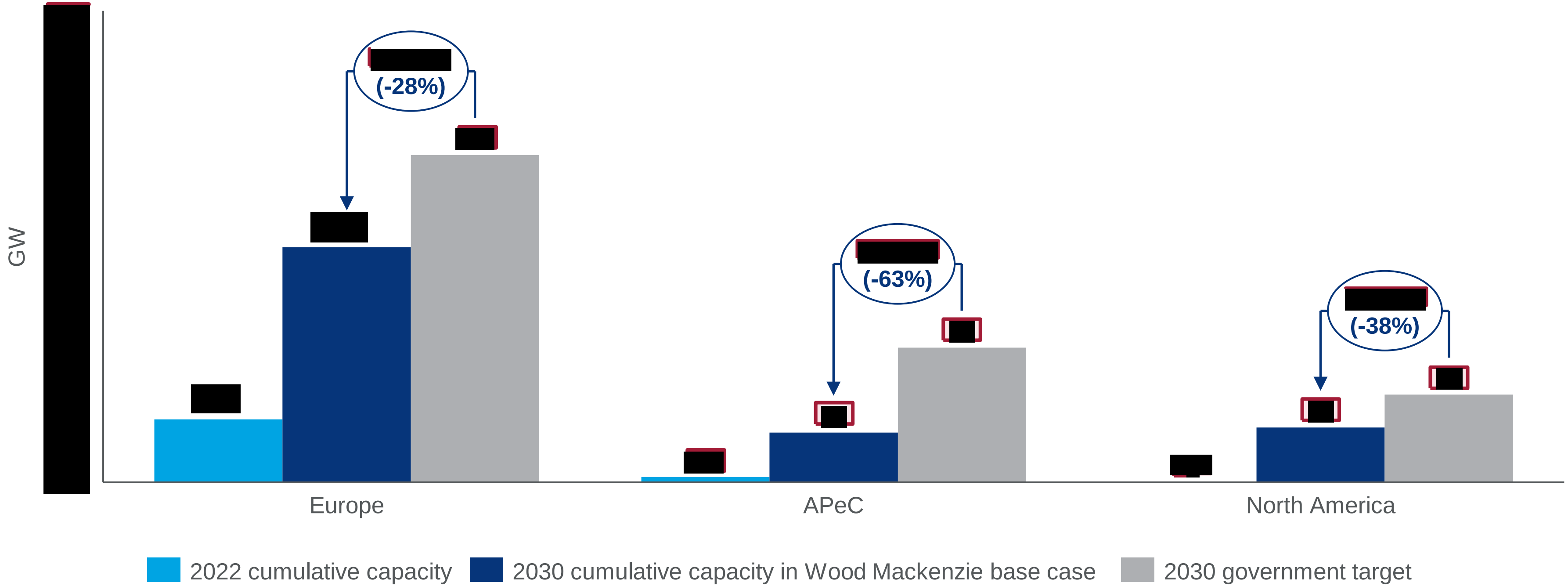


Source: Wood Mackenzie

Wood Mackenzie’s base case is 100 GW below* 2030 government targets

When new targets have been set in markets where no offshore wind exists, like in North America, additional financial policy support is required to tap the potential for installations

2030 government targets vs. 2030 cumulative capacity in Wood Mackenzie’s base case

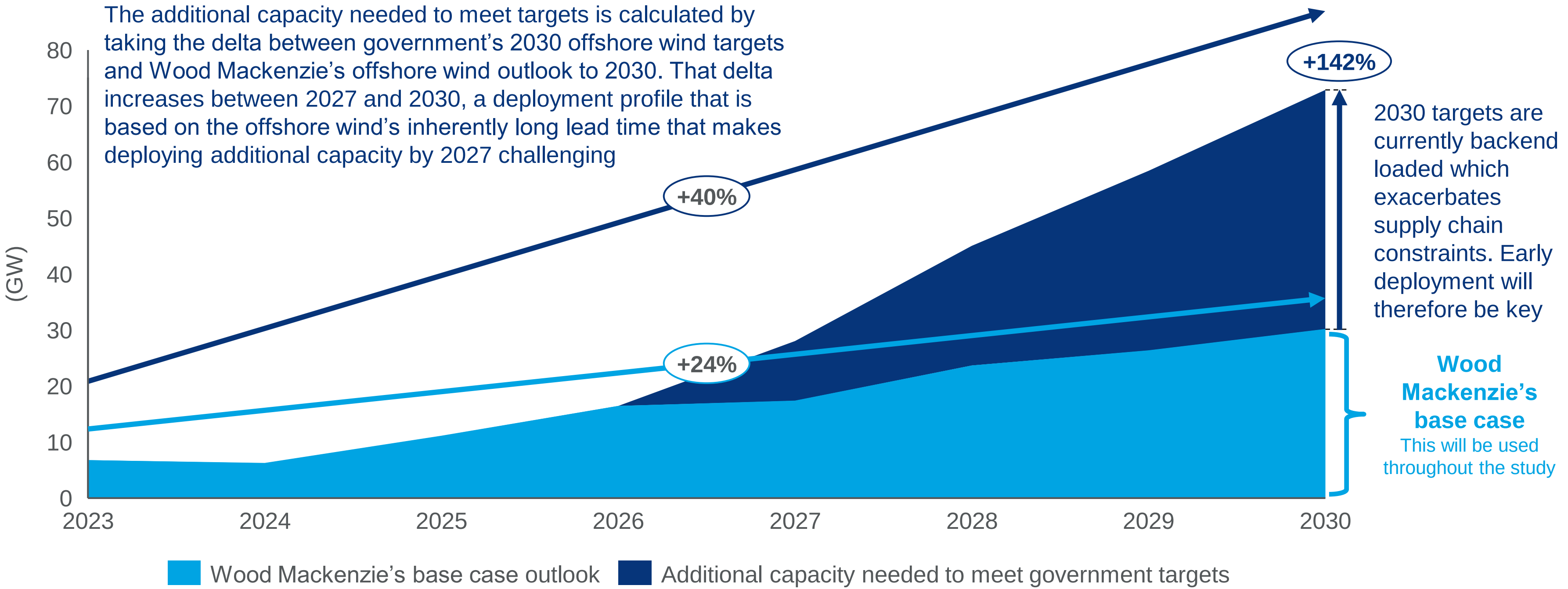


Note: *Excluding China
Source: Wood Mackenzie

Significant ramp-up needed in the late 2020s to meet government targets

Long lead times mean that the additional capacity coming from targets announced from 2021 will need to be deployed between 2027 and 2030 - a period when the supply is already tight

The delta between Wood Mackenzie's base case offshore wind outlook and 2030 government targets



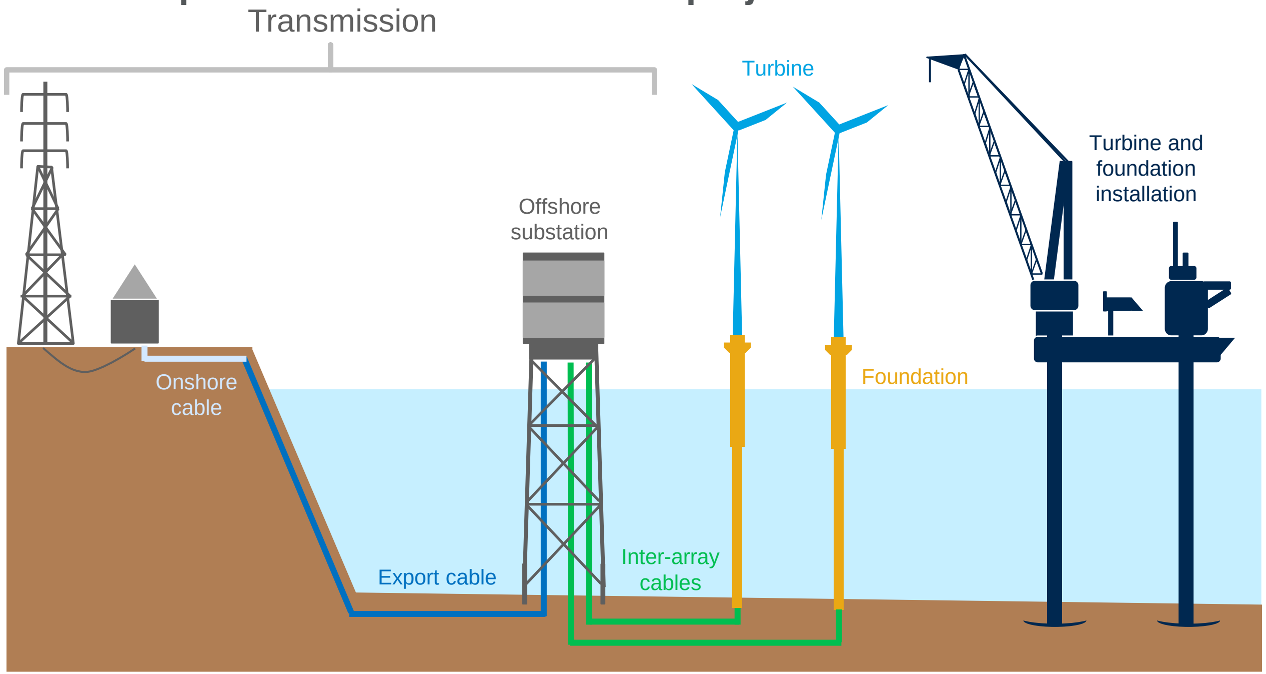
Note: *Excluding China
Source: Wood Mackenzie

2.3 Parameters of study

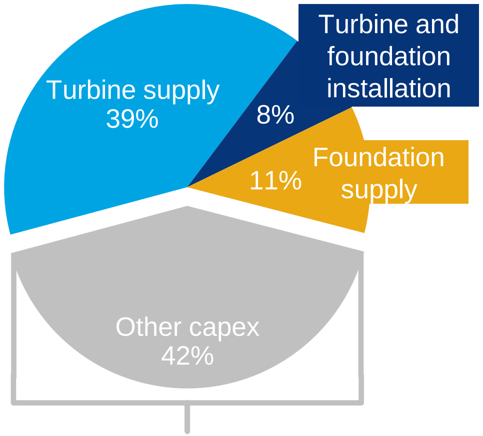
The analysis will cover the turbines, foundations and installation of both

The supply and installation of foundations and turbines are the focus of this study as they are the key parts of a typical offshore wind project and make up almost 60% of the total capex

Main components of an offshore wind project



Illustrative capex split by components*



The suppliers of the other components (primarily transmission) are also supplying to other industries. As the supply vs. capacity for these components will be heavily influenced by the activity in the other sectors, these components are omitted from this analysis.

Note: *Capex in this pie chart excludes construction insurance, project management and contingency. Capex split varies from project to project and market to market. The split shown should therefore be considered illustrative.
Source: Wood Mackenzie

GW outlooks do not translate directly into supply chain demand

To conduct supply vs. demand analysis for the offshore wind sector, the capacity demand needs to be translated into relevant demand drivers for the major components.

Converting capacity outlooks to supply chain demand

Blades

For blade suppliers it is the number of blades that defines the demand.

Each turbine uses three blades so the conversion from GW capacity to number of blades depends on the rate of upgrades and adoption of new generation turbines.

Nacelle assembly

For nacelles it is the number of nacelles that defines the demand.

Each turbine uses one nacelle so the conversion from GW capacity to number of nacelles depends on the rate of upgrades and adoption of new generation turbines.

Tower

Each turbine uses one tower, but each of the towers are made up of multiple sections. As such, it is the number of sections that is the main driver of demand for the tower suppliers.

The dimensions are chiefly decided by the turbine model but area characteristics and permitting also influence the dimensions.

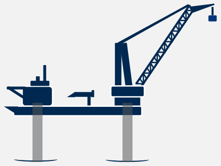
Offshore wind turbine

Foundation

Monopiles are the main foundation technology, with an 81% share of Wood Mackenzie’s 2030 bottom-fixed outlook. Therefore, monopiles are taken for foundation demand.

Monopile sizes vary based on the turbine model and area characteristics. As such, the tonnes of steel is the demand driver. As monopile suppliers supply both the pile and the primary steel for the transition piece, the demand of both is included in the analysis.

Installation



Installation refers to the installation of turbines and foundations.

Installation campaigns are susceptible to area characteristics, foundation and turbine dimensions, vessel efficiency, distance to the installation port and regulation. As such, the number of vessel days is used to derive demand for installation vessels.

Source: Wood Mackenzie

3. Offshore wind supply

3.1 Offshore wind supply vs. demand summary

Supply chain risk to meeting offshore wind build out is as high as 80%

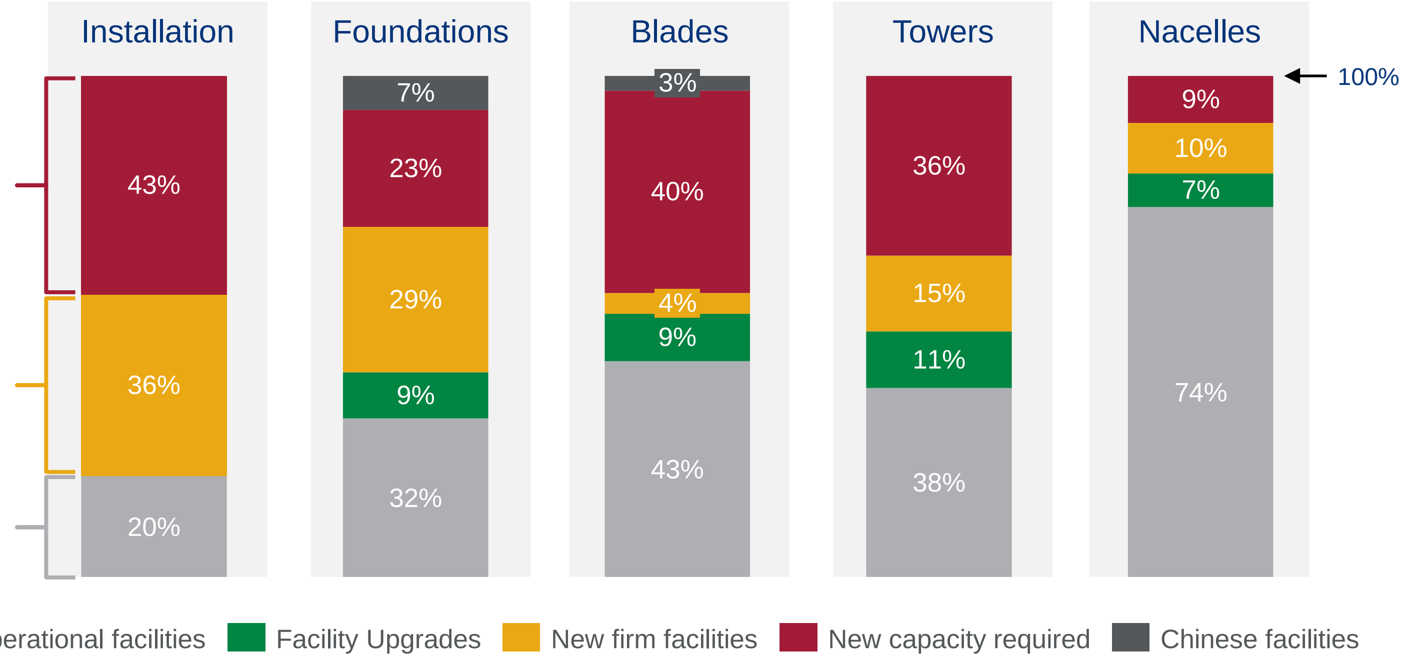
The lack of supply chain capacity required by 2030 that is operational today introduces risk, as delays to facility construction and investments will initiate bottlenecks in offshore wind build out

2030 supply for each segment by status of facilities today

This capacity is **not online today**, and has not received a firm investment. This capacity is required to be fully operational by 2030 and poses the highest risk to offshore build out.

This capacity is **not online today**, but is under construction, or has received firm investment. Risk sits within facility timelines and delays in facility operations.

This capacity **is online today**, and therefore has a low risk.

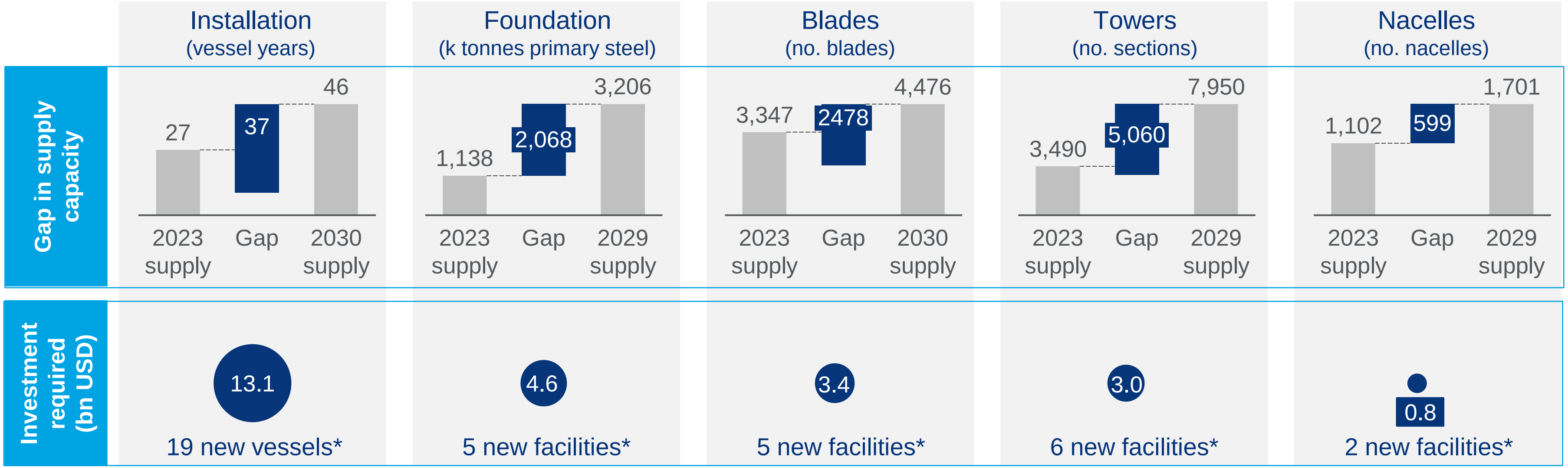


Note: Only Chinese facilities which have received a firm order for supply chain components for projects in Europe or the US are included in the supply and demand analysis. Demand excludes projects in China.
Source: Wood Mackenzie

25 billion USD of investments in new supply capacity needed by 2030

The turbine and foundation installation segments require the greatest investments to meet 2030 demand. The main reason is that a lot of the existing fleet is being pushed out of the market.

Supply capacity gap out to 2030 and the investments required to meet demand



Please note that there are additional streams of investments needed beyond the investments in new assets. That includes new mission equipment for vessels, new infrastructure – not least in ports – to accommodate the new facilities and vessels and continuous investments in R&D, process improvements and maintenance of the assets.

Notes: Investments exclude the cost of R&D and facility capability upgrades. In cases where the gap is negative, it means that capacity is coming out of the market and therefore needs to be replaced. *Based on an average new vessel/facility capacity per year. USD figures represent total Capex including announcements, facility level only indicates investments yet to be finalised. Source: Wood Mackenzie

The long lead time pushes new supply chain investments post 2025

The lead time highlights the urgency of investments with USD 25 billion required to be allocated by 2026 to 2027 to meet the demand peak at the end of the decade

Lead time for new facilities and vessels and the investments needed by MW

	Installation	Foundation	Blades	Towers	Nacelles
Lead time for a new facilities or vessels	3-4 years	4-5 years	3 years	3-4 years	2 years
Investment per MW (kUSD)	200	248	207	150	66

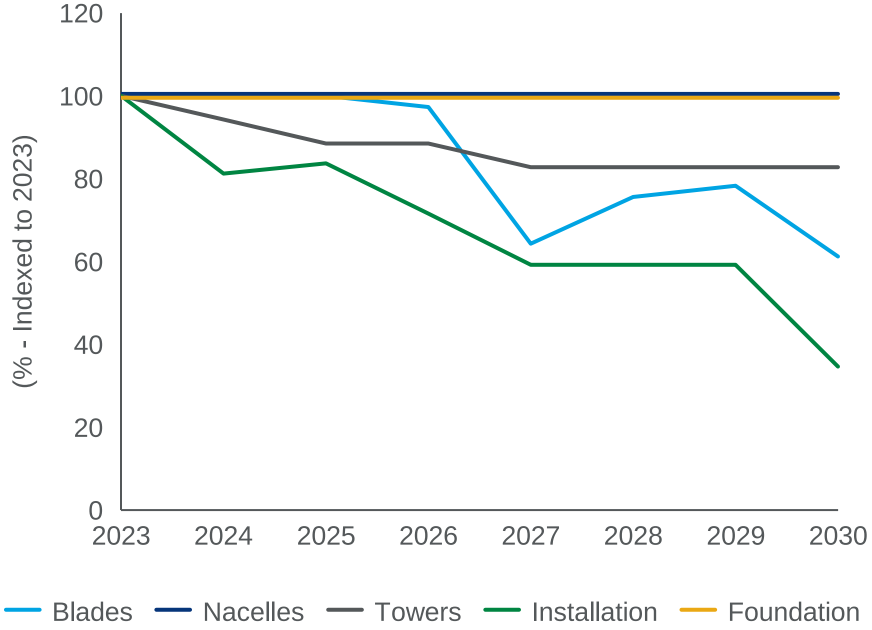
Note: Lead times can vary significantly from market to market and even facility as the facilities must go through permitting and get acceptance from local stakeholders.
Source: Wood Mackenzie

3.2 Implications of supply chain constraints

Next generation +15MW turbines will push existing supply out of the market

The exposure to increasing turbine ratings varies across the supply chain with 65% of todays capacity being unsuitable for use by 2030 in the case of installation vessels.

Share of 2023 operational supply capacity still active in 2030



Nacelle assembly and foundations

Whilst Wood Mackenzie forecast all facilities active today to remain in the market by 2030 – that does not mean that active facilities will not see significant investment. Investment in facilities, equipment and R&D is required to maintain the level of output as component sizes and complexities increase. As such, investments are required to even keep supply stable over time.

Blades

As blade lengths increase, so does the time taken per mould to fabricate a blade. Additionally, facilities will need to replace blade moulds with each new turbine model launched, to allow for the fabrication of the larger blades. In many cases this could require expansions of the buildings. This also pulls capacity out of the market.

Towers

Increasing section diameters will significantly decrease the efficiency of sites based in-land as logistics of transportation become a hurdle.

Installation

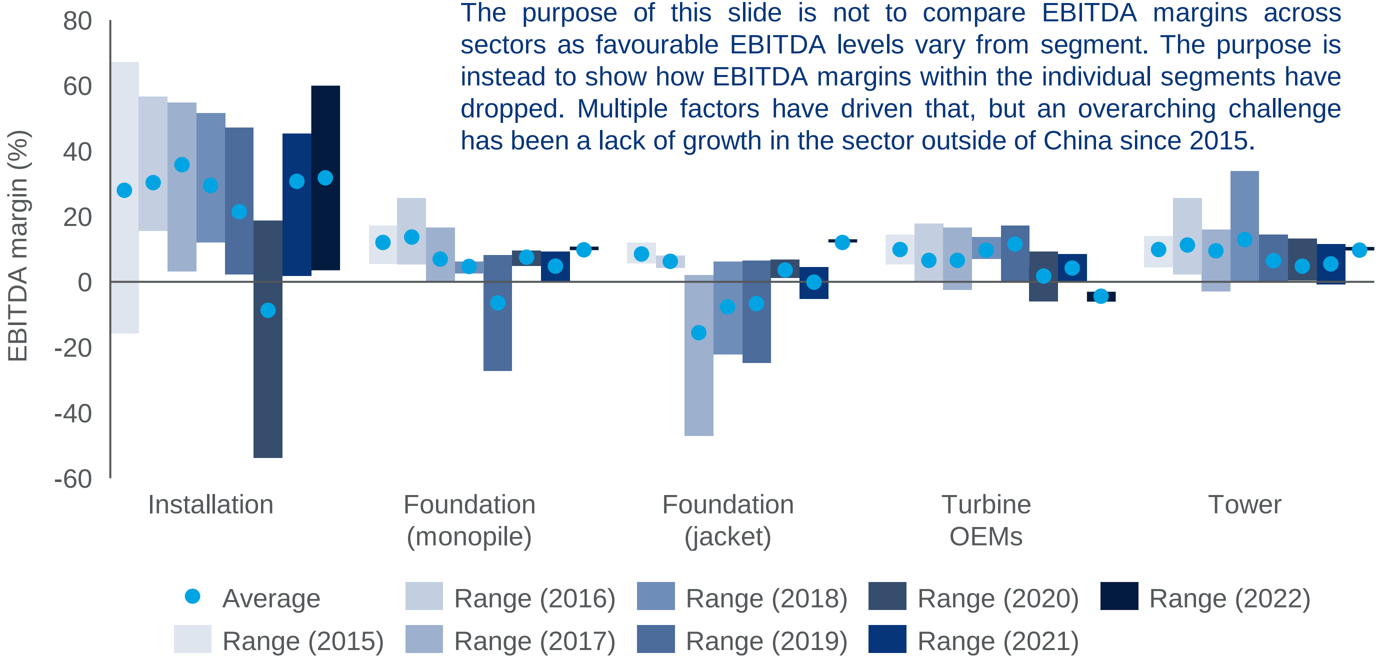
Larger turbines and foundations increase the lift height and weight requirements, pushing legacy vessels that were built for smaller component sizes out of the market. Just 20% of the capacity active in 2023 will be able to remain in the market by 2030.

Source: Wood Mackenzie

Margins across the offshore wind supply chain have been squeezed since 2015

Low margins challenge investments in new assets and R&D. In worst cases, it can even push some suppliers to pivot to other segments or sectors in pursuit of greater margins.

EBITDA margins for key offshore wind supply segments (excl. China)



The purpose of this slide is not to compare EBITDA margins across sectors as favourable EBITDA levels vary from segment. The purpose is instead to show how EBITDA margins within the individual segments have dropped. Multiple factors have driven that, but an overarching challenge has been a lack of growth in the sector outside of China since 2015.

Investing in new supply capacity

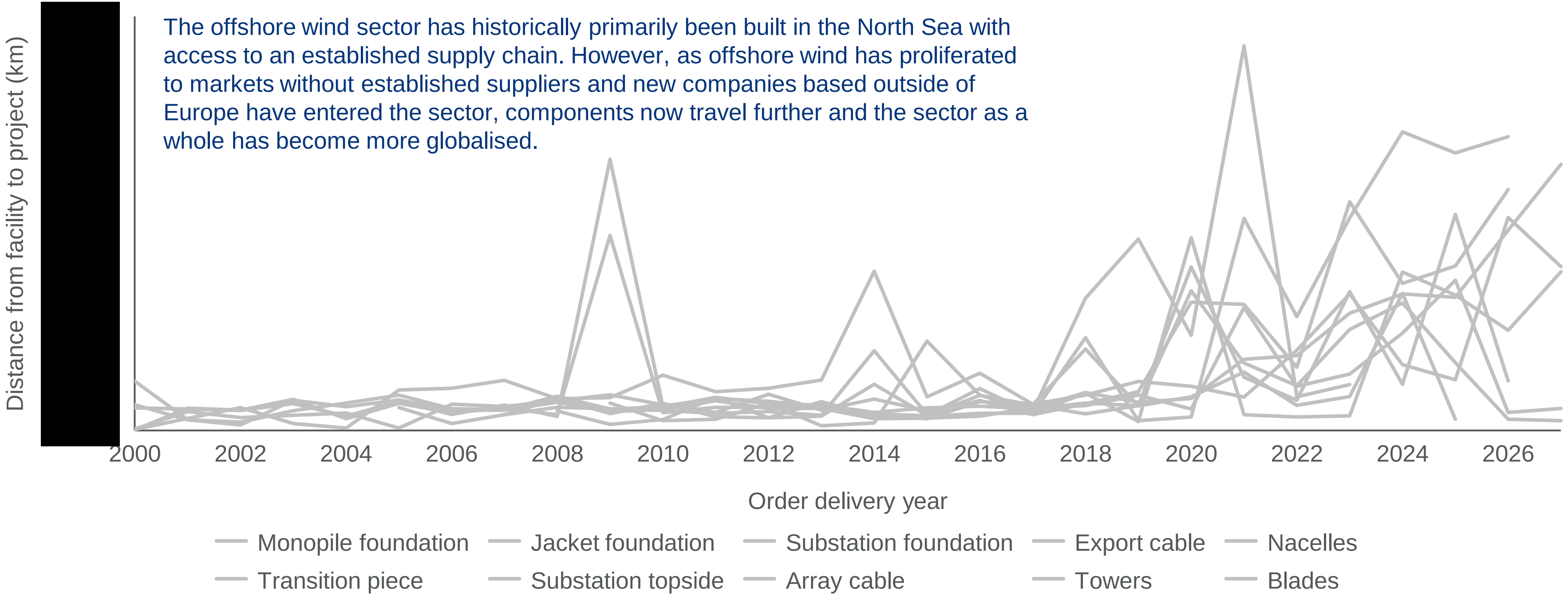
The low EBITDA margins for the suppliers challenge their ability and requirements for new investments. These challenges are amplified by two factors. Firstly, the cost of capital is going up and that they cannot equity finance the new assets meaning that they have to go for the more expensive debt finance. Secondly, the macro-economic pressures are substantially driving up capex of new investments. Lastly, the suppliers are also vulnerable to project delays.

Note: EBIDTA: Earnings before interest, taxes, depreciation and amortisation. EPCI: Engineering, procurement construction and installation. OEM: Original equipment manufacturer. Not all suppliers have released 2022 results, so the small range seen in some sectors in 2022 will likely expand. Source: Wood Mackenzie

The offshore wind sector is becoming increasingly global

The supply vs. demand analysis will therefore not be local, but global. The analysis will meanwhile exclude China demand, unless otherwise specified as the market operates independently.

Weighted average distance travelled by offshore wind component

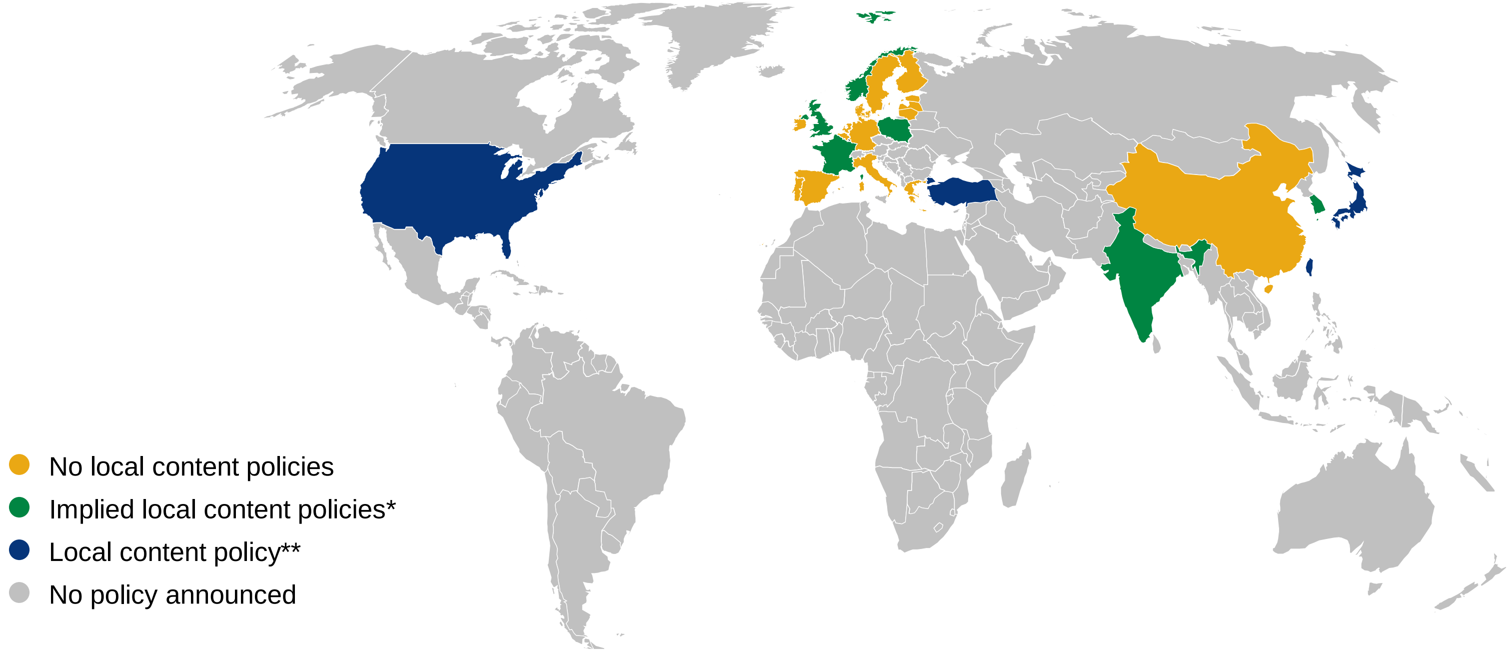


Note: Excludes projects in China and Vietnam. Note that more orders will be placed for projects from 2024-2027.
Source: Wood Mackenzie

Local content policies are proliferating, exacerbating supply chain constraints in some markets

Markets are different. As the offshore wind sector globalises, the supply chain shifts and introduce new inefficiencies and risks. These risks are amplified by local content policies.

Strength of local content policies for offshore wind

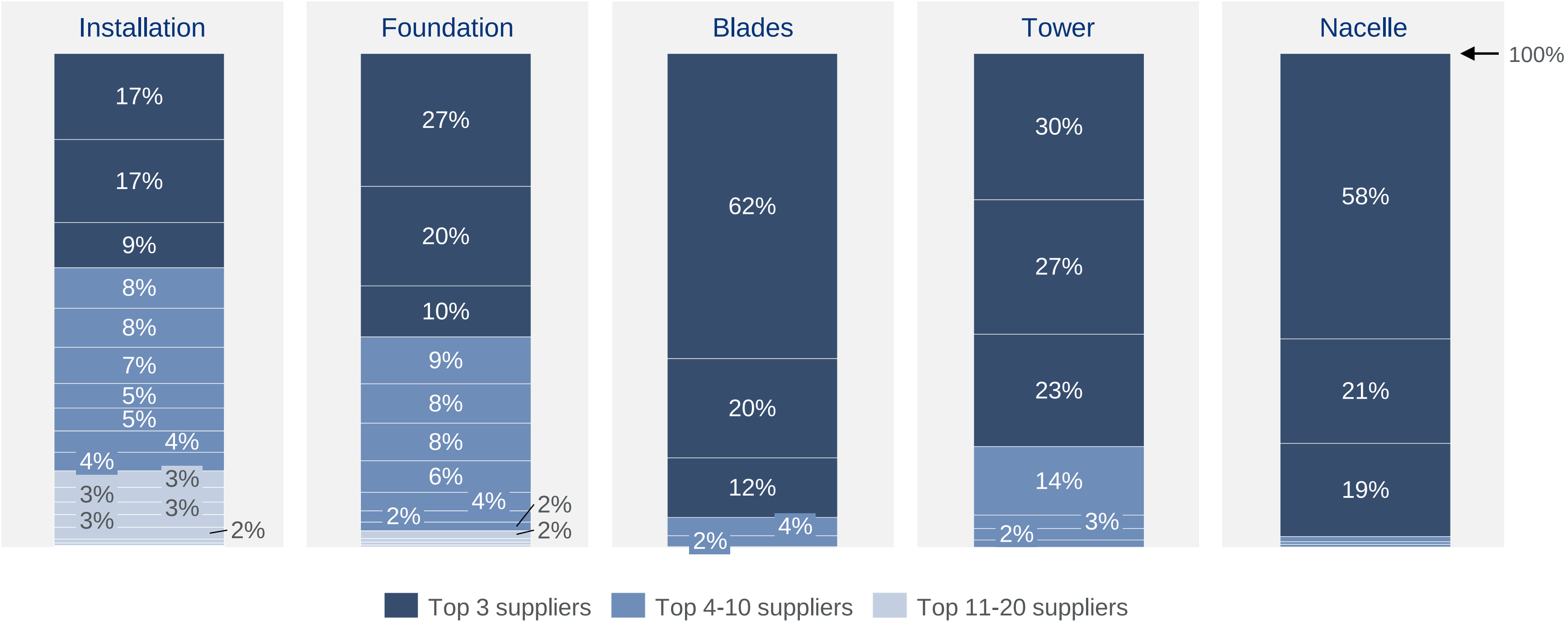


Note: *Implied local content policy – local content is being explicitly targeted by policy-makers but does not feature as competitive parameters in tenders or auctions.
**Local content policy – local content feature as competitive parameters in tenders or auctions.
Source: Wood Mackenzie

Consolidation in the market limits the options for developers

As it is a consolidated market, not securing capacity with a well established supplier results in dealing with a player with considerably less experience

2020-2030 market share of announced orders by supplier

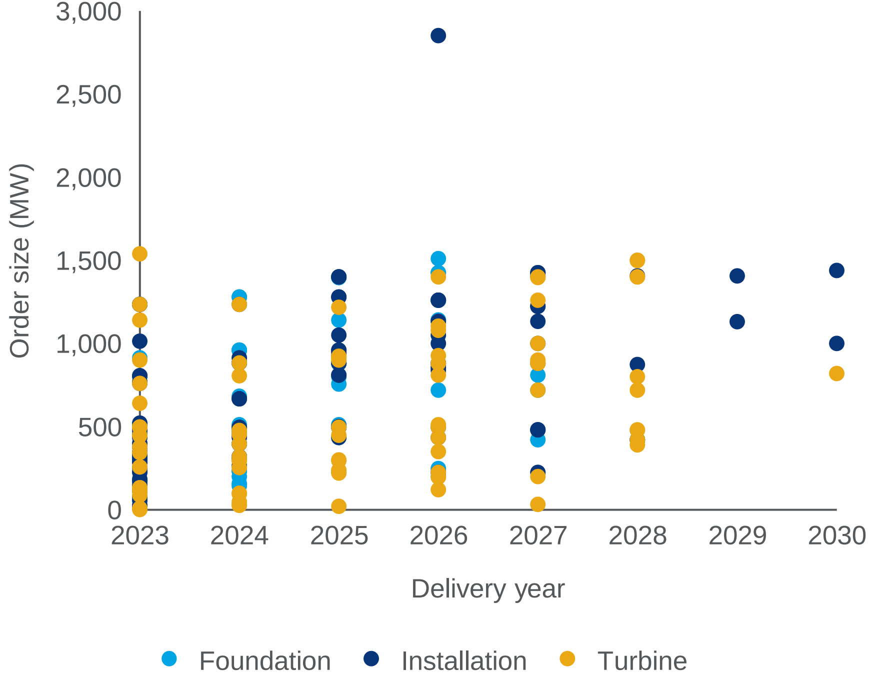


Note: Foundation market share is for primary steel components for monopiles and transition pieces. Source: Wood Mackenzie

Over the past two years the sector has become a sellers market

The tightening supply has changed procurement patterns, pushing developers to buy earlier, even before FID, to secure the right capacity at the right capability and reduce schedule risk.

Delivery year of announced orders



Early commitments

Developers are committing earlier – slot agreements for production capacity lasting five years with upfront payments and capacity reservations going all the way out to 2030 are now being awarded. Developers do that, not only to secure supply capacity, but also to secure the right quality. That includes getting the next generation vessels, established suppliers with a track record with fully operating facilities or suppliers they trust and can expand capacities. In markets with local content, facilities located in the market is also favoured.

Limited contingency

If an order gets delayed, it is difficult to find the spare capacity to execute the order. The delay itself can therefore also reduce the utilisation of the supply chain and in turn the supply capacity down. It also introduces more risk for the supplier.

Suppliers' influence

With the tighter supply vs. demand, suppliers are now in a position where they can influence project timelines.

Source: Wood Mackenzie

4. Supply vs. demand by major offshore wind component

Supply vs. demand is more than just supply and demand

Supply vs. demand in offshore wind

Supply capacity

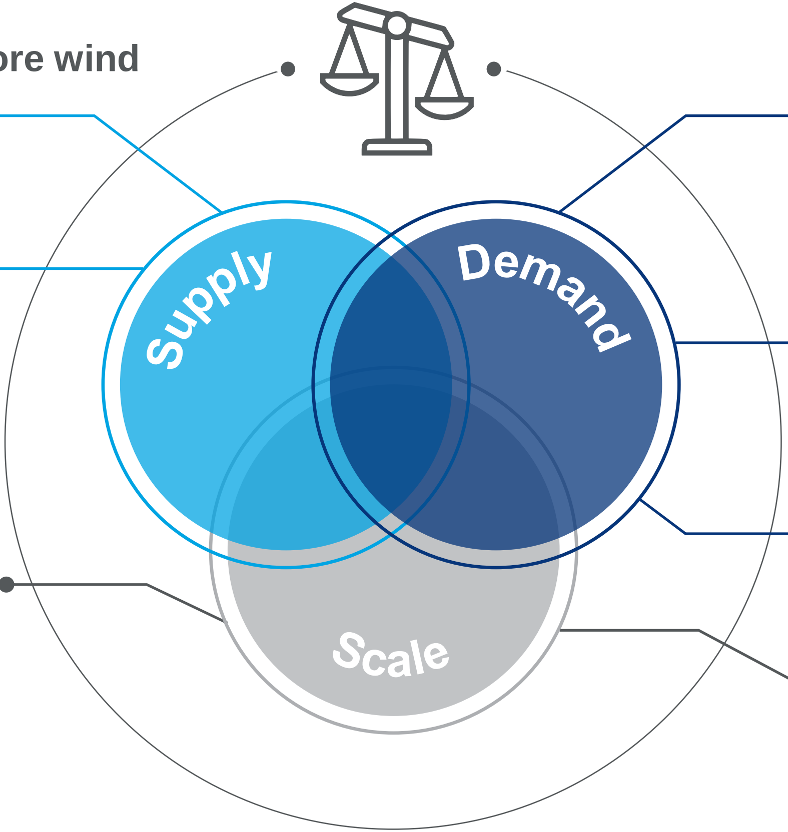
The supply capacity is analysed at the facilities or vessels level.

Capability

The growing weight and dimensions of the components means that supply is both about the capacity and the capabilities of the facilities and vessels. This also includes securing up-tier supply capacities, e.g. heavy steel.

Inefficiencies with tight supply

The relationship between supply and demand is dynamic. As such, changes in supply, demand – both technically and commercially – bring inefficiencies which are amplified when supply is tight.



Government policy*

Government policies, from offshore wind targets through to tender roadmaps and support schemes remain foundational to offshore wind's buildout.

Project pipeline*

Project pipelines and the maturity of these pipelines define the offshore wind potential over the coming five years.

Power market fundamentals*

The power market fundamentals influence the demand and viability of the offshore wind projects

Material and time per MW

The relationship between MW demand and component level demand varies by component and even project as technology choice and area characteristics vary.

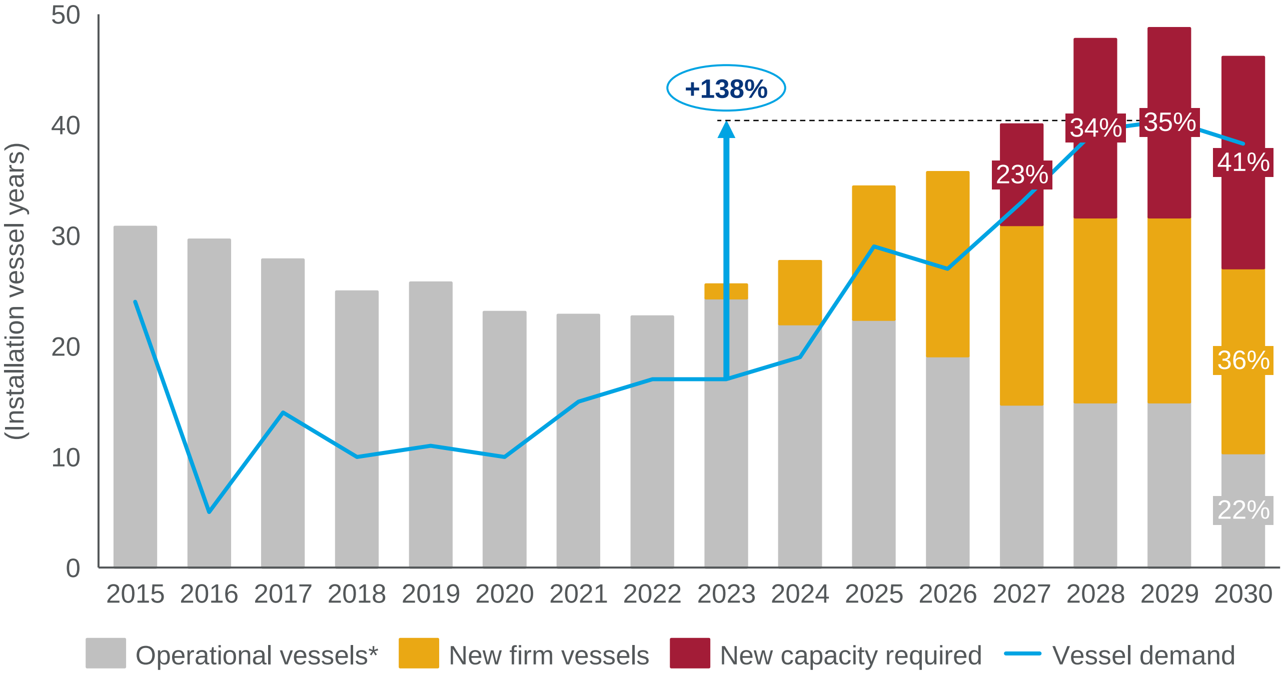
Notes: *The overall demand for offshore wind applies to all components and is therefore covered in Section 1, allowing the following sections to focus on the demand by component.
Source: Wood Mackenzie

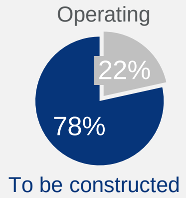
Supply vs. demand for turbine and foundation installation

19 new next-generation vessels will be required by 2030

Supply in the installation market tightens from 2025 due to a combination of growing demand and intensifying vessel requirements, which is pushing the existing fleet out of the market

Offshore wind installation supply and demand





22% of the fleet supply required by 2030 is online today.

$13.1 billion of investments in new vessels is needed to meet 2030 installation demand.

The lead time for a new vessel is **3-4 years**.

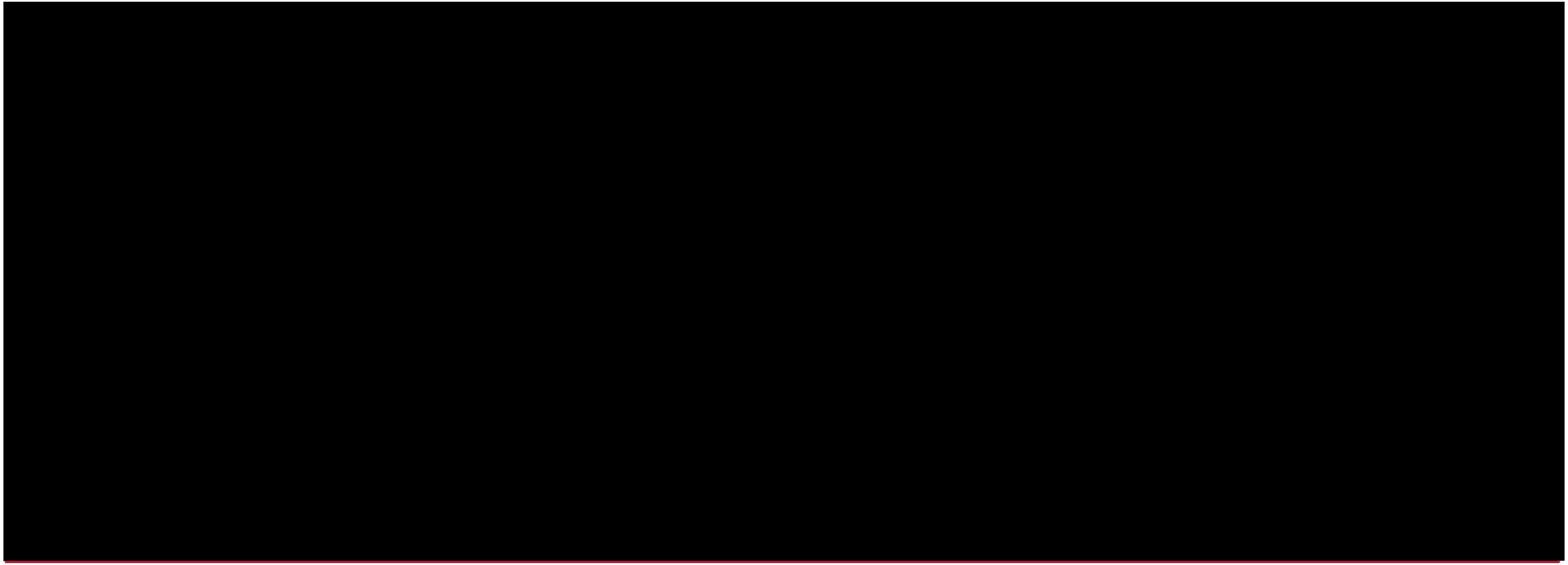
Note: Please see Appendix 1 for definitions of the development statuses of the supply capacity. Excludes China and Vietnam. Excludes demonstration and intertidal projects. Demand based on foundation and turbine installation year. Source: Wood Mackenzie

Methodology: Breaking down demand assumptions

Demand

Demand is calculated on a per project basis and is underpinned by over 1,500 offshore wind vessel order benchmarks verified through VesselTracker[TM] AIS data

Deriving the demand for offshore wind installation days



Market wide outlook · Project level outlook · Supply chain segment outlook · Final demand outlook

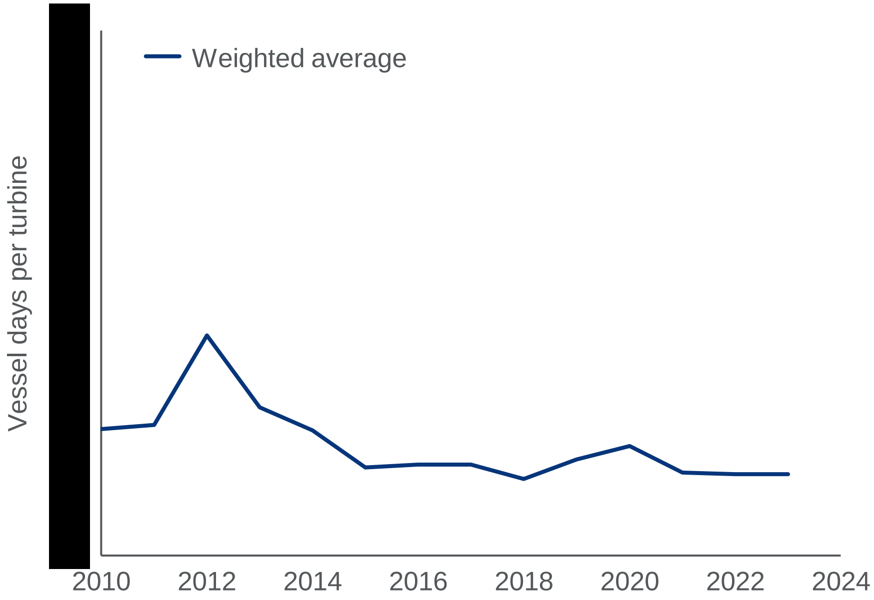
Source: VesselTracker[TM], Wood Mackenzie

Stabilised installation times/turbine slash installation time/MW

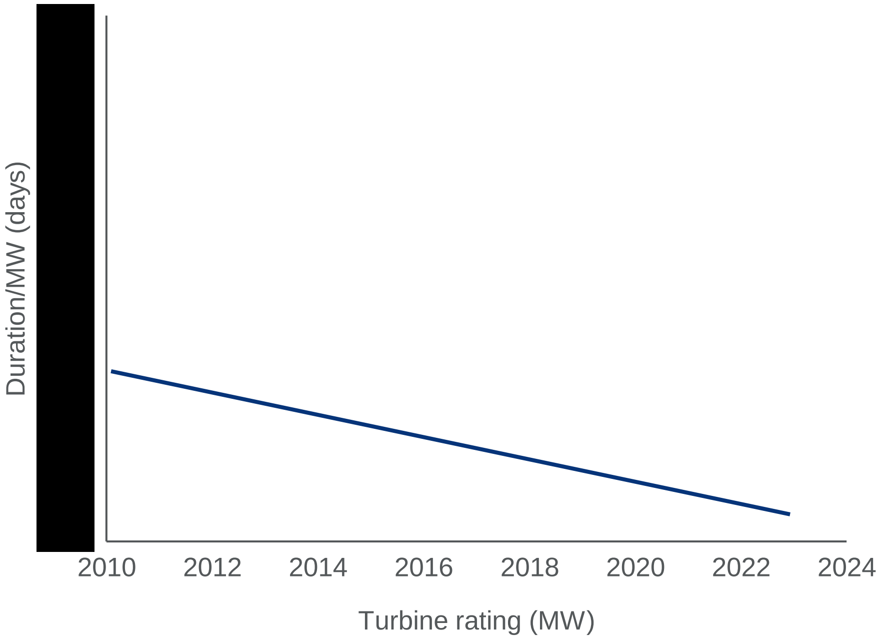
Scale

Despite increased complexity from larger turbines, increased water depths, and project distance from shore, vessel advancements have resulted in a stable installation time per unit.

Installation time per turbine* (2010-2023)



Installation time per MW* (2010-2022)



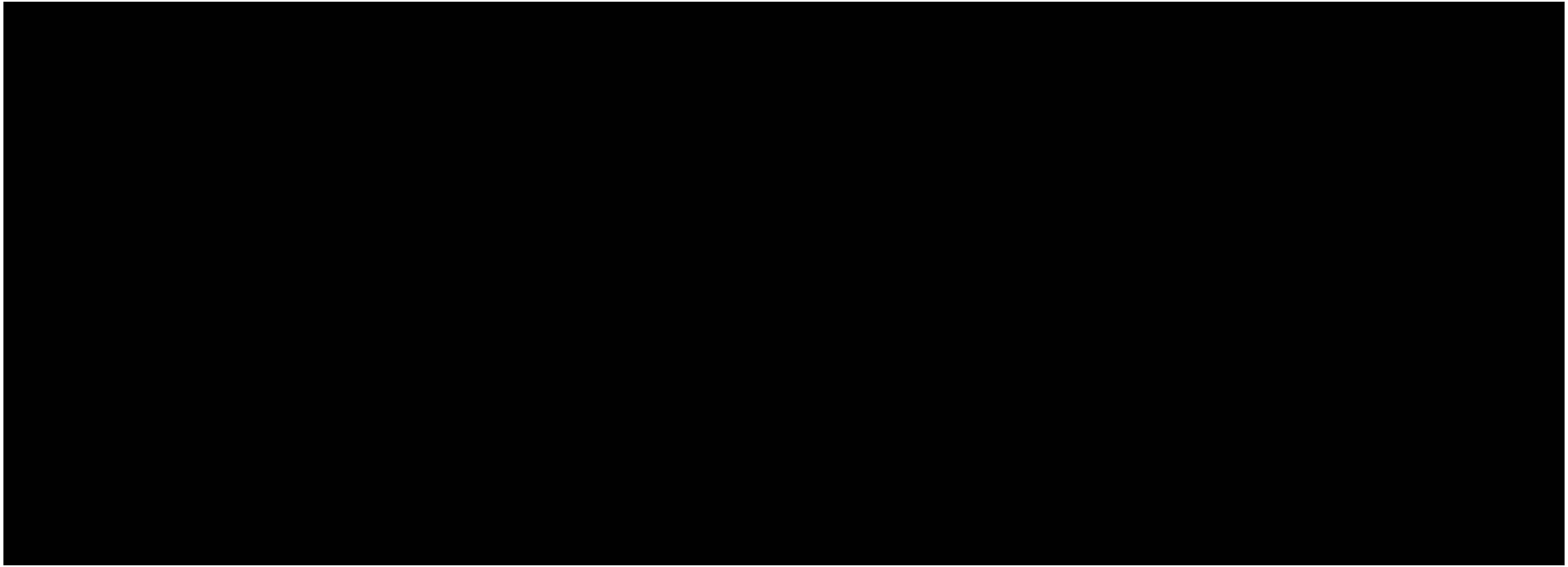
Note: Excludes China and Vietnam. Excludes floating turbines and inter-tidal projects. Outliers with over 20 days per turbine excluded. Only orders confirmed via VesselTracker.com shown.
Source: VesselTracker™, Wood Mackenzie

Methodology: Breaking down supply assumptions

Supply

Supply in vessel days is calculated for each vessel fully or partially targeting the offshore wind installation market outside of China

Deriving the supply of installation days for offshore wind



Market wide outlook | Vessel level outlook | Supply chain segment outlook | Final supply outlook

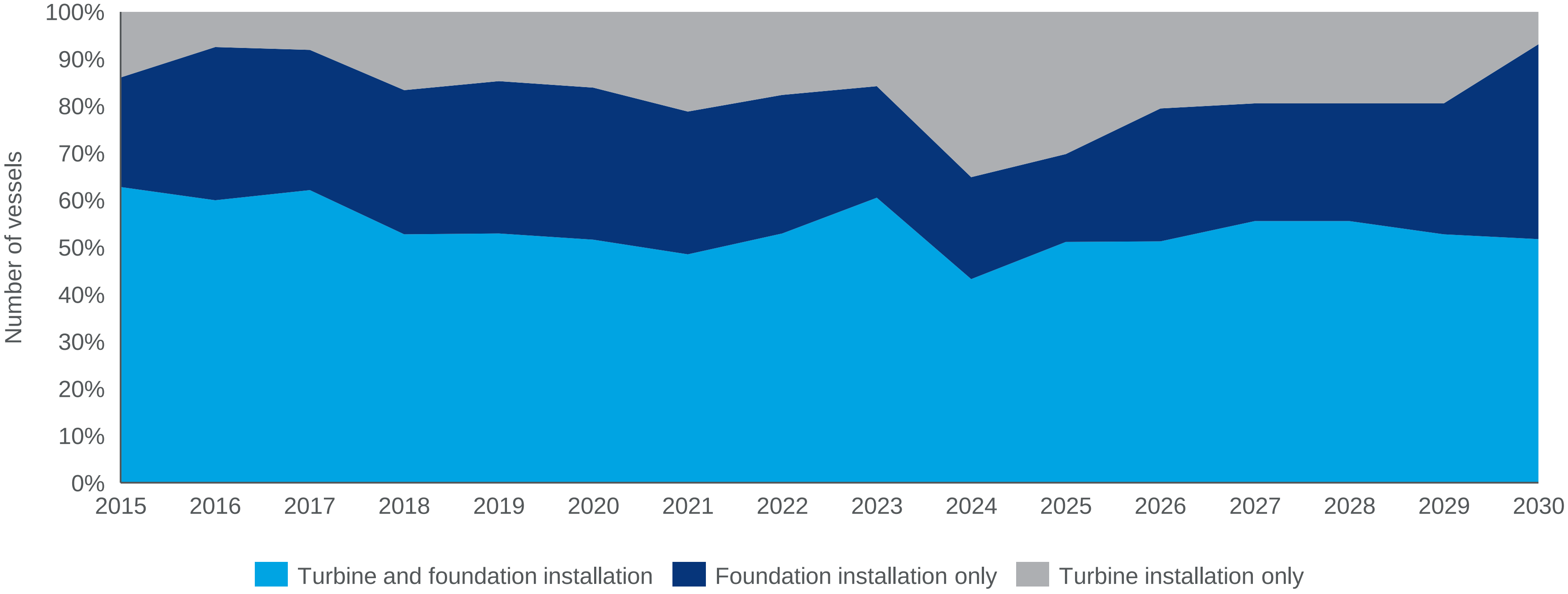
Source: Wood Mackenzie

The foundation and turbine installation markets are interlinked

Supply

Many vessels can install both turbines and foundations, their market participation is determined by company strategy and investment in equipment to handle specific components

Offshore wind vessel segmentation



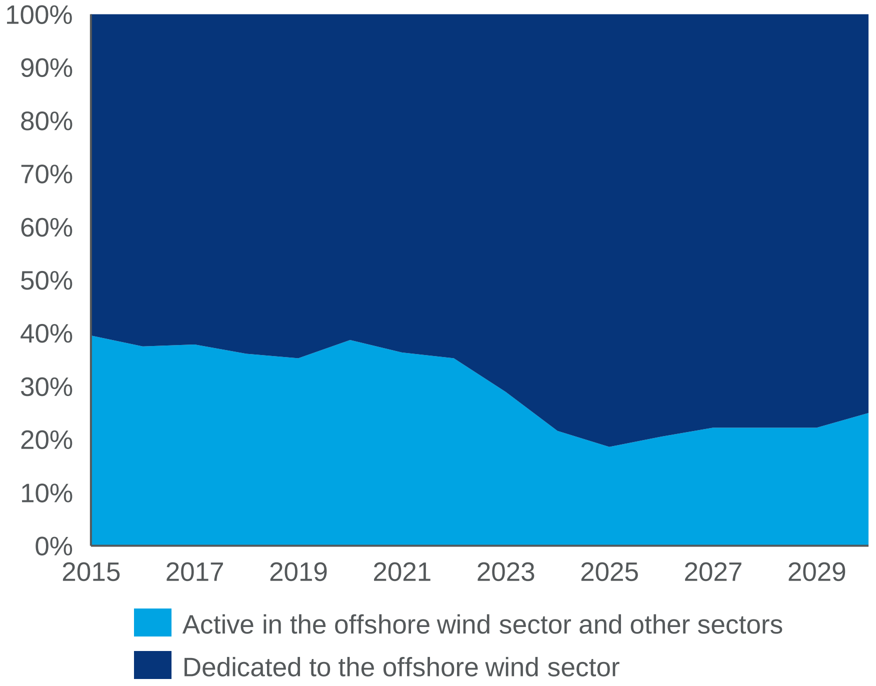
Source: Wood Mackenzie

Heavy lift O&G vessels have been able to penetrate the wind space

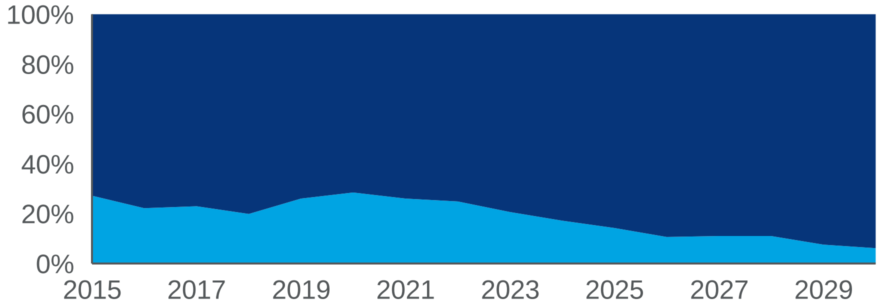
Supply

Increasing component sizes limits the opportunity for heavy lift O&G vessels – particularly for turbine installation, which is increasingly specialised

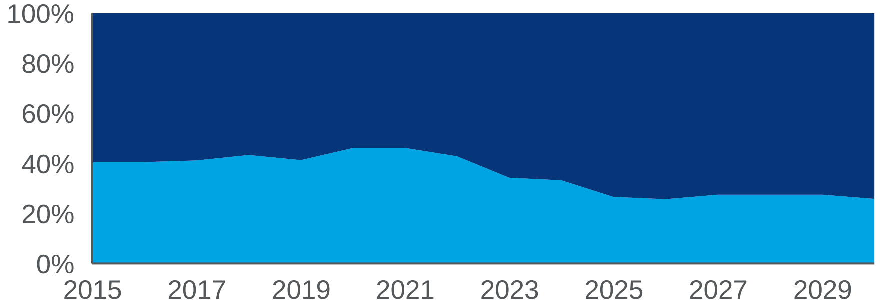
Offshore wind fleet exposure to other segments



Turbine fleet exposure to other sectors



Foundation fleet exposure to other sectors



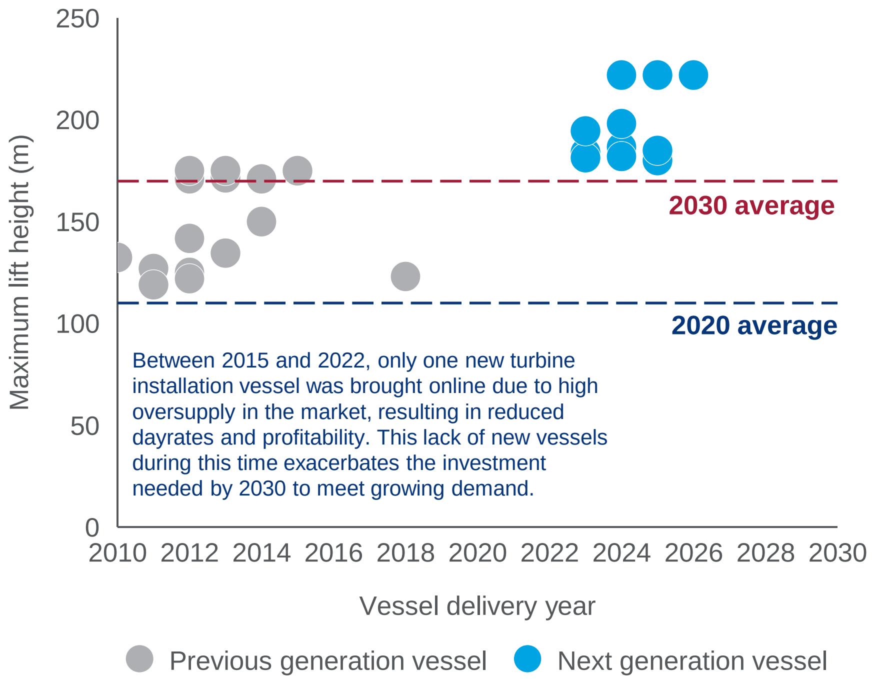
Source: Wood Mackenzie

Increasing lift parameters will challenge previous generation vessels

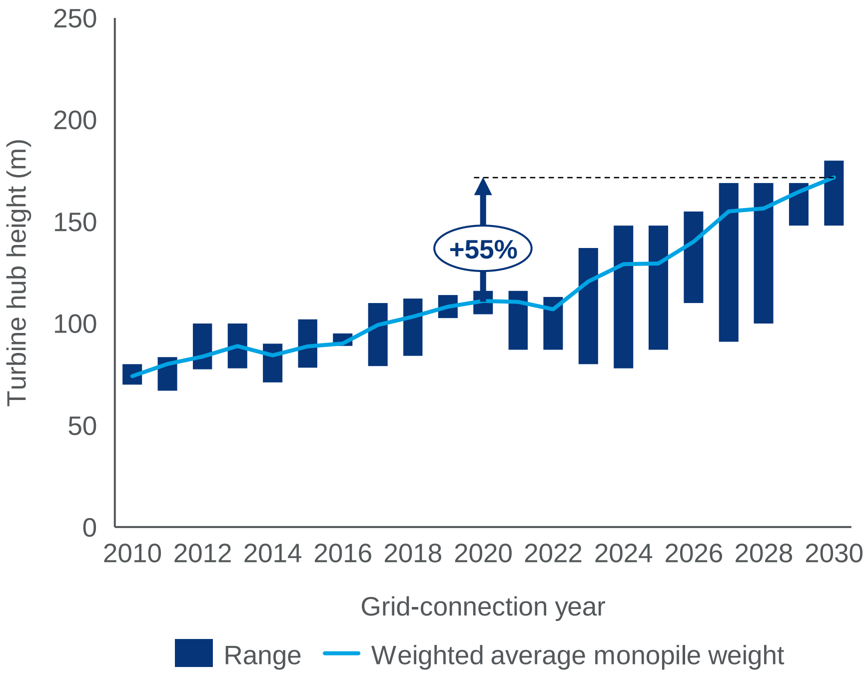
Supply

Increasing hub heights will require vessels to upgrade cranes where possible, demanding investment from owners while pulling supply capacity from the market.

Turbine vessel lift capabilities



Turbine lift height requirements by year**



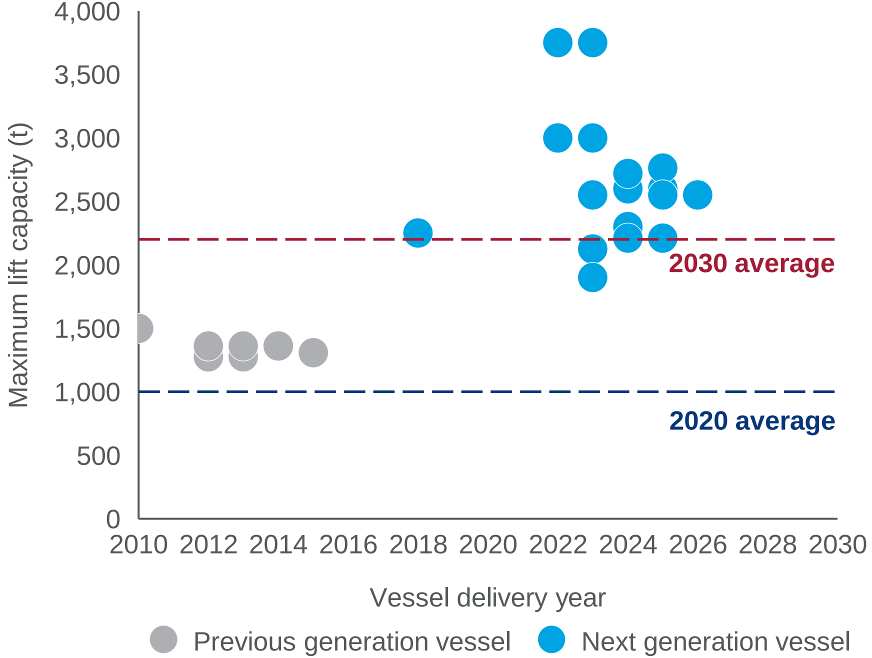
Note: *Excludes vessels which are active in other sectors outside of offshore wind and vessels only installing in China. **Excludes projects in China and Vietnam.
Source: Wood Mackenzie

Soaring monopile weights challenge the fleet's crane and deck space

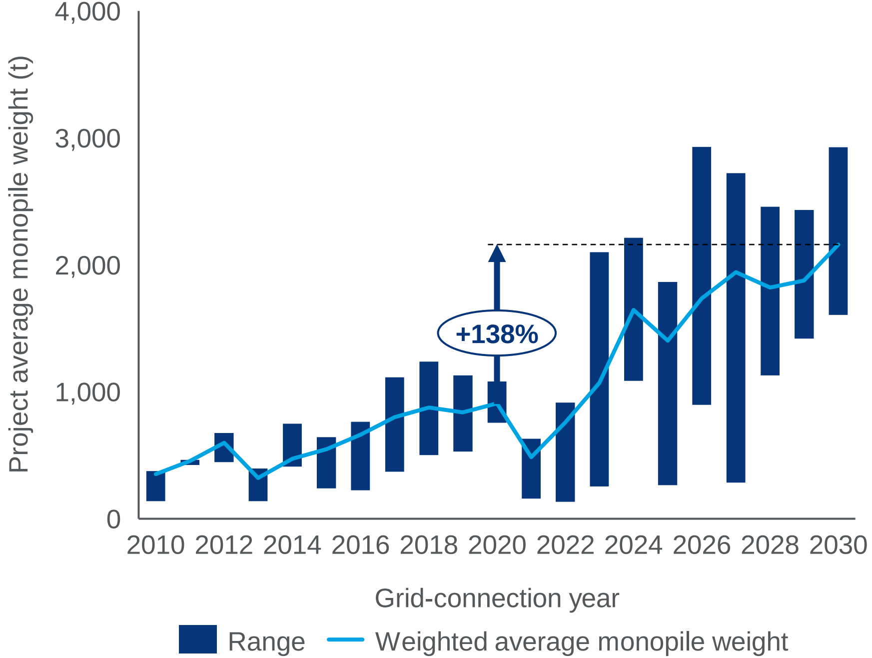
Supply

Increasing foundation sizes reduces the fleet and lowers the efficiency of capable vessels due to deck space restrictions

Foundation vessel lift capabilities



Foundation lift weight requirements by year**



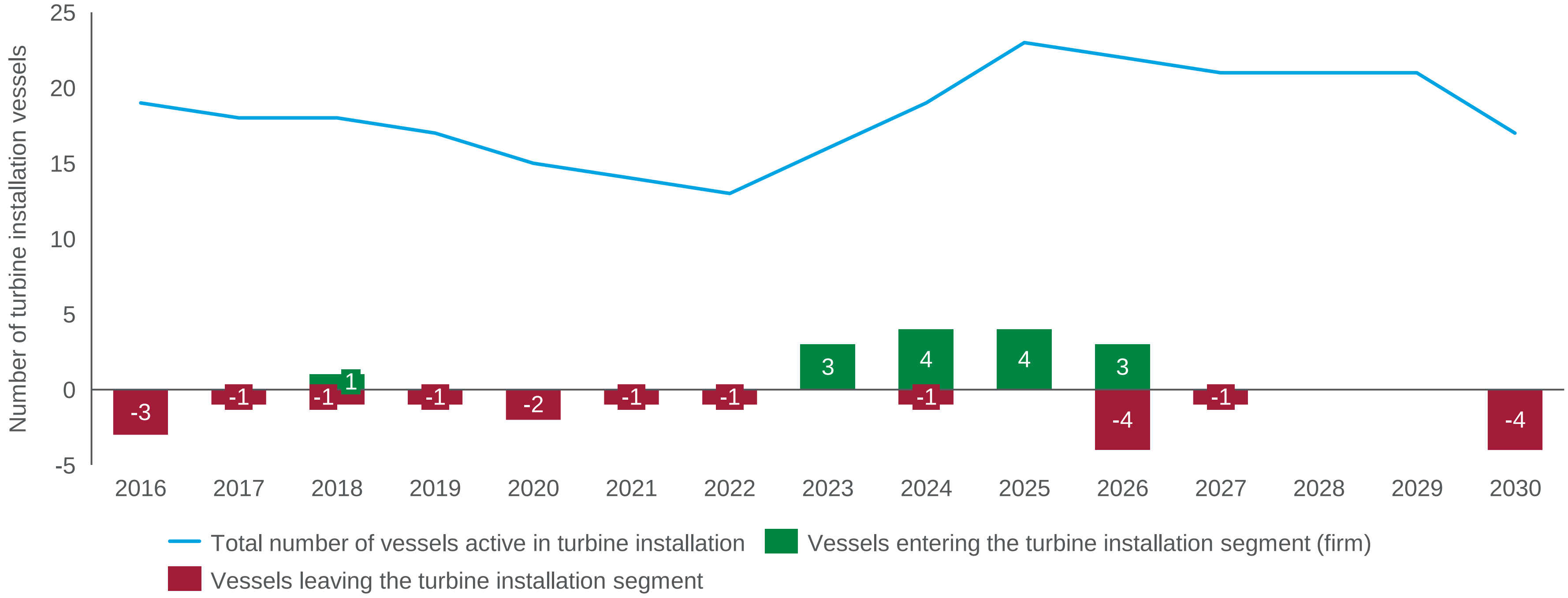
Note: *Excludes vessels which are active in other sectors outside of offshore wind and vessels in China. **Excludes projects in China and Vietnam. Please note that the weight illustrated in these graphs represents the average across the project.

Source: Wood Mackenzie

Supply

13 vessels are expected to be pushed out of the turbine installation sector from 2024-2030

The developments of the turbine installation fleet



Note: Please note that this fleet only includes announced vessels which have placed a firm order with a fabrication yard.
Source: Wood Mackenzie

Section summary: Offshore wind turbine and foundation installation

How big is the gap?

- The offshore wind turbine and foundation installation sector is projected to require an investment of $13 billion to meet Wood Mackenzie's base case build-out. This represents the largest investment requirement among the segments analysed in this report.
- Increasing turbine ratings offer cost efficiencies, but larger component sizes induce challenges for vessel availability. By the end of the decade, only 42% of vessels capacity currently operational will remain, fulfilling just 22% of total demand required by 2030.
- Installers have already placed firm orders for 15 new installation vessels, accounting for 36% of the demand projected for 2030. Yet an additional 19 vessels beyond the existing orders is needed to meet future requirements, meaning 41% of the supply necessary by 2030 is still awaiting financing. This will necessitate over $7 billion of investment.
- By as early as 2027, the sector will require nine additional vessels. The offshore wind market must see this investment imminently and cannot face delays given that there is a three to four-year lead time taken from ordering a vessel to its' delivery.

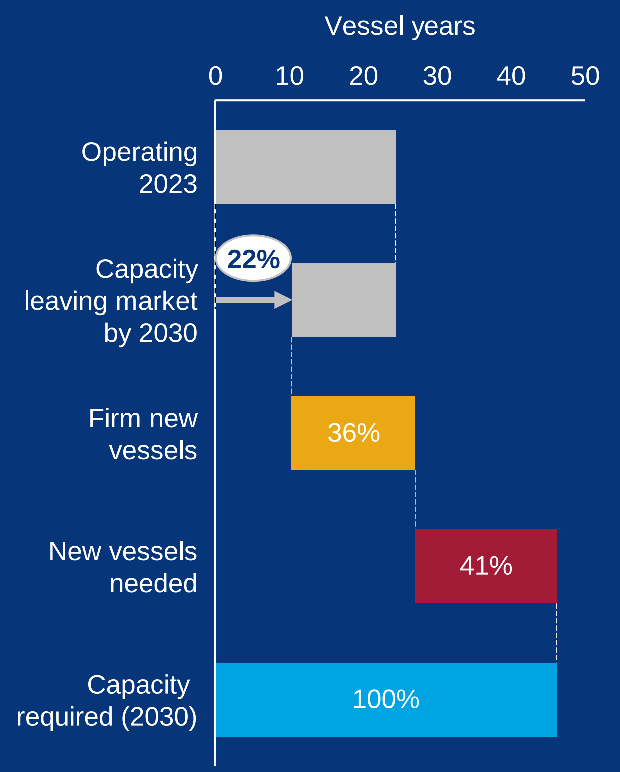
How difficult is it to ramp up?

- Limitations in deck space on vessels challenge upgrades. As larger components are used, deck space hinders installation efficiency. Therefore, meeting demand is heavily reliant on the introduction of new vessels to the market to accommodate the larger components.

What are the challenges with the supply constraints?

- Tightening supply and demand has forced developers to reserve capacity with installers as far out as 2030, as early commitments are crucial to securing the best vessels. Late orders could increase development cost, as less optimised vessels will be less efficient.
- Additionally, the installation sector is fragmented with many installation companies targeting the sector. This limits the efficiency of the industry, as timelines are not optimised between projects or companies. This is exacerbated by the supply and demand tightening, leading to limited contingencies which in turn increases the risk to developers.

Supply vs. demand for installation



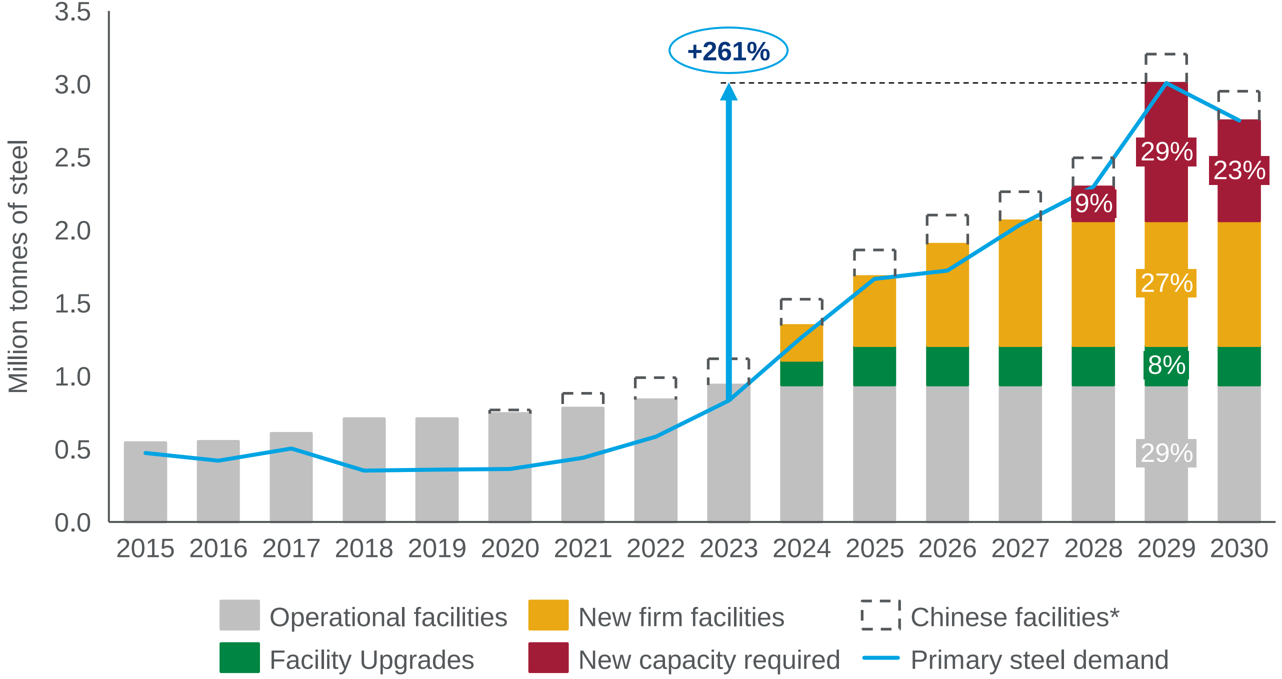
Source: Wood Mackenzie

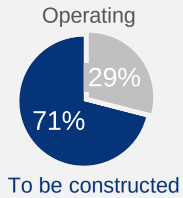
Supply vs. demand for primary steel (monopile foundations)

Supply falls almost one million tonnes short of 2029 demand

The narrowing of supply and demand from 2025 onwards has led to multiple developers placing orders in the Chinese market, as leading European suppliers are fully utilised.

Offshore wind foundation primary steel supply and demand*





29% of the primary steel production capacity required by 2029 is online today.

$4.6 billion of investments in new facilities is needed to meet 2029 primary steel demand.

The lead time for a new monopile facility is **4-5 years.**

Note: Please see Appendix 1 for definitions of the development statuses of the supply capacity. Excludes China and Vietnam. Excludes demonstration and intertidal projects. Demand based on foundation and turbine installation year. Source: Wood Mackenzie

Methodology: Breaking down demand assumptions

Demand

Demand is calculated on a project basis and is underpinned by in depth analysis of global power markets, combined with turbine technology forecasts and individual site characteristics.

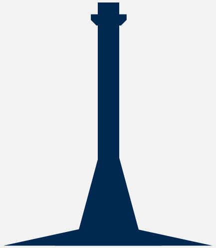
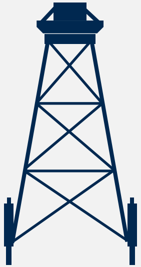
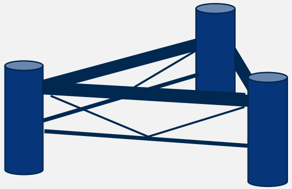
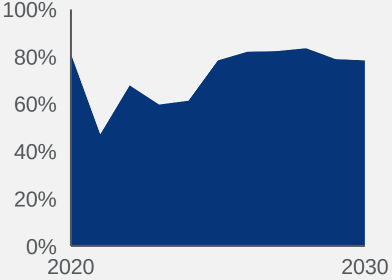
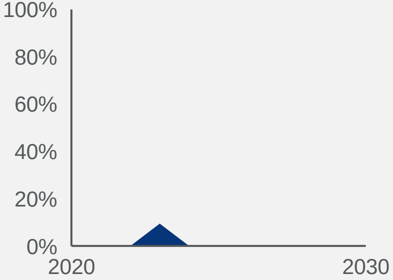
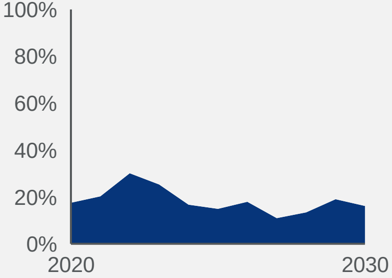
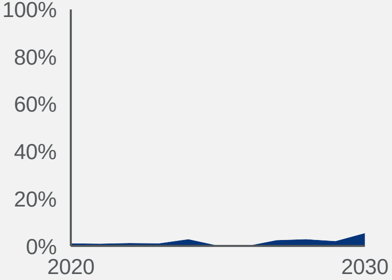
Deriving the demand for offshore wind foundation primary steel

[redacted]

Market wide outlook | Project level outlook | Supply chain segment outlook | Final demand outlook

Source: Wood Mackenzie

Monopiles remains the preferred foundation technology

	Monopile	Gravity-based	Jacket	Floating
How it works				
Market share	79% market share from 2020-2030 	<1% market share from 2020-2030 	18% market share from 2020-2030 	2% market share from 2020-2030 
Depths	5 m to +60 m	1 m to +60 m	20 m to +90 m	80 m to +1000m

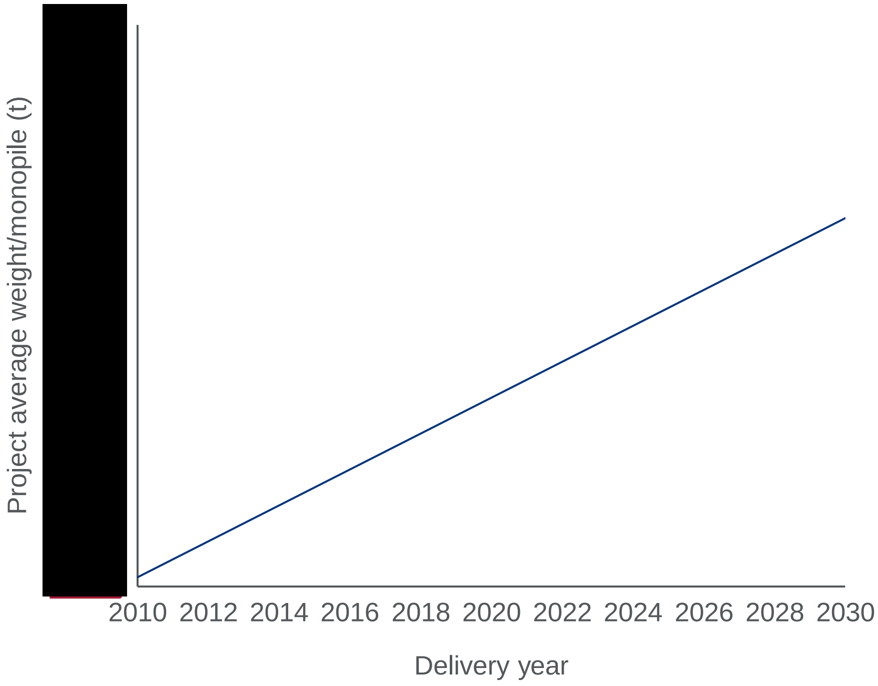
Note: Market share is as a MW share taken from Wood Mackenzie's 2020-2030 outlook, excluding China and Vietnam.
Source: Wood Mackenzie

Stabilised monopile weight per MW maintains high demand

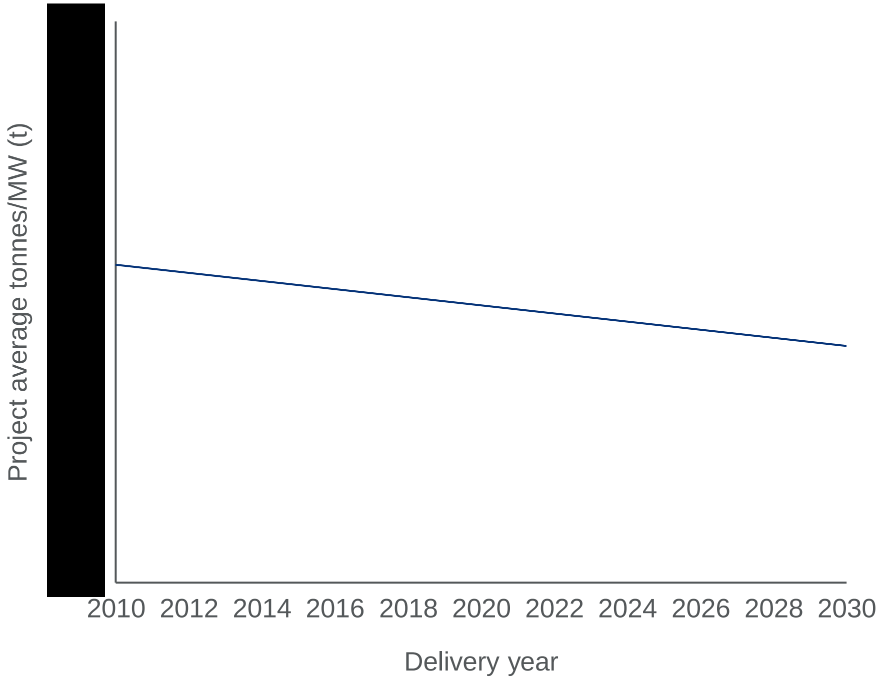
Scale

Increasing complexity of project site characteristics, notably water depths, will continue to stretch the weight of components which will limit the benefits of scaling turbine sizes.

Monopile weight by delivery year (2010-2030)



Monopile weight/MW by delivery year (2010-2030)



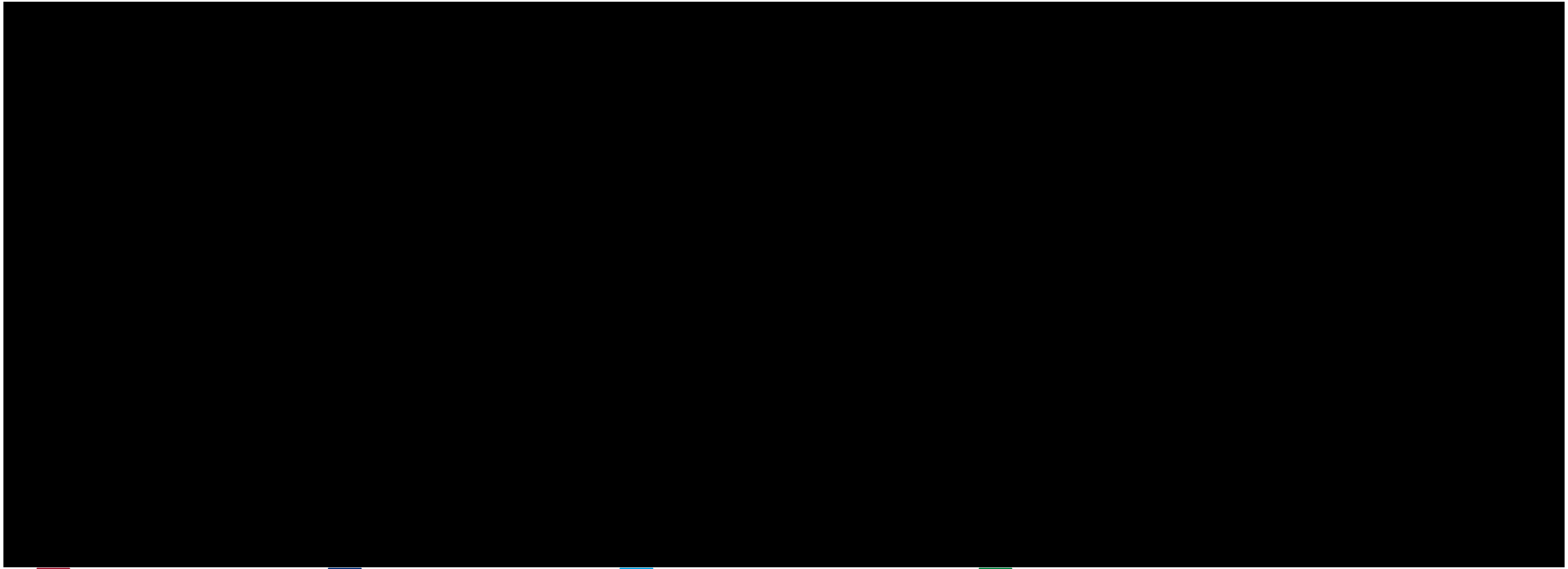
Note: Excludes demonstrators, intertidal projects, and projects in China. Please note that the weight illustrated in these graphs represents the average across the project.
Source: Wood Mackenzie

Methodology: Breaking down supply assumptions

Supply

Supply in tonnage is calculated for each facility supplying offshore wind foundations and is determined by analysis of historical output and company strategy.

Deriving the supply for offshore wind foundation primary steel



Market wide outlook | Facility level outlook | Supply chain segment outlook | Final supply outlook

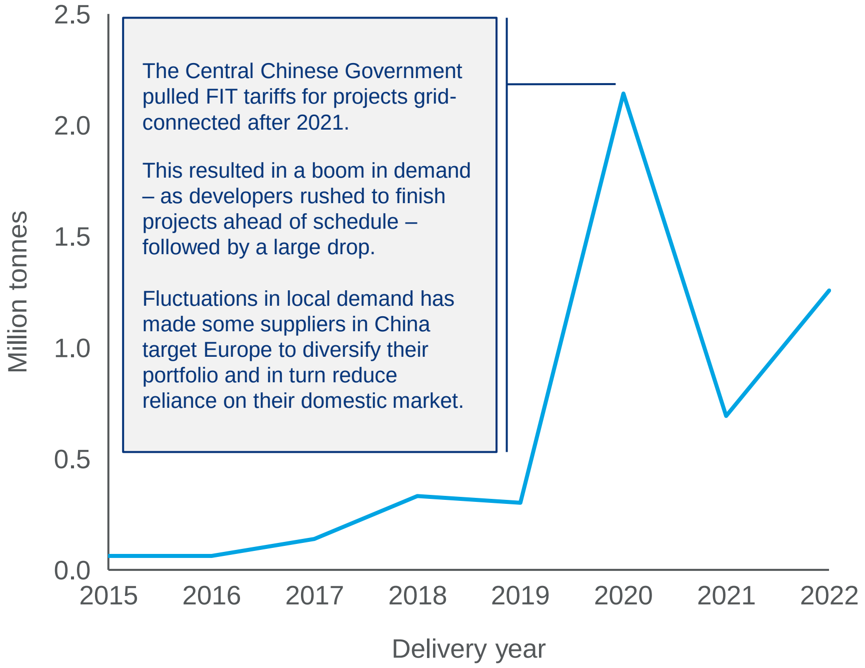
Source: Wood Mackenzie

In 2022 Chinese monopile suppliers penetrated the European market

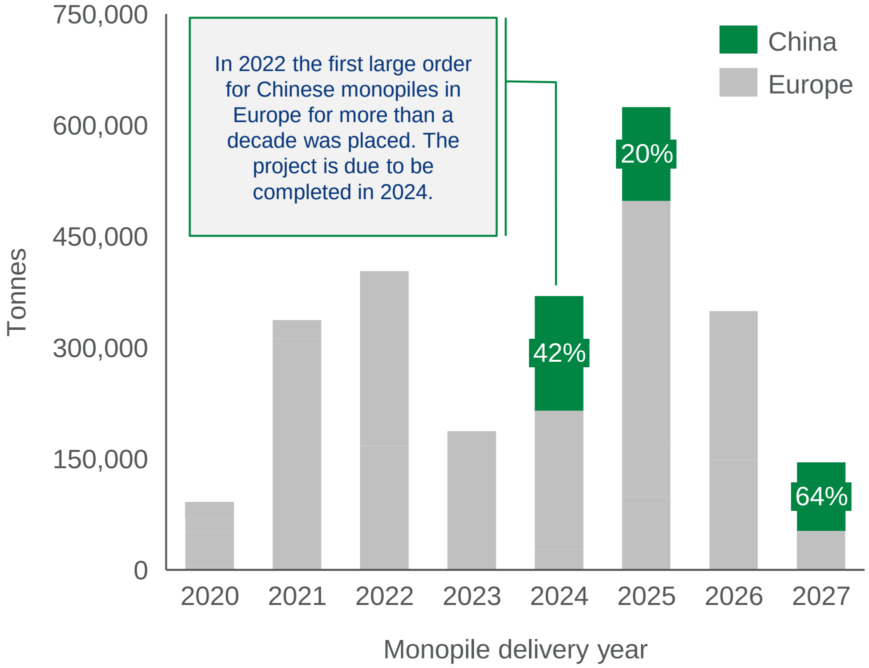
Supply

The role of Chinese foundation suppliers on the global stage is still to be defined. Policies and the outcome of the delivery of the first monopiles will shape the role of Chinese suppliers in Europe.

Chinese monopile demand by delivery year



Location of monopile suppliers to Europe*



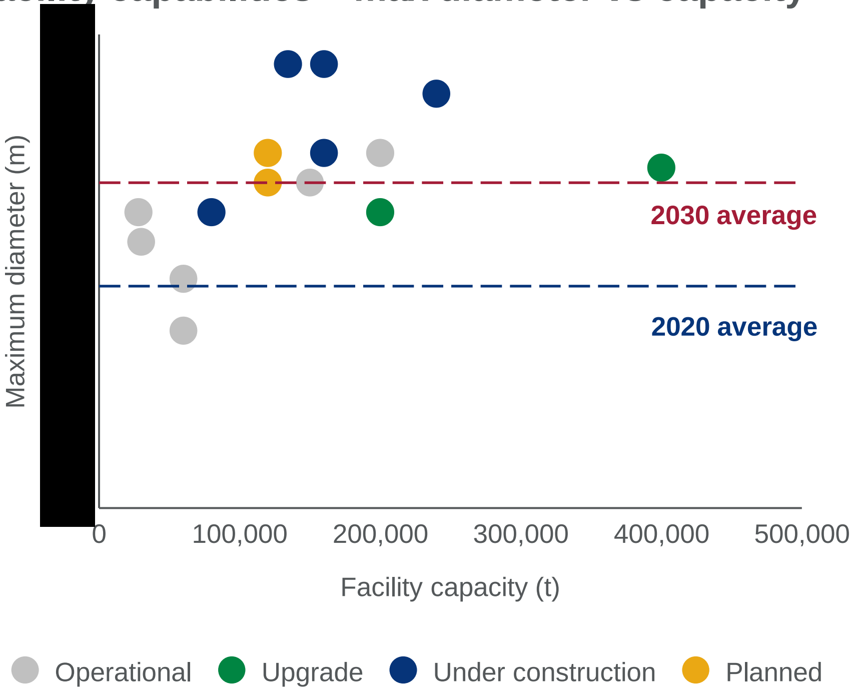
Note: *Based on announced awarded orders only. There will be more orders that have yet to be announced or awarded for 2024-2027.
Source: Wood Mackenzie

A new wave of next-generation monopile facilities are emerging

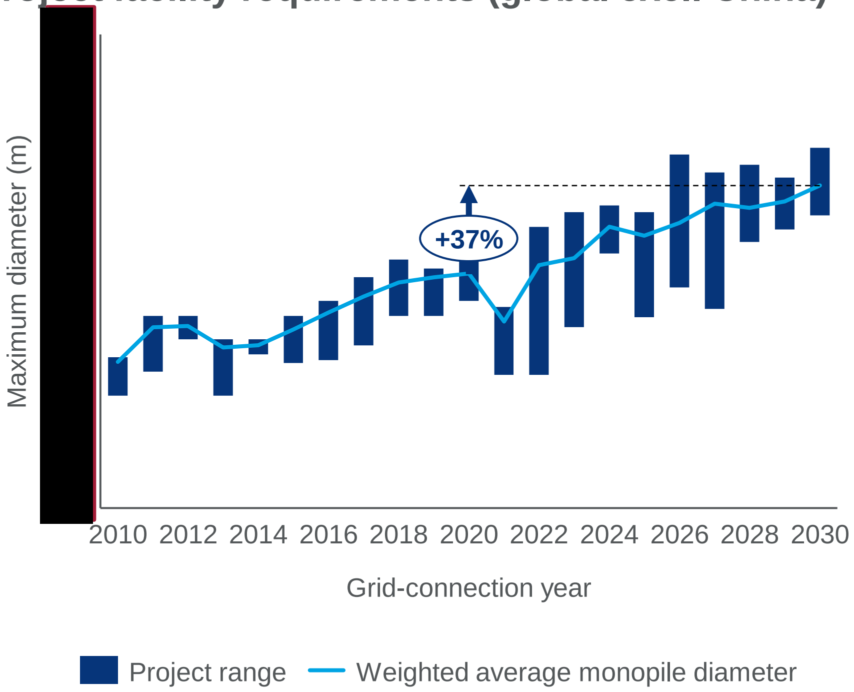
Supply

Due to the high costs of upgrading facilities, new facilities are dimensioned for the future.

Facility capabilities – max diameter vs capacity



Project facility requirements (global excl. China)



Note: *Excludes demonstration projects. Excludes inter-tidal projects.
Source: Wood Mackenzie

Section summary: Offshore wind foundation primary steel fabrication

How big is the gap?

- The offshore wind foundations sector faces a four-fold growth in demand in just six-years from 2023 to 2029. The demand is driven by limited scaling benefits of larger turbine ratings, as well as the industry's expansion into deeper waters with more challenging site conditions.
- Currently, only 29% of the production capacity required by 2029 is active in the market. To meet Wood Mackenzie's base case build-out for offshore wind, a total investment of $4.6 billion will be needed.
- While the sector has seen commitments from established players in the foundation space, representing 27% of the projected demand for 2030, an additional one million tonnes per annum of steel fabrication capability is still required. This represents five new sizable facilities, at a cost of $2 billion, with new investments required to be online by 2028. Given the four to five-year timeline from facility FID to operations, there is little room for delays.

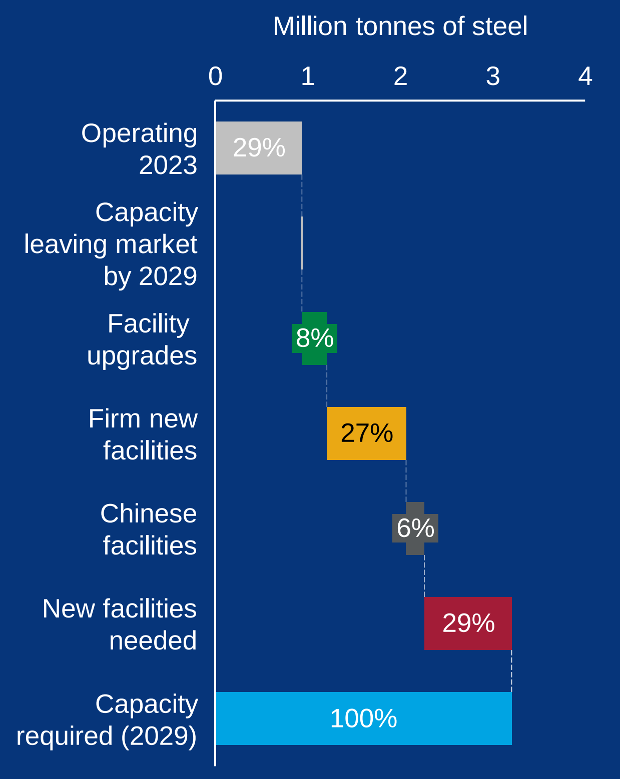
How difficult is it to ramp up?

- The diameters of monopile foundations will grow by 29% from 2023 to 2030, with dimensions exceeding 12 m as early as 2026. Larger components require larger yards and machinery, but also take longer to weld, reducing capacity output without additional investment.
- Additionally, there is limited access to large steel plates with thickness exceeding 120mm and flange supply is also extremely tight, posing obstacles to scaling up production.

What are the challenges with the supply constraints?

- Whilst there have been substantial capital commitments, with enough new capacity financed to almost double what is active today, the risk lies in delays in executing plans. Large order commitments required prior to financing new facilities also pose a threat to expansion.
- Furthermore, major suppliers have already filled their order books until 2025-2026, leading to new players and Chinese suppliers entering the market with a lower track record, increasing the risk associated with the supply chain.

Supply vs. demand for foundations



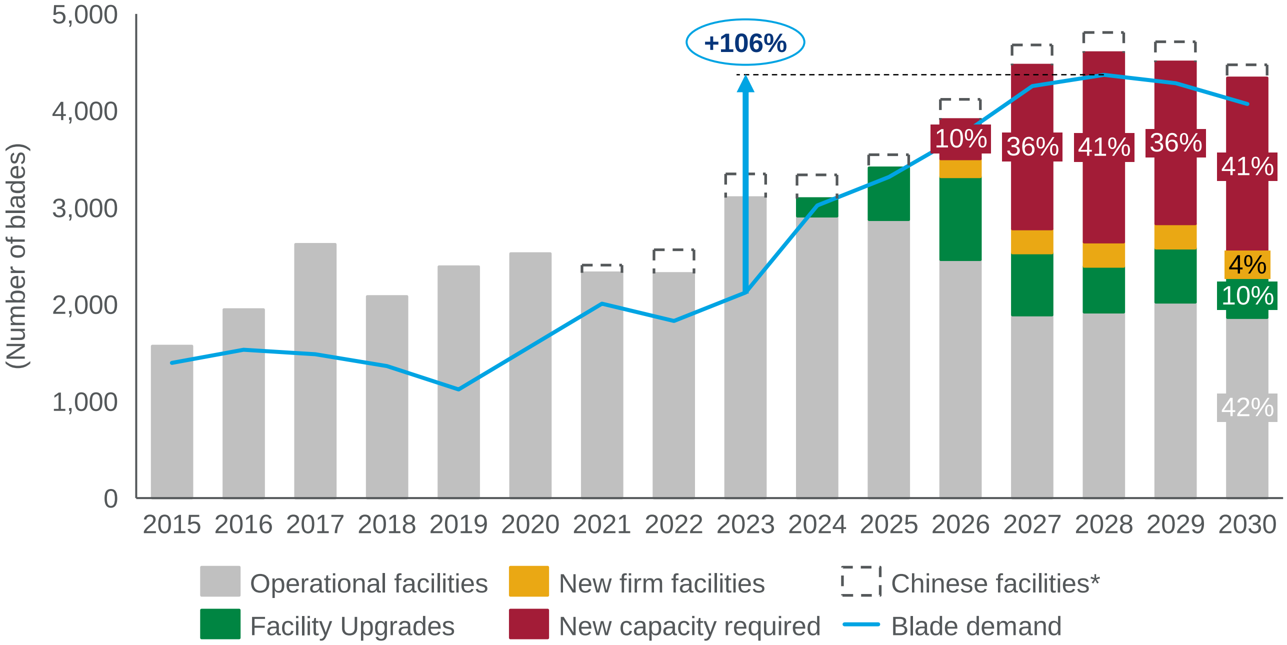
Note: Demand excludes projects in China. Supply includes Chinese facilities which have firm orders for components to Europe. Source: Wood Mackenzie

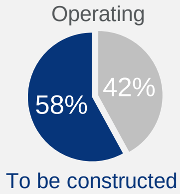
Supply vs. demand for blades

Larger blades tighten supply and demand from the mid-2020s

High capex and long lead times makes the lack of supply challenging and costly to fill.

Offshore wind blade supply and demand*





42% of the blade production capacity required by 2030 is online today.

$3.4 billion of investments in new facilities is needed to meet 2030 blade demand.

The lead time for a new blade facility is **3 years**, meaning that 2026 is still up for investments.

Note: See Appendix 1 for definitions of the development statuses of the supply capacity. *Only includes Chinese facilities which have an order backlog to supply blades to Europe. Demand excludes projects located in China and Vietnam. Demand based on blade fabrication year.
Source: Wood Mackenzie

Methodology: Breaking down demand assumptions

Demand

Demand is calculated on a project basis and is underpinned by in depth analysis of global power markets, combined with turbine technology forecasts.

Deriving the demand for offshore wind blades

[redacted]

Market wide outlook | Project level outlook | Supply chain segment outlook | Final demand outlook

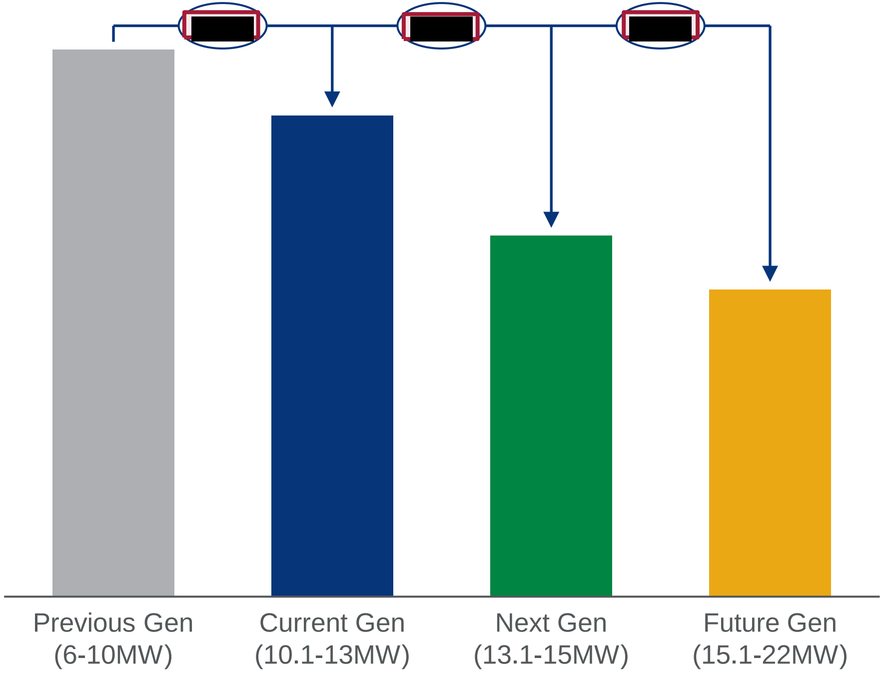
Source: Wood Mackenzie

Scale

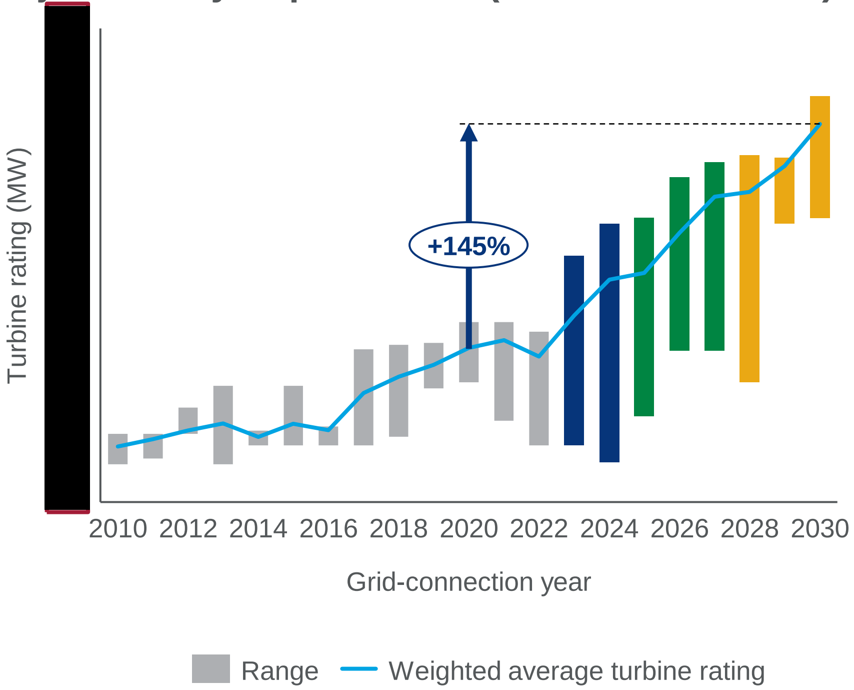
Output per blade mould decreases as length increases

Output by mould has varied by manufacturer and even turbine model. The output per mould, not just the number of moulds, will be key in optimising supply capacity.

Blades per mould per year by turbine rating



Project facility requirements (Global excl. China)



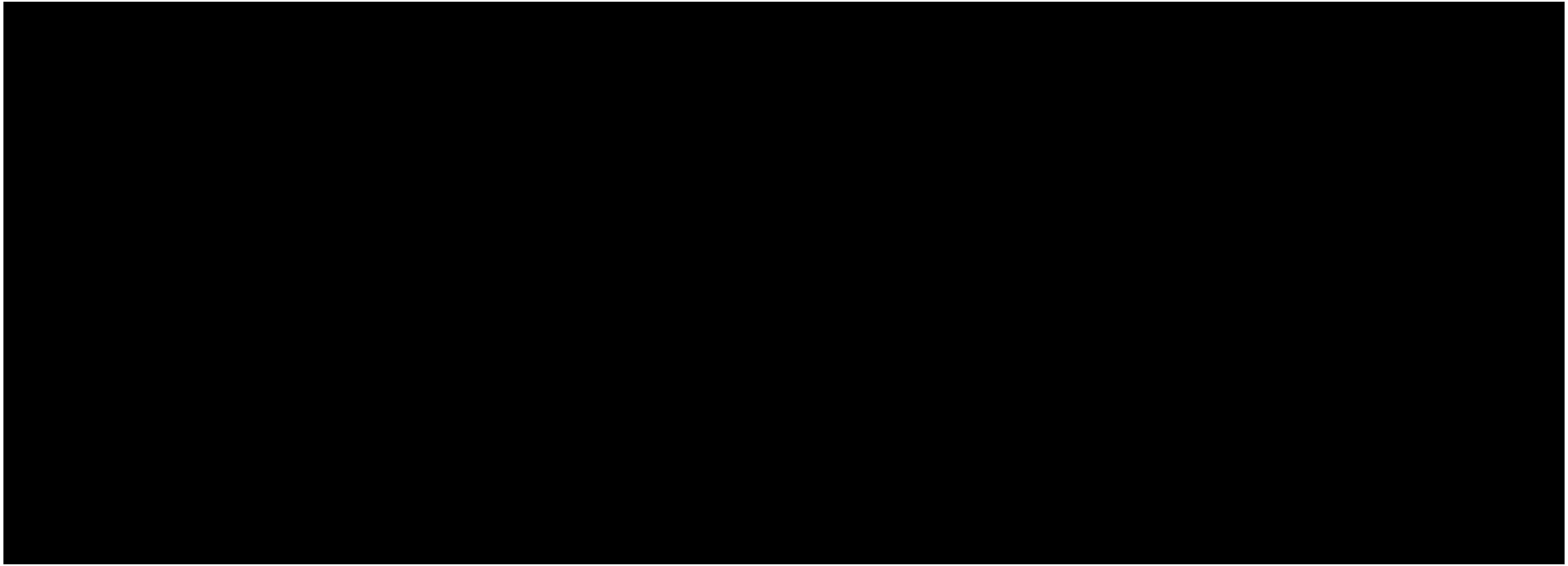
Source: Wood Mackenzie

Methodology: Breaking down supply assumptions

Supply

Supply in tonnage is calculated for each facility supplying offshore wind foundations and is determined by analysis of historical output and company strategy

Deriving the supply for offshore wind foundation primary steel



Market wide outlook | Facility level outlook | Supply chain segment outlook | Final supply outlook

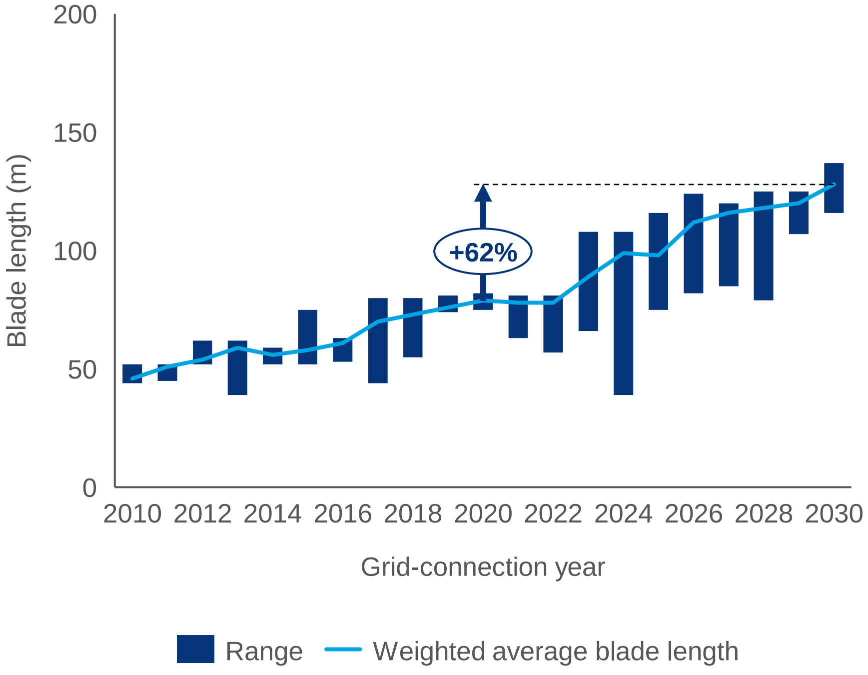
Source: Wood Mackenzie

A multitude of mould upgrades are needed to meet demand

Upgrading moulds is not just costly, but also takes out supply of the market whilst the new moulds are built and the facilities ramp up.

Facility capabilities – blade length vs capacity

Project facility requirements (global excl. China)



Source: Wood Mackenzie

Section summary: Offshore wind blades

How big is the gap?

- Only 42% of the blade production capacity required by 2030 is online today. $3.4 billion of investments in new facilities is needed to close that gap and meet Wood Mackenzie's base case outlook.
- The blade manufacturing sector requires a substantial ramp up in the short-term, 36% of the capacity necessary by 2027 is yet to be financed, meaning the sector must act imminently.
- As blade designs are consistent per turbine model, it is possible to pre-fabricate blades a couple of years ahead. That also means that it is easier to spread out the supply for blades compared to other components that are more site-specific.

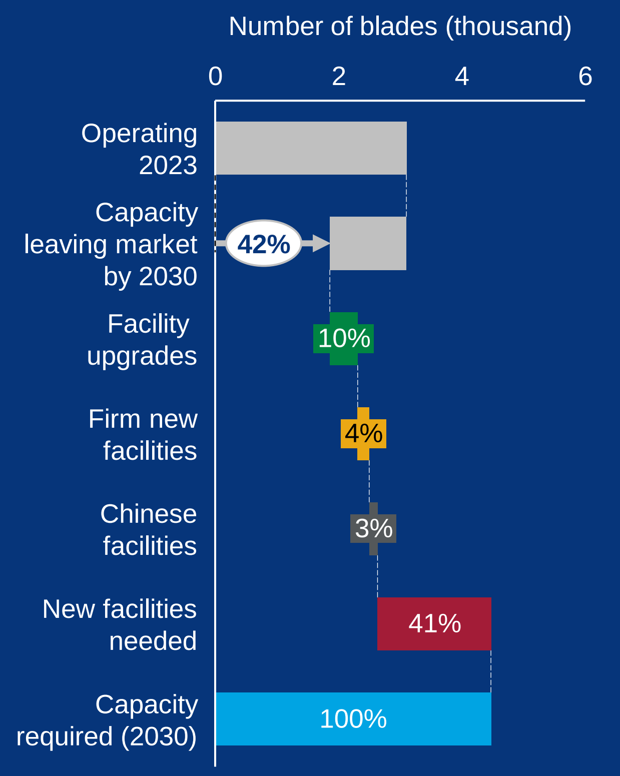
How difficult is it to ramp up?

- The gap in supply and demand for blades is driven equally by an increase in demand and the rapid increase in blade lengths, growing by more than 60% between 2020 and 2030. The increase in blade length means that new moulds are required, facilities need to be extended and the output per mould drops. Given that moulds must be updated for each new turbine model, most facilities will see two overhauls between now and 2030 which will require additional investment.
- New capacity and upgrades are both costly and supply constraining as manufacturers need to take supply out of the market whilst upgrading moulds and production lines.
- The lead time for a new blade facility is three to fives years, therefore FID and construction for the new required 2030 capacity must be sanctioned at the first half of the 2020s.

What are the challenges with the supply constraints?

- Turbine OEMs have seen a significant drop in EBITDA margins, especially over the last two years. The harsh financials challenge the turbine OEMs' ability to invest in new facilities.
- In order to proactively address the growing demand and supply challenges, OEMs are presently fabricating blades well in advance of their delivery schedules to fulfill future orders and optimise production capacity across their facilities.

Supply vs. demand for blades



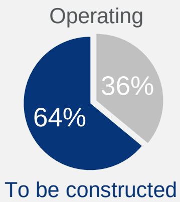
Source: Wood Mackenzie

Supply vs. demand for towers

$3.0 billion of new investments are needed to meet 2029 demand

Multiple tower facilities have been proposed but only a few are materialising.

Offshore wind tower supply and demand (global excl. China)



36% of the tower production capacity required by 2029 is operating today.

$3.0 billion of investments in new facilities is needed to meet 2029 tower demand.

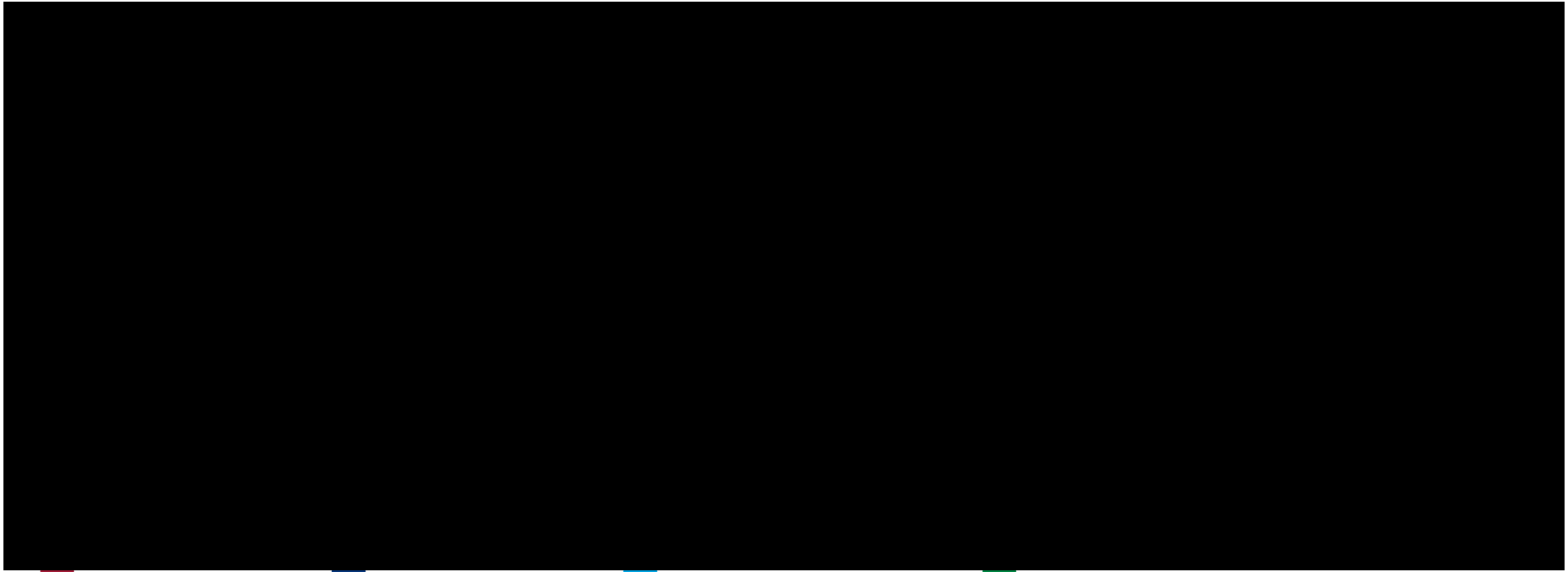
The lead time for a new tower facility is **3-4 years**.

Note: Please see Appendix 1 for definitions of the development statuses of the supply capacity. Excludes production facilities in China. Demand based on tower fabrication year.
Source: Wood Mackenzie

Methodology: Breaking down demand assumptions

Turbine model forecasts, along with Wood Mackenzie in-depth analysis of global power markets, are utilised to calculate demand in tower sections at the project level.

Deriving the demand for offshore wind towers



Market wide outlook | Project level outlook | Supply chain segment outlook | Final demand outlook

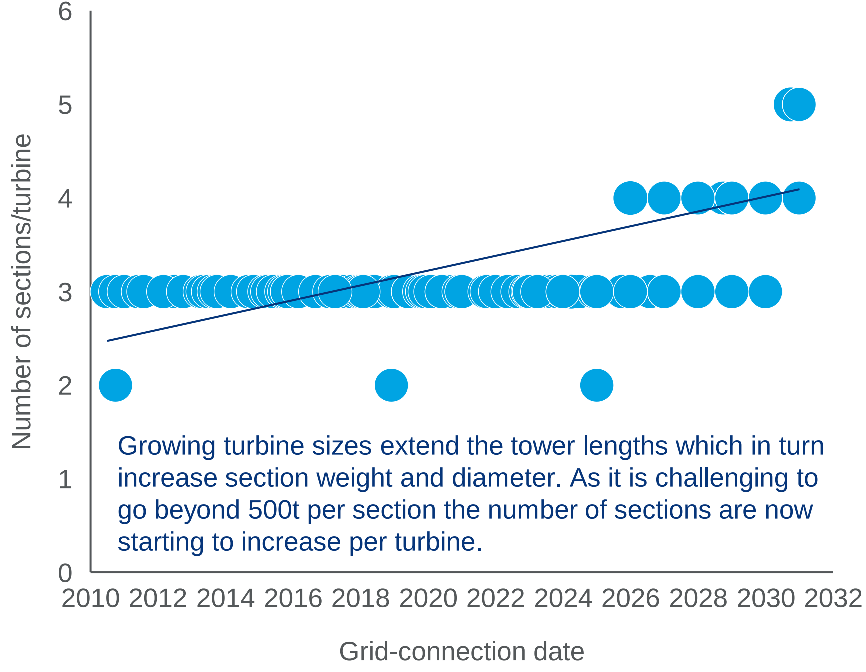
Source: Wood Mackenzie

Efficiencies on the per MW level is set to continue

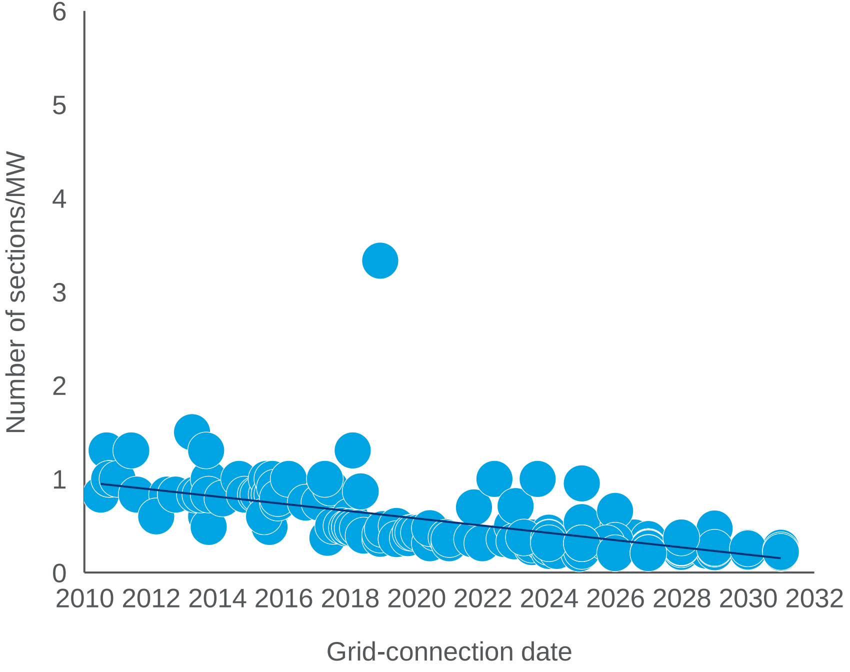
Scale

Three section towers have been the mainstay, yet for future generation units, designs for four and five section towers are in the works. This limits the scale effects seen from larger units

Number of tower sections per turbine (2010-2030)



Number of tower sections per MW (2010-2030)



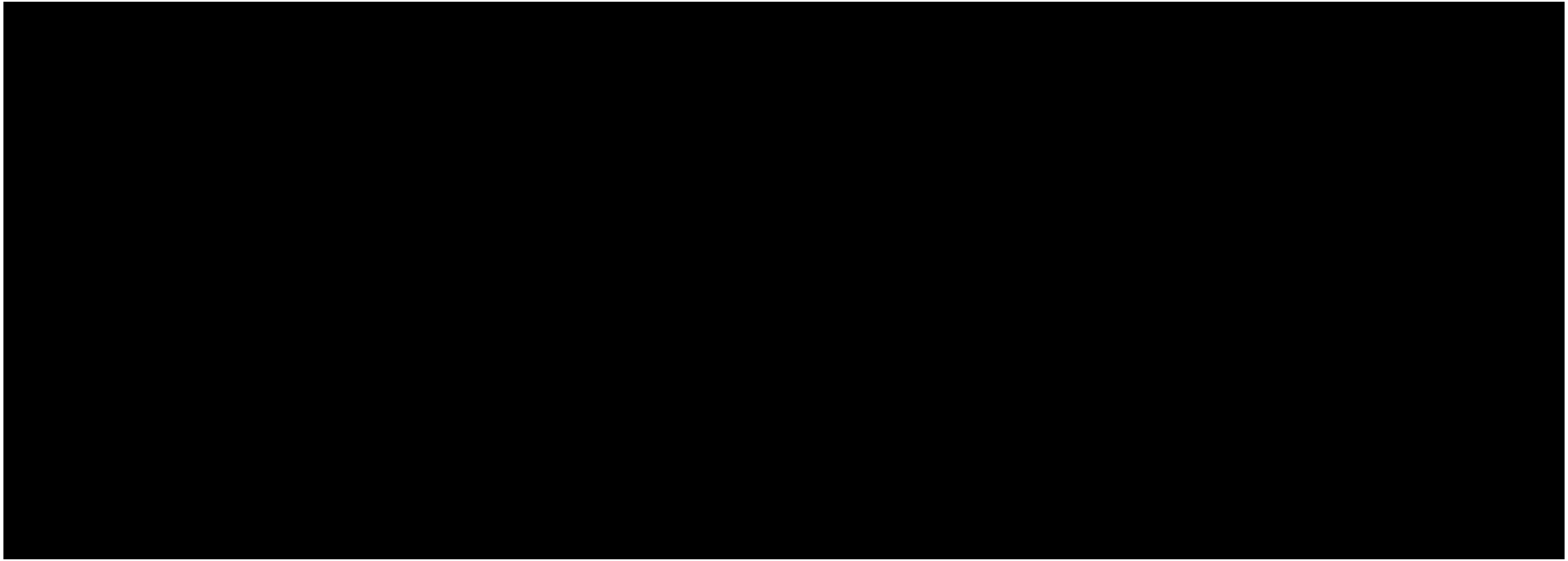
Note: Excludes demonstrators, intertidal projects, and projects in China.
Source: Wood Mackenzie

Methodology: Breaking down supply assumptions

Supply

Supply in tonnage is calculated for each facility supplying offshore wind foundations and is determined by analysis of historical output and company strategy

Deriving the supply for offshore wind foundation primary steel



Market wide outlook | Facility level outlook | Supply chain segment outlook | Final supply outlook

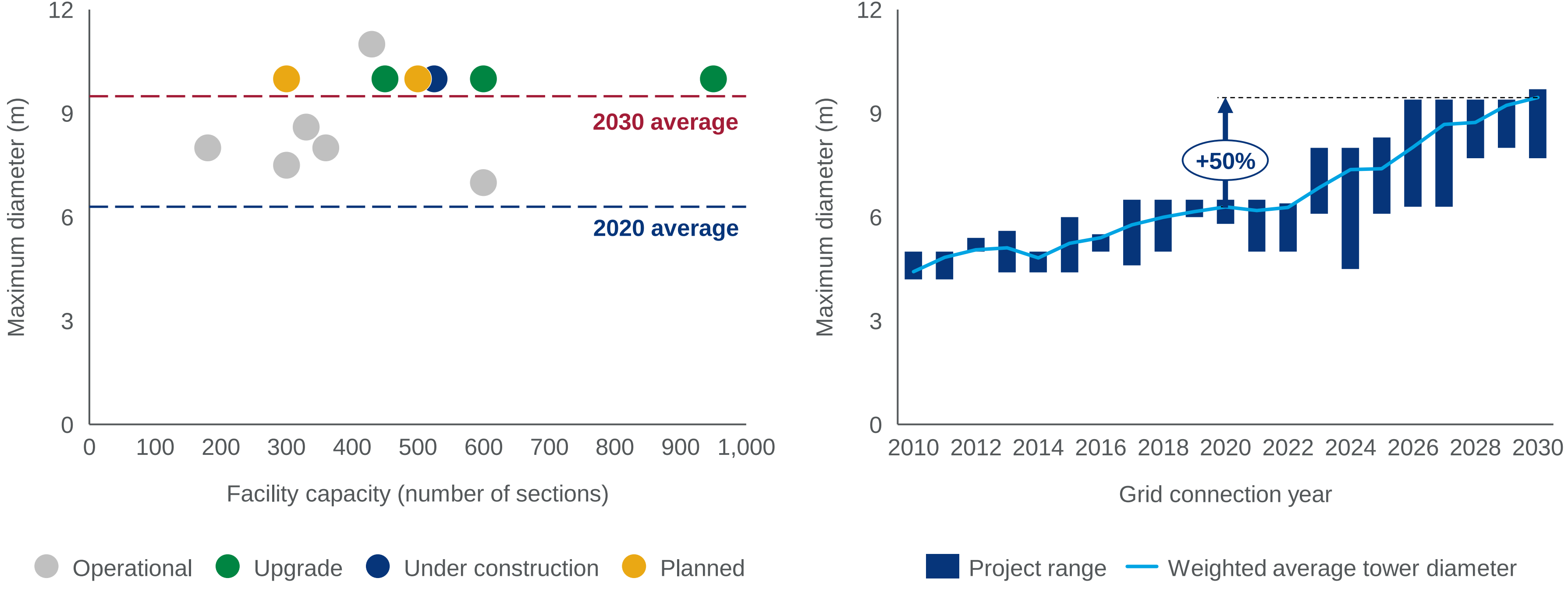
Source: Wood Mackenzie

Increasing turbine sizes challenge existing tower facilities

Tower diameters approach 10m by 2030, forcing facilities to upgrade capabilities and will push facilities located in-land out of the market.

Facility capabilities – max diameter vs capacity

Project facility requirements* (global excl. China)



Note: *Excludes demonstration projects. Excludes inter-tidal projects.
Source: Wood Mackenzie

Section summary: Offshore wind towers

How big is the gap?

- The demand for offshore wind towers is experiencing the largest growth of any segment included in the analysis, with the section demand set to increase four-fold from 2023 to 2029 as next generation turbines will demand more sections and larger section diameters and weights - limiting scaling opportunities.
- Just 36% of the production capacity required by 2029 is operational today. To achieve Wood Mackenzie's forecasted offshore wind build-out, $3.0 billion of investments will be required.
- Facility upgrades and new facilities will contribute to 25% of the demand in 2029. Yet the total investments committed thus far remain insufficient, as the committed capital falls 3,000 sections per year short of demand. This is equivalent to approximately six new facilities at a cost of $1.5 billion. Given the three to four-year lead time from facility FIDs to operations, there is little room for delays.
- Additionally, the sector is reliant on new facilities and facility upgrades coming online as early as 2024. This further highlights the low mitigation for delays in facility operations and new investments, posing a high risk to the market.

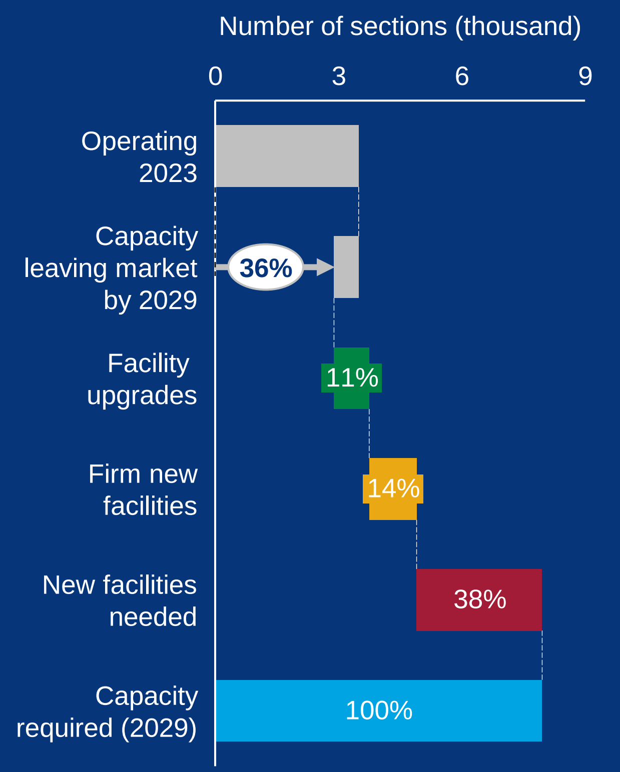
How difficult is it to ramp up?

- Increasing tower section diameter will reduce facility efficiency, particularly for facilities located inland due to logistical limitations in land transportation. This will force existing capacity out of the market, making it more challenging to meet the growing demand.

What are the challenges with the supply constraints?

- Leading suppliers in the sector already have their order books fully booked out until 2027. The lack of availability and capacity from suppliers adds pressure to the industry's ability to meet the demand. Moreover, access to tower flanges is limited, leading to higher component prices and longer lead times, further impacting the industry's capacity and efficiency.
- Additionally, as the complexity and size of towers increase, the output per year from facilities may decrease without additional investments, exacerbating the supply constraints.

Supply vs. demand for towers



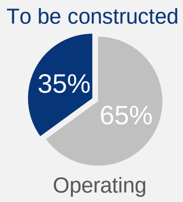
Source: Wood Mackenzie

Supply vs. demand for nacelles

Nacelle assembly is less exposed to supply constraints

In-house nacelle production by OEMs, combined with strong scaling factors, reduces nacelle undersupply risk from a capacity standpoint.

Offshore wind nacelle supply and demand



65% of the nacelle production capacity required by 2029 is online today.

$0.8 billion of investments in new facilities is needed to meet 2029 nacelle demand.

The lead time for a new nacelle facility is **2 years**.

Note: Please see Appendix 1 for definitions of the development statuses of the supply capacity. Excludes projects and facilities in China and Vietnam. Demand based on nacelle fabrication year.
Source: Wood Mackenzie

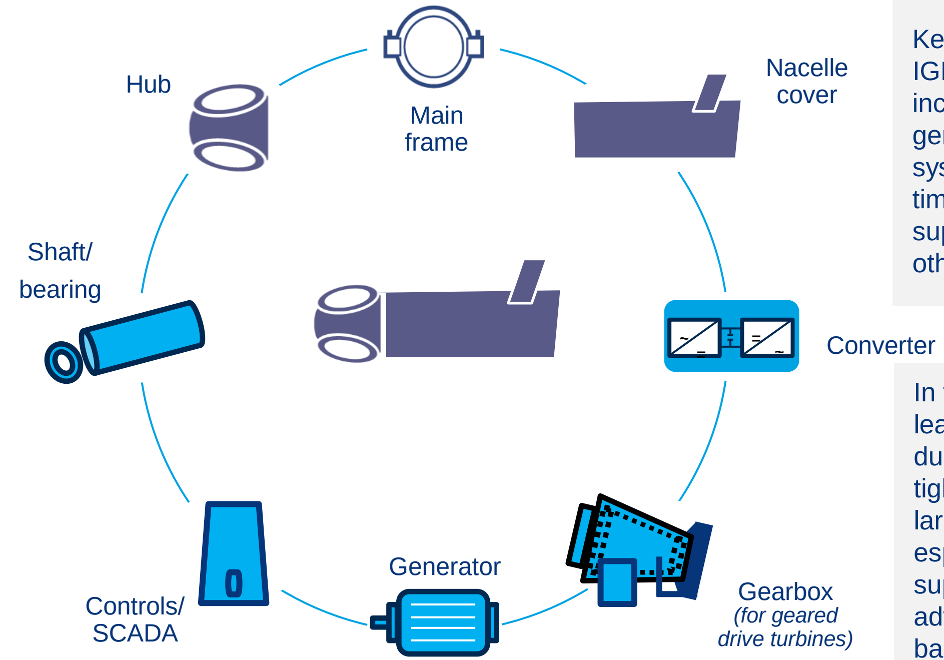
Nacelles are made up of multiple components sourced externally

While the ramp up of the nacelle assembly capacity will be limited compared to the other components, the coordinated ramp up of all of the sub-suppliers does pose a challenge.

Major components of the nacelle for an offshore wind turbine

Vertical integration

Nacelle assembly is vertically integrated for all the turbine OEMs. However, the subcomponents are not. Turbine OEMs have had varying degrees of vertical integration for the turbine components over the years but are now pushing towards outsourcing. Therefore, turbine OEMs are more reliant on their sub-suppliers. That means that nacelle assembly is particularly vulnerable to any delays or constraints across the sub-components.



Key electronic components (like IGBTs, switchgears, etc.) included on the converters, generators, control and SCADA systems are experiencing lead time up to 1,5 year due to thin supply and soaring demand from other industries

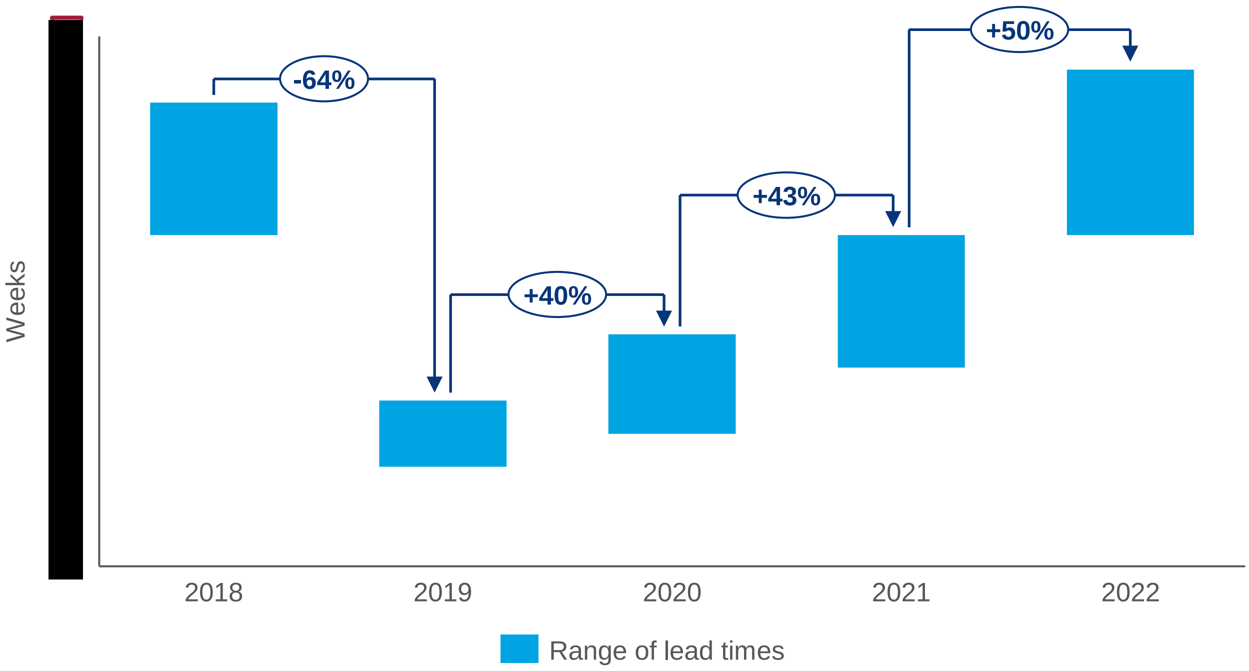
In the short-to-mid-term bearing lead times will continue to mount due to lingering Covid delays, tight supply, and high demand for larger gearbox bearings, especially from China as Western suppliers enjoy competitive advantage despite district cost baseline

Source: Wood Mackenzie

Long lead times and shortages are already prevalent on electronic components

Electronic components are essential as OEMs are developing software in-house, while outsourcing hardware.

Lead times for electronic components from Asia



[redacted]

Source: Wood Mackenzie

Methodology: Breaking down demand assumptions

Demand

Deriving the demand for offshore wind nacelles

[redacted]

Market wide outlook | Project level outlook | Supply chain segment outlook | Final demand outlook

Source: Wood Mackenzie

Methodology: Breaking down supply assumptions

Supply in tonnage is calculated for each facility supplying offshore wind foundations and is determined by analysis of historical output and company strategy

Deriving the supply for offshore wind nacelles

[redacted]

Market wide outlook | Facility level outlook | Supply chain segment outlook | Final supply outlook

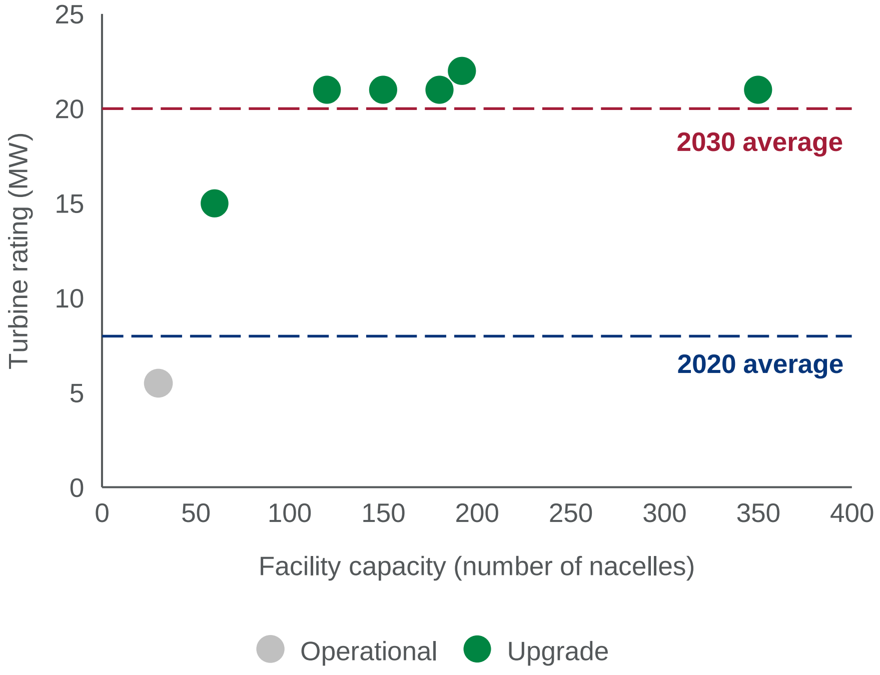
Source: Wood Mackenzie

Nacelle facilities must ramp up to keep up with the OEMs arms race

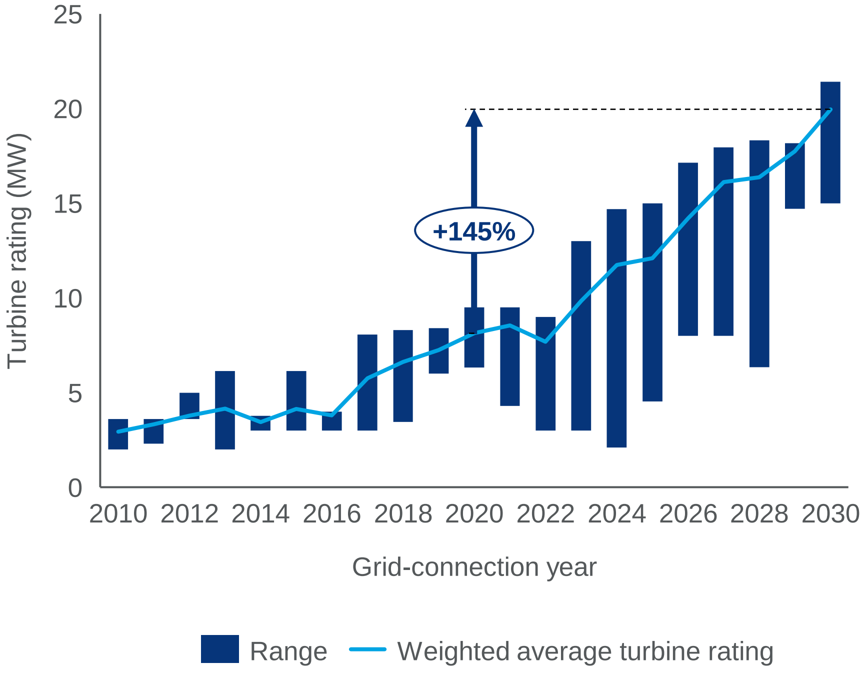
Supply

Offshore wind turbine ratings to skyrocket by 145% from 2020-2030. The facility upgrades required to match this will pull nacelle supply capacity out of the market.

Facility capabilities – turbine rating vs capacity



Project facility requirements (global excl. China)



Source: Wood Mackenzie

Section summary: Offshore wind nacelles

How big is the gap?

- Almost three quarters of the offshore wind nacelle production capacity that is needed to support Wood Mackenzie's demand outlook to 2030 is already online.
- The existing in-house nacelle production capacity of OEMs, combined with strong scaling factors makes nacelle assembly the component that is the least exposed to supply chain constraints.

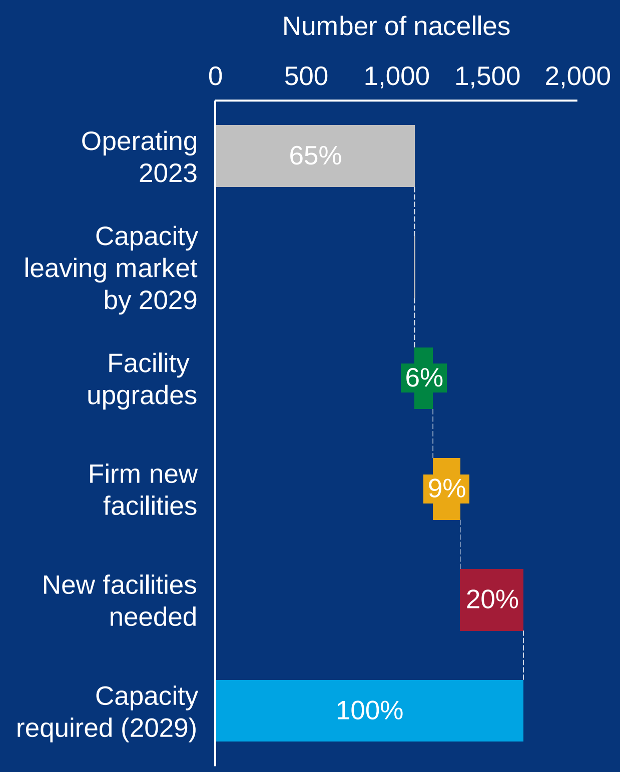
How difficult is it to ramp up?

- Upgrades to the nacelle assembly facilities will be needed to match increased turbine ratings over time. However, the costs of the required upgrades are low compared to other components.

What are the challenges with the supply constraints?

- As turbines grow, the challenges are shifting from technology development to subcomponent procurement and operational issues, involving logistics, construction and maintenance.
- Subcomponent electronics and main bearings experience delays of up to one and half years due to high demand from other sectors.
- Local content requirements and regional demand will define the location of new facilities.
- As offshore nacelle facilities require proximity to the sea, high land acquisition costs can impact supply.
- The industry is increasingly focused on nacelle modularisation and this will facilitate nacelle transportation and component standardisation across different wind turbine types.

Supply vs. demand for nacelles



Source: Wood Mackenzie

5. Introducing Wood Mackenzie

Introducing Wood Mackenzie

Wood Mackenzie is a globally recognized industry leader that has been providing quality data, analytics, and insights used to power the energy, renewables, and natural resources industry for nearly 50 years

- Wood Mackenzie operates across more than 35 offices, which are home to 500 researchers and 150 specialised consultants

Over the past 7 years, the acquisitions of MAKE Consulting, Green Tech Media and Genscape have bolstered an already bankable power and renewables practice

- Wood Mackenzie operates at the nexus of current energy industry tailwinds, offering clients leading energy data and analytics with the bold purpose of transforming the way the planet is powered
- Wood Mackenzie is a portfolio company of Veritas Capital, a leading investor at the intersection of technology and government

Source: Wood Mackenzie

The Wood Mackenzie value proposition

A trusted partner to help guide and capitalize on energy transition investment

Trusted advisor to the energy industry

500+
Power dedicated analysts & consultants

35
offices across 5 continents

Wood Mackenzie has been working with clients to support their decision making across the energy sector for over 50 years. Now, our depth of data and knowledge across the entire power value chain – renewable technology trends and supply chain, power market design and modeling – gives us unrivalled insight.

Industry-leading proprietary data

1+ million high-quality datapoints

Through innovative monitoring technologies, strong industry relationship networks, and a lot of hard work and ingenuity, our content gives you unique insights that you can't easily get anywhere else.

Leveraging the broader capabilities of WM

Integrated modeling and forecasting with power and renewables, metals and mining, natural gas, oil and coal teams leads to full consideration of all the value chains most impacted by the energy transition.

Offshore wind supply chain and technology

Wood Mackenzie has worked with the wind power value chain for more than a decade. We leverage this daily to provide an unparalleled supply chain and technology offering

Offshore wind balance of plant supply chain reports

Wood Mackenzie's offshore wind balance of plant reports cover central topics, including technology trends, segmented demand outlook, supply chain analysis, financial analysis of the suppliers and cost trends of the major balance of plant segments.

Quarterly global turbine order analysis

The Global Wind Turbine Order Analysis report presents an analysis of global and regional wind turbine order activity in the last quarter. It includes a detailed look at global order activity, offshore orders, and regional order intake analysis.

Global wind turbine technology trends

Wood Mackenzie's Global Wind turbine technology trends report projects the latest technology developments across key capital components, and how these advancements will impact the future of the industry.

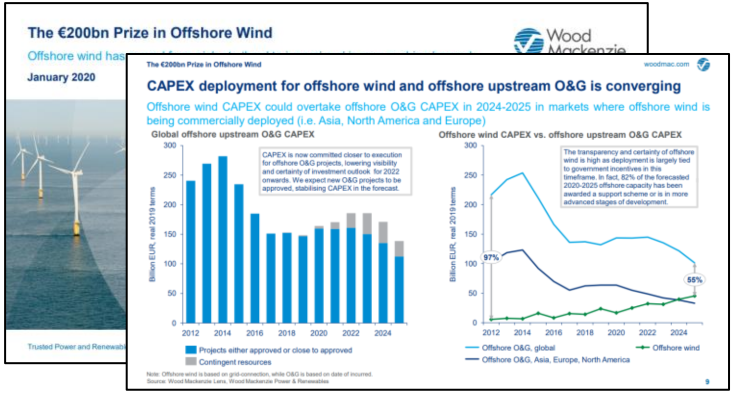
Global bottom-fixed offshore wind operations and maintenance (O&M) trends

The report provides an outlook for the future of the global offshore wind operations and maintenance (O&M) market over the coming 10 years, focusing on regional trends, challenges, and opportunities the industry faces as installed capacity soars and the fleet ages.

Offshore wind supply chain engine rooms

Offshore wind supply chain engine rooms contain information on orders, supply chain facilities and vessels. Seven supply chain engine rooms are available for the key supply chain segments. Please see slide 11 for more information on the engine rooms.

The engine rooms cover, foundation and substation supply, turbine blade, nacelle and tower supply, Installation of turbine, foundation and substation, cable supply and cable installation



Select insight titles covering supply chain and technology
The €200bn prize in offshore wind: Offshore wind has moved from niche to 'hard to ignore
Major component replacement dynamics
The momentum of floating wind and its outlook implications
Potential impact of a hard Brexit on UK offshore wind

Wood Mackenzie is widely regarded as the leading commercial advisor in wind market, policy, technology and supply chain advisory

Wood Mackenzie Differentiators

- Global advantage on top of local knowledge
- Top-Rated Wind Consulting and Research Team
- Wood Mackenzie Research & Proprietary Wind Industry Database
- Extensive Wind Industry Experience and Networks in Global and China Wind Market
- Capability of providing insights and Delivering Deep-dive Study in Each Niche Market of Wind
- Integrated and Established Track-Record on Wind Industry and Power Market Advisory

Examples of Wood Mackenzie Credentials

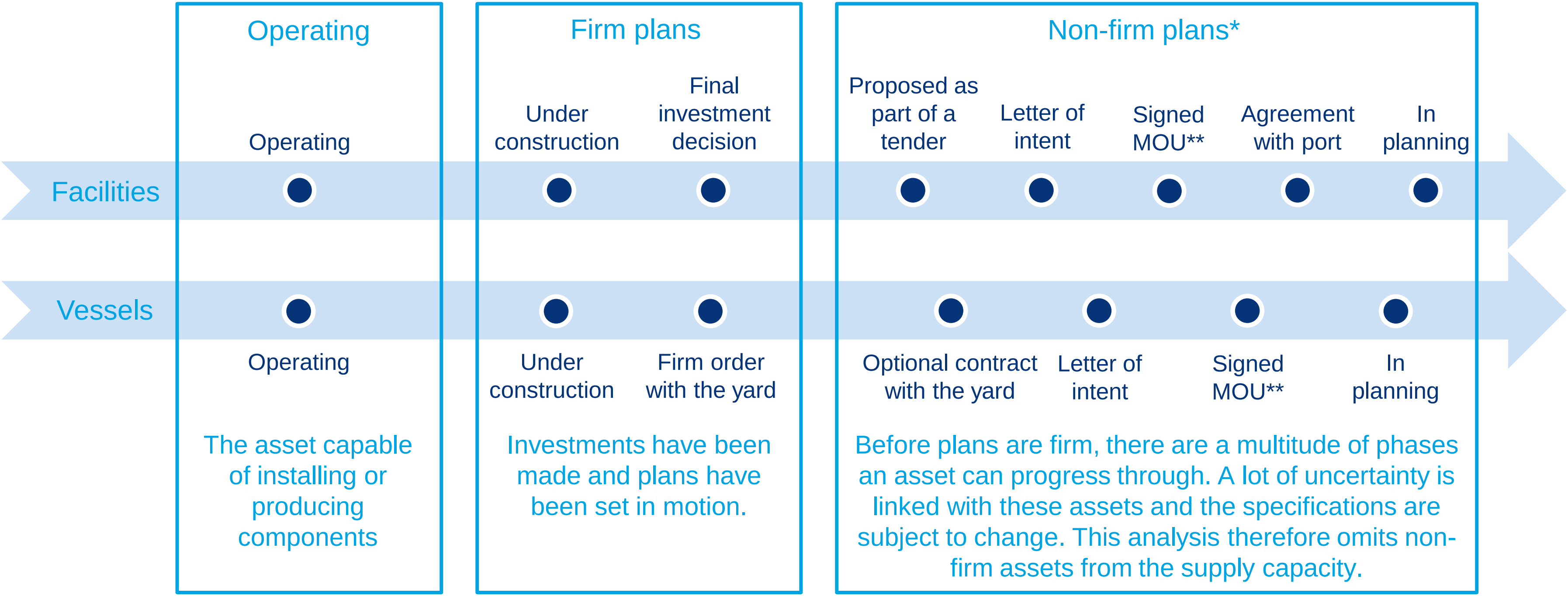
- **Global footprint and dedicated team**
  - 30+ consultants and analysts in wind industries offer deep knowledge of renewables, gained during years of working at leading companies in the business
  - 18+ years of experience analyzing global wind industry
  - 11 sub-regions covered: China, Asia Pacific excluding China, West Europe, North Europe, East Europe and the Caspian Sea, South Europe, Middle East, Africa, North America and Latin America
- **Wind Database and Research Products** – Our database includes all relevant power and renewable policies of each country, projects, orders and tenders, technologies, supply chain, O&M, as well as thorough data points and forecasts across the whole value chain of offshore industry
  - 140 + regional wind market covered through different local based offices
  - 400+ onshore and offshore suppliers covered into our data collection through
  - 1200+ global and regional interviews per year for insight collection and data cross check
- **Our capability to execute consulting projects** in wind industry derives from our market knowledge together with our close relationships and interaction with professional experts and decision makers across the global wind value chain:
  - Institutional investors
  - Utilities, IPPs and asset owners
  - Original equipment manufacturers and service providers
  - Government institutions, third parties and NGOs
- **Wind Consulting Experience** – covering topics such as:
  - Market entry and investment decision-making
  - Competitor benchmarking and competitive positioning
  - Product portfolio and technical solutions
  - Supply chain strategy of turbine OEM and key component supply matrix
  - Cost model and profitability analysis
  - Due Diligence from market, commercial and financial perspective

6. Appendix

Appendix 1. Development phases of new facilities and vessels

This study exclude non-firm plans from its supply capacity due to the high uncertainty linked with non-firm plans.

Development phases of construction facilities and installation vessels



Note: *There are other categories announced by suppliers, however this encompasses the main criteria. **MOU = Memorandum of Understanding
Source: Wood Mackenzie

Disclaimer

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BEFORE THE
PUBLIC SERVICE COMMISSION
STATE OF NEW YORK

In the Matter of Offshore Wind Energy	)))	Case 18-E-0071
Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard	)))))	Case 15-E-0302

VERIFICATION

I, Steven Knell, as a Vice President of Wood Mackenzie, do hereby affirm that the contents of this document are true to the best of my knowledge and belief.

Signed: ______________________
Date: June 7, 2023

22 Bishopsgate, London, EC2N 4BQ
United Kingdom

On this 7th day of June, 2023, before me, the undersigned notary public, personally appeared STEVEN KNELL, proved to me through satisfactory evidence of identification, which was personally known to me, to be the person whose name is signed on the preceding or attached document, and acknowledged to me that they signed it voluntarily for its stated purpose.

____
Notary Public

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MY COMMISSION EXPIRES
WITH LIFE

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