No wind shield required

Europe’s offshore wind ambitions are challenged by capacity bottlenecks and trade tensions

December 2025

Preface

This report assesses the outlook for the European offshore wind industry.

The report invites authorities, investors, developers, OEMs, and suppliers to unpack the challenges and opportunities related to the supply chain fuelling Europe's offshore wind expansion.

The offshore wind industry has struggled with supply issues, cost increases, and a disconnect between political ambitions and commercial realities. This puts the achievement of the 2030-targets at risk while new trade tensions are arising that can further challenge the industry.

The report analyses the capacity constraints in the European supply chain and explores the role of imports of offshore wind components in the supply chain and assess the risk of trade tensions against the backdrop of inflated costs, increasing risk, and erratic demand.

The report aims to contribute to finding a viable pathway towards Europe's energy independence and green transition amidst geo-political tensions and increasing protectionist trade policies. Such a pathway will require an accelerated domestic capacity and complementary external supply to manage timing and cost pressures.

A report of Implement Consulting Group

This report is produced by Implement Consulting Group. Implement is dedicated to helping decision makers in public and private organisations across the world implement solutions, which will support the necessary energy transition to meet the objectives of the Paris Agreement.

We extend our gratitude to experts from across the offshore value chain whose insights have contributed to the study. Implement would like to thank Dajin Heavy Industries for their contributions to this study.

SUMMARY

Europe is installing too little offshore wind to meet its political ambitions

European governments (EU, Norway and United Kingdom) have set ambitious targets for offshore wind totalling 142GW, equivalent to quadrupling the currently installed capacity by 2030.

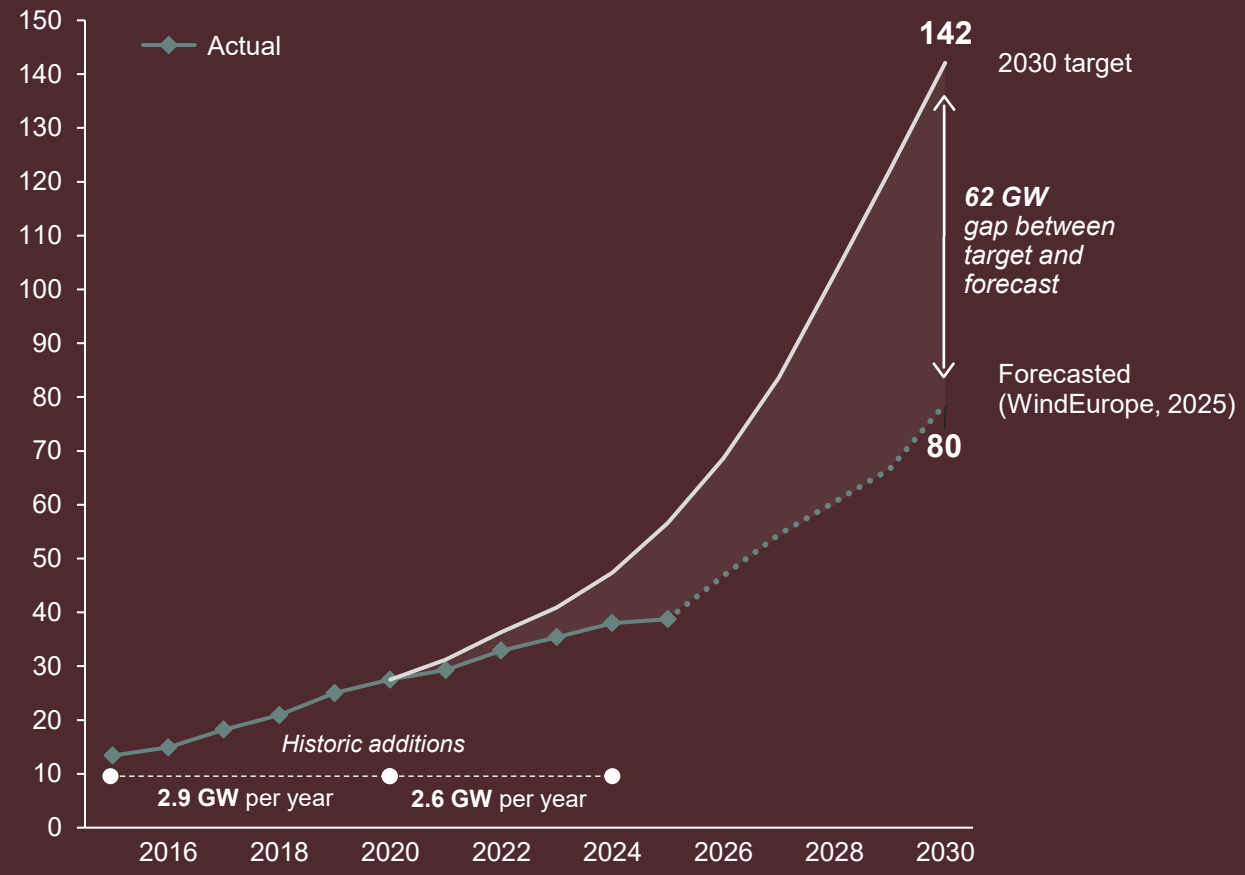
The offshore wind buildout is one of the EU's most critical transformations towards energy independence and climate neutrality. Europe has a strong offshore wind industry accounting for 26% of global manufacturing capacity and is a large exporter of offshore wind projects. Offshore wind offers more "strategic autonomy" than other renewables with over 90% of European capacity coming from European producers (versus less than 5% for solar).

The offshore wind industry was developing well until around 2020 with increasing installations, capacity investments and a downward trend in the price of offshore wind.

In recent years, and despite the strategic importance, offshore wind is slowing, and Europe is now expected to fall short of its buildout targets. The gap to target is mainly explained by:

- **Lack of political commitment:** Too little offshore wind capacity has been auctioned by European governments, creating a misalignment between the political goals and the available project pipeline.
- **Lack of commercial viability:** Recent cost increases has reversed the otherwise steadily dropping price of offshore wind, causing project cancellations and unsuccessful auctions.

European offshore wind capacity
GW



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SUMMARY

The European supply chains is not scaled to meet the political targets

The stop/go demand and cost increases has led to underinvestment in the offshore wind supply chain and stalled expansion of capacity. The new uncertainty around the US offshore wind market has further worsened the willingness to invest in new European capacity as the recent delays and cancelations has cause underutilization of current capacity.

However, Europe is expected to massively ramp-up on installations going forward. To reach the 2030 targets, Europe would need to install 21 GW of new capacity every year until 2030 against a historic pace of 2-3 GW per year. Such ramp up will lead to supply chain bottlenecks.

Despite expectations from WindEurope of an expanding European supply chain , the uncertain investment climate for offshore wind has caused many large European manufactures to pause of cancel capacity expansions e.g. Vestas' blade factory in Poland, Siemens Gamesa's nacelle manufacturing plant in Denmark, and Baltic Structures Company's monopile facility in Denmark. This leaves an average annual capacity gap of at least 12GW for Europe to succeed on its 2030-target.

The supply chain capacity gap is most pronounced for large scale nacelles and blades (>10 MW), rare earth magnets and monopile foundations (especially large diameters >12m). For example, European monopile manufacturers can only meet around half of capacity needed to meet the 2030 targets. Today, the waiting time for offshore foundations is already up to 3-4 years in some cases. Bottlenecks in one part of the supply chain, e.g. for monopiles, will have rippling effects across the entire supply chain and will slow down the overall offshore wind expansion.

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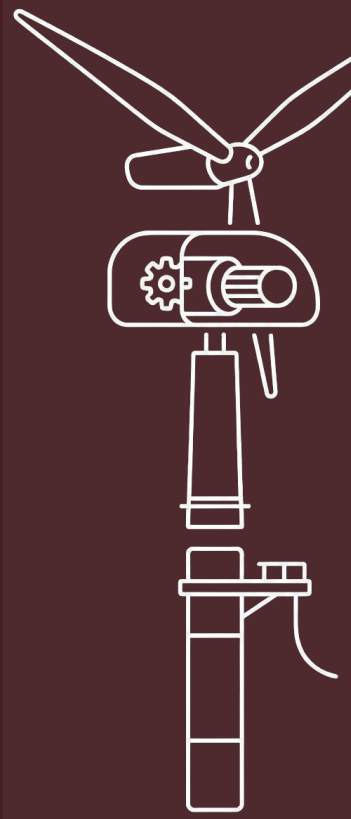
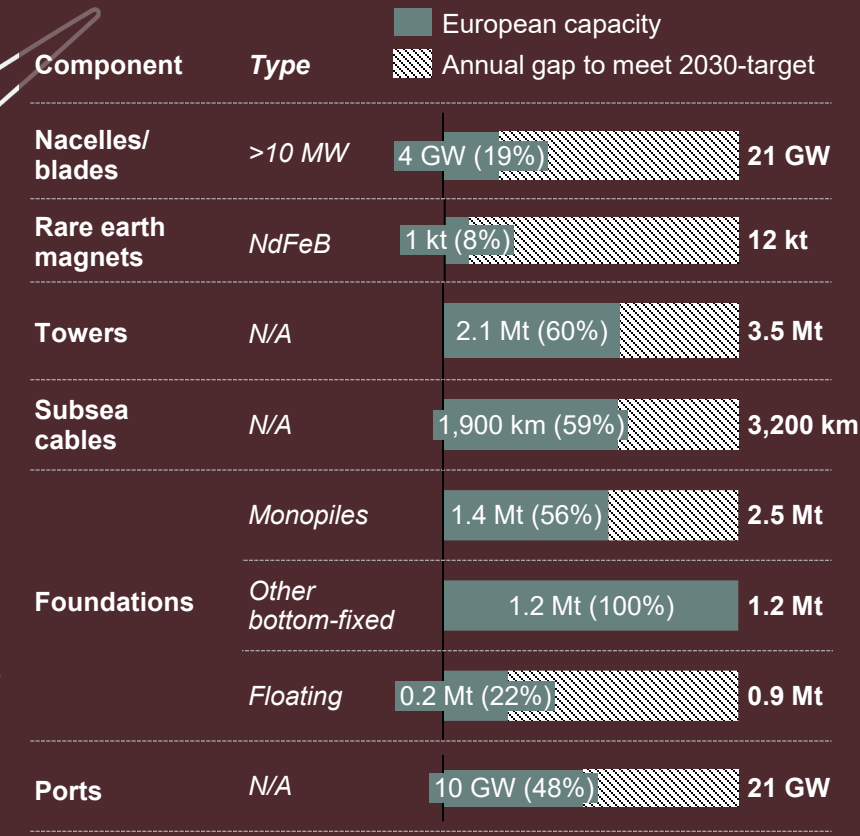
European supply chain capacities and future demands





SUMMARY

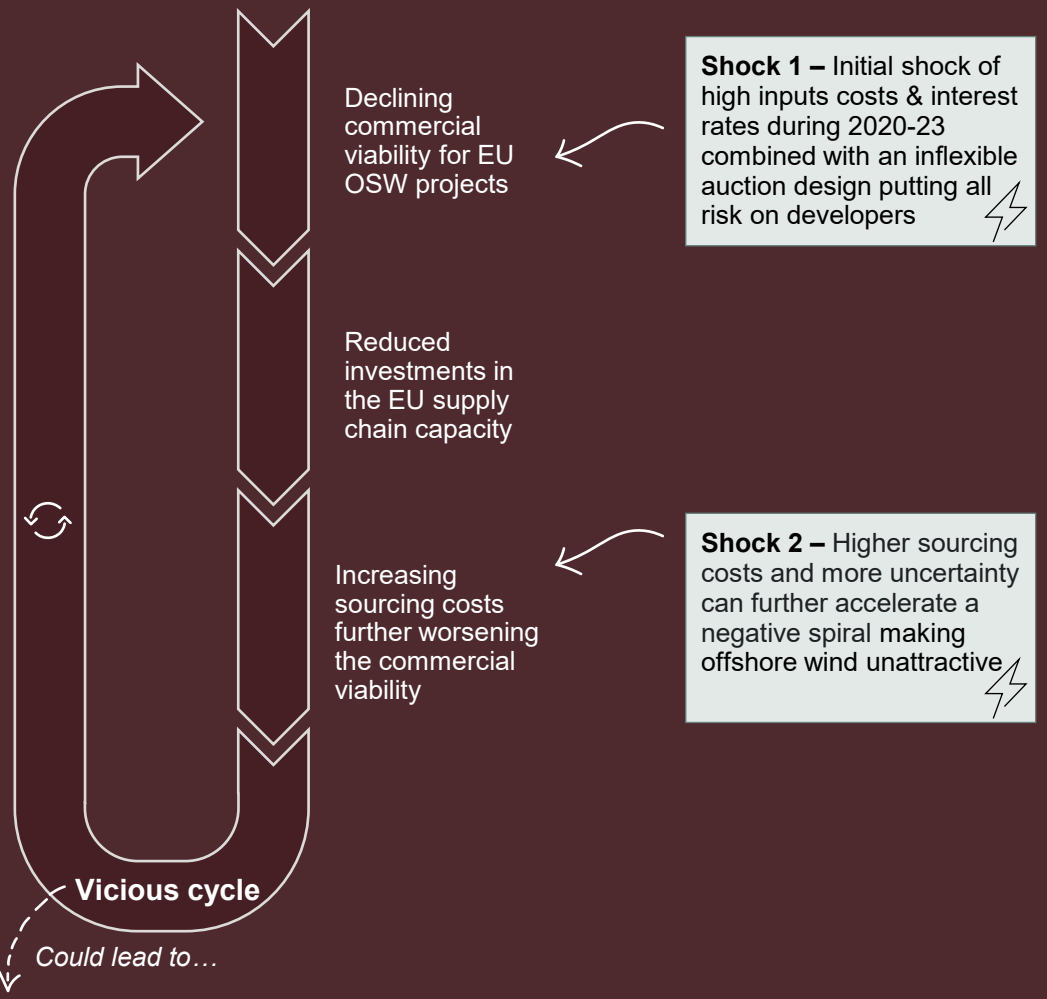
Foreign components will be key for Europe to ramp up offshore wind installations

Europe cannot meet its 2030-target solely through local manufacturing. Foreign supply of key components to offshore wind projects will be key for enabling a ramp-up in installations, especially in constrained parts of the supply chain such as nacelles, magnets and monopiles. While expansion of the European manufacturing capacity is surely needed, it will not be possible at the needed scale within the 2030 timeline. Lifting the European supply chain capacity to 20GW annually would take at least 4-5 years and up 10 years for vital part of the supply chain like deep-sea ports.

EU's emerging protectionism in the offshore wind supply chain could make matters worse by adding more uncertainty, creating new bottlenecks, and increase sourcing costs. While Europe's new stance on trade and industrial policies is intended to support EU competitiveness in offshore wind, limiting outside sourcing of key inputs to the EU supply chain would only accelerate existing bottlenecks and will at the end of the day impact the entire industry outlook. Higher sourcing costs will also challenge the commercial viability for developers and reduce interest in future auctions and capacity investments.

A slower offshore build-out will heavily impact job creation across the very strong EU-based manufacturing. Not delivering on the 2030-targets puts 54,000 new jobs in the offshore sector at risk and weakens Europe's journey towards energy independence.

The vicious cycle for Europe's offshore wind industry



Shock 1 – Initial shock of high inputs costs & interest rates during 2020-23 combined with an inflexible auction design putting all risk on developers

Shock 2 – Higher sourcing costs and more uncertainty can further accelerate a negative spiral making offshore wind unattractive

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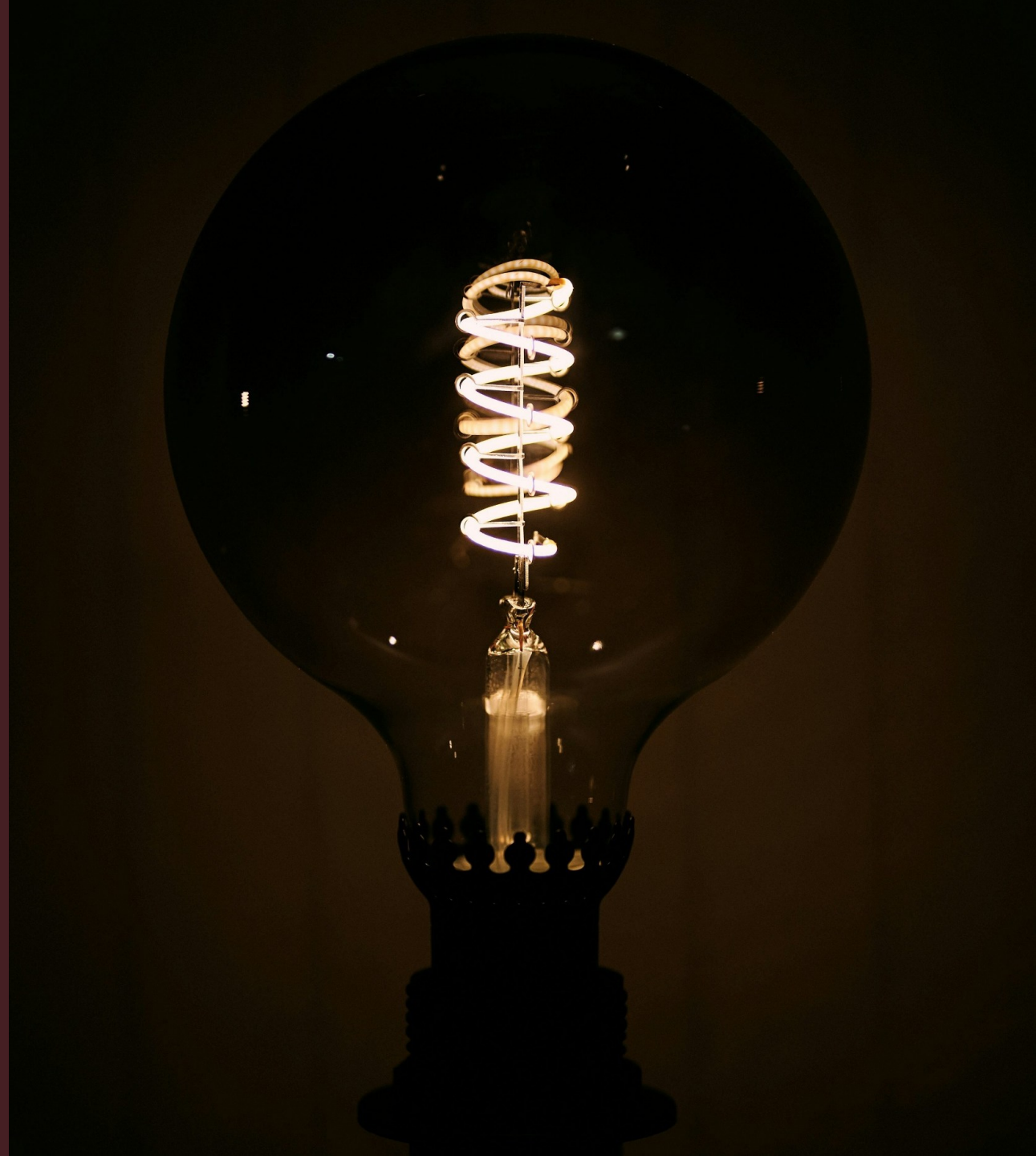
CHAPTER 1

Meeting the ambitious targets for offshore wind is key for energy independence

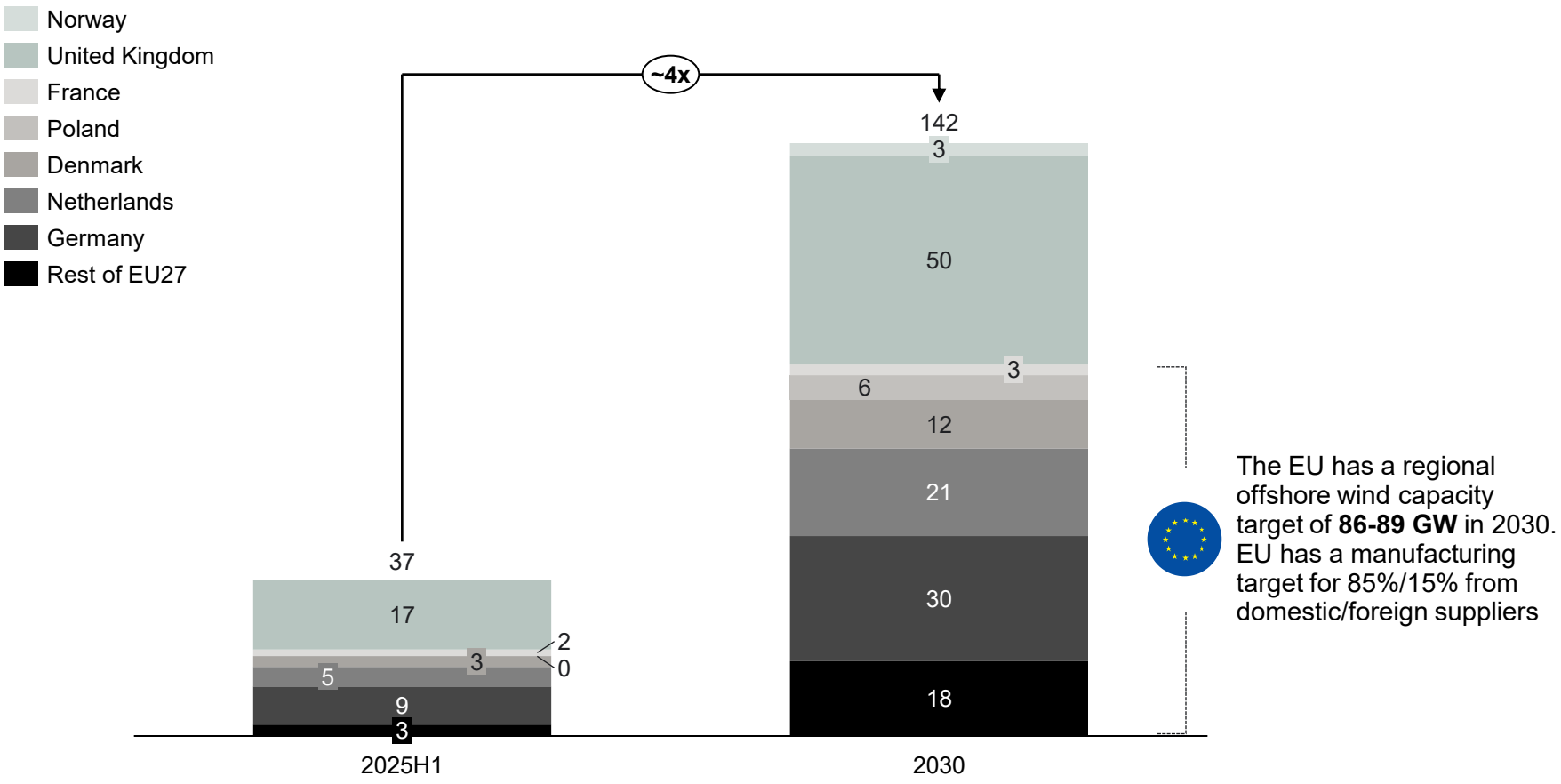
Introduction



The targets set by the EU, UK and Norway aims to quadruple European offshore wind capacity by 2030

European offshore wind capacity build-out

GW



The EU has a regional offshore wind capacity target of **86-89 GW** in 2030. EU has a manufacturing target for 85%/15% from domestic/foreign suppliers

The targets set by the EU, UK and Norway aims to quadruple offshore wind capacity reaching over 140 GW by 2030. Offshore wind is one of the EU's most critical transformation initiatives. Meeting these goals is vital for energy security and the green transition.

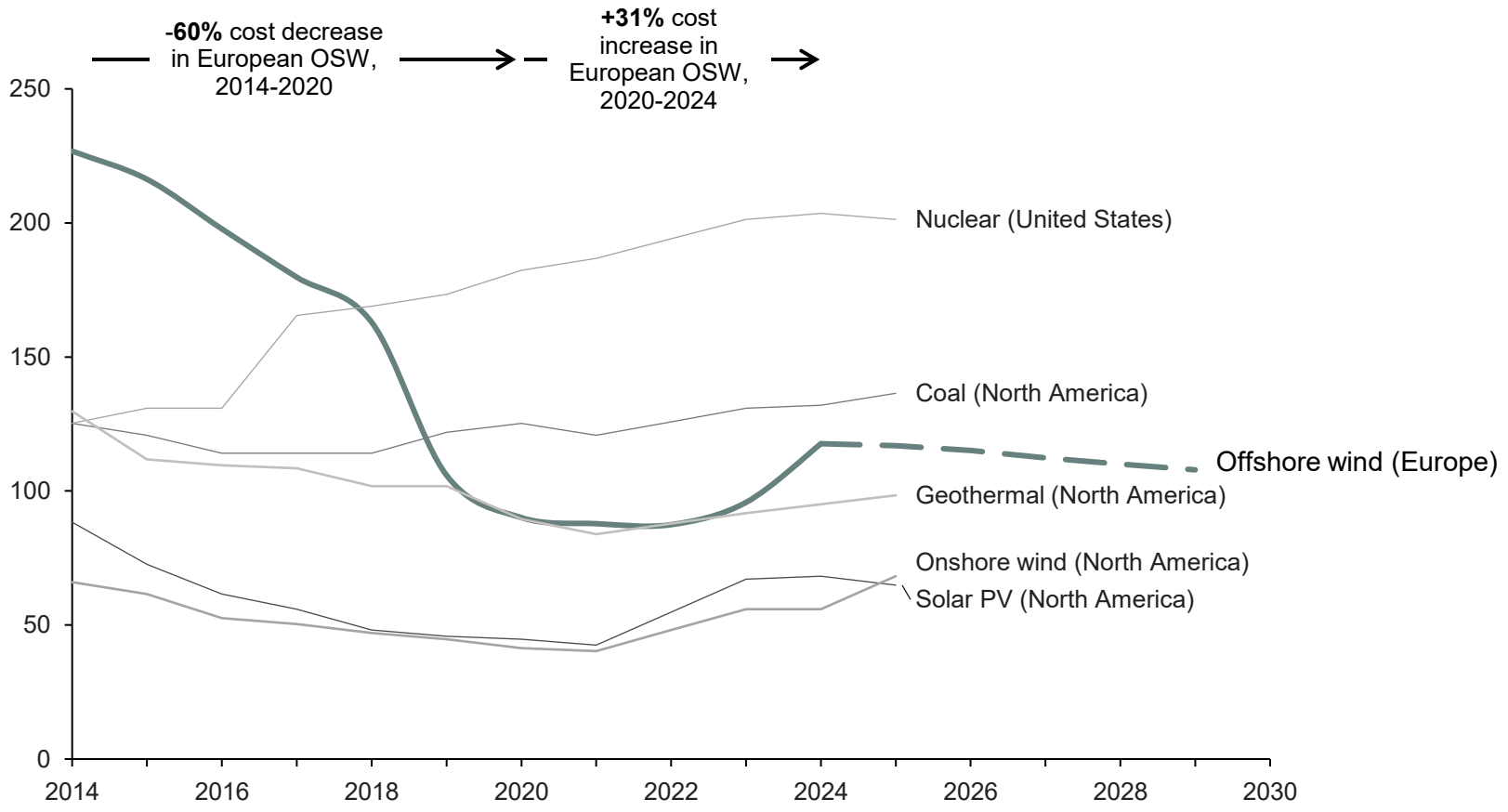
- With targets of up to 89 GW in the EU, up to 50 GW in the UK, and up to 3 GW in Norway[1] these would require a fourfold increase in the current capacity of 37 GW in five years.
- For the EU, the build-out will help meet an expected increase in electricity consumption of 60% between 2023 and 2030, driven by data centre demand, electrification and more EVs.
- Offshore wind is a key technology in EU's long-term strategic goals:
  - **Clean**: EU has a binding target of a 42.5% share of renewable energy in the energy mix by 2030. In 2023, the share was 24.5%. If targets are reached, offshore wind will contribute around 4 p.p.[2] to the 42.5%.
  - **Affordable:** EU's Affordable Energy Action Plan aims to deliver cheaper energy. In 2023, industrial electricity prices in EU were double relative to China and the US.
  - **Secure:** Energy independence is key to upholding EU sovereignty. In 2023, 45% of European energy was imported.

Note: 1) Norway's target of 3 GW forms part of the Ostend declaration of energy ministers from April 2023. 2) Assumes 87.5 GW of offshore wind running at a 47.5% capacity, which yields 87.5×8,760×0.475 ≈ 364 TWh per year, and dividing this by the EU's 2030 final energy proxy of 763 Mtoe ≈ 8 874 TWh, gives ≈ 4 percentage points toward the 42.5% renewables target.
Source: Implement Consulting Group based on European Commission, UK Government and WindEurope.

The average cost of electricity from offshore wind has increased since 2020, but is expected to fall again as temporary headwinds ease and turbine innovation continues

Levelised cost of electricity (LCOE) from renewable energy sources

EUR/MWh, real 2024



Note: LCOE expresses the average cost of generating one MWh over a project's lifetime. Except construction, sewerage, waste management and remediation activities. Awarded price trend is calculated as a quadratic trend.
Source: Implement Consulting Group based on Eurostat, BloombergNEF, IRENA, 4C Offshore, UK Department for Energy Security and Net Zero and Global Wind Energy Council.

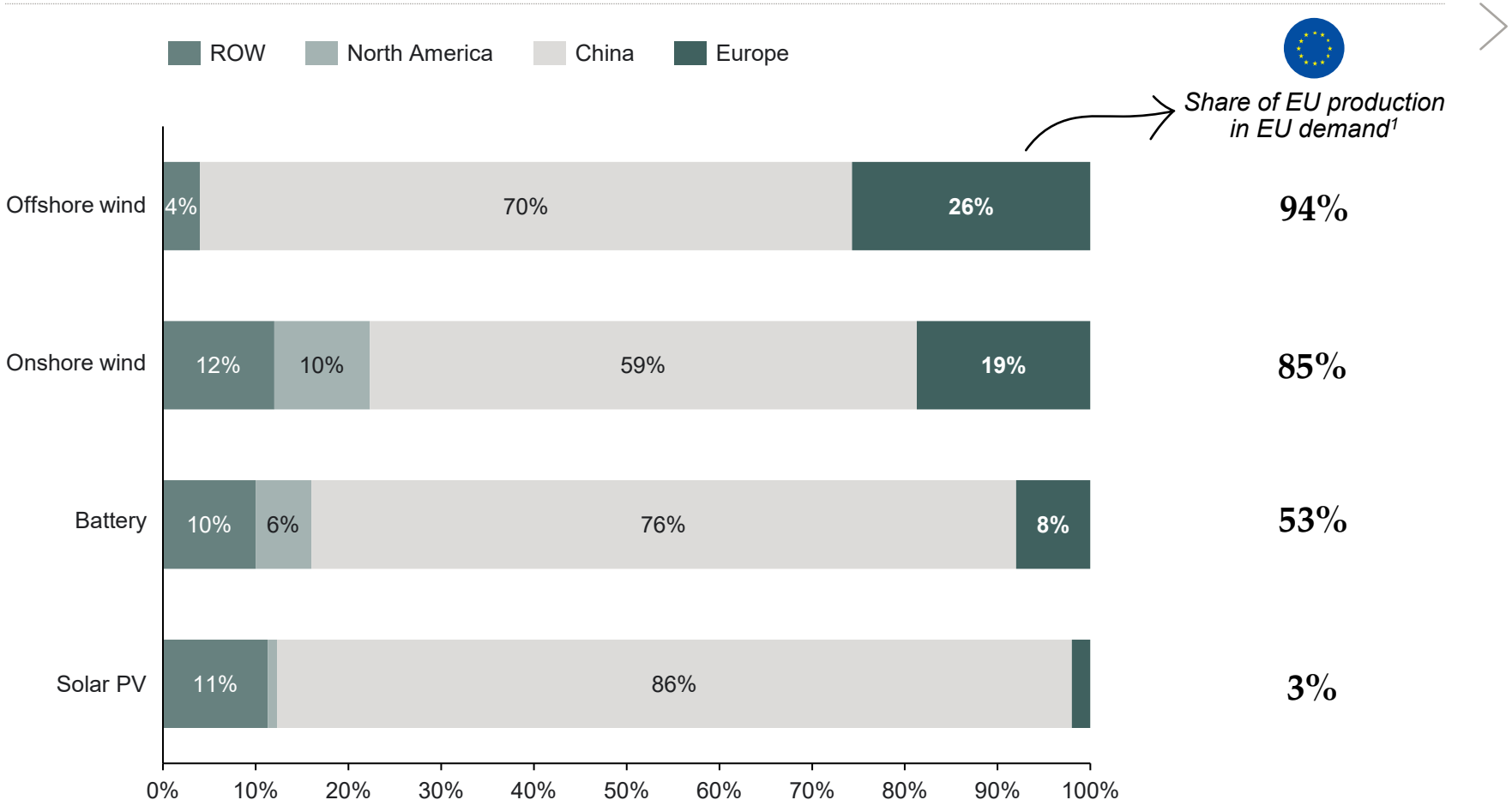
Offshore wind remains a competitive energy source despite recent cost increases, and European countries are committed to their plans to build out capacity.

- The levelised cost of offshore wind electricity in Europe fell from about 225 EUR/MWh in 2014 to about 80 EUR/MWh in 2020/21, driven in part by larger turbines and stable costs.
- Since 2020, offshore wind costs have increased and other energy sources have seen similar cost increases. Maintaining multiple supply options enhances price competition, delivery certainty and helps balance grid production.
- Auction awards have roughly followed LCOE, and policymakers are shifting to CfD-style contracts that share risk, reduce required returns, support projects, and lower consumer power costs.
- The levelised cost of electricity in offshore wind is higher than that of onshore wind. However, onshore wind faces opposition from NIMBY (not in my back yard), making off-shore wind a favourable alternative.
- According to BloombergNEF data, the LCOE is expected to decrease in real terms through to 2029 as bigger turbines push down costs per MWh, policy reduces financing risk and temporary headwinds from inflation are expected to ease.

Offshore wind offers higher “strategic autonomy” compared to other renewable power sources

Regional manufacturing capacity of clean technology, 2021

%



The majority of wind installations deployed in the EU are provided by the domestic wind manufacturing sector

- The European Commission reports that European manufacturers account for 94% of the EU offshore wind energy market and 85% in wind in general.
- Offshore wind is also a strong European technology from a global perspective with a 26% share of global manufacturing capacity according to the Draghi report.
- Europe has been a first mover in wind energy technologies which means that the EU has much more “strategic autonomy” (i.e. a diversified and resilient supply chain) in wind compared to other renewables such as solar and batteries, where Europe relies on a few foreign producers.
- If bottlenecks in offshore wind result in slower build-out of offshore wind, then it will have much bigger job impacts in the EU than a corresponding slowdown in solar or battery expansion.
- If future offshore wind capacity is replaced by solar (+ batteries), then Europe would also become more dependent on imports, in particular from China.

Note: 1) The share of EU production in EU demand is based on the Status Quo scenario in the European Commission’s Staff Working Document (SWD 2023 68 final) “Investment needs assessment and funding availabilities to strengthen EU's Net-Zero technology manufacturing capacity”, table 1 for wind, battery and solar and on the European Commission “European Wind Power Action Plan” (COM 2023 669 final) for offshore wind. See also European Parliament Briefing “Wind Energy in the EU”, page 3.
Source: Implement Consulting Group based on The Draghi Report, European Commission, European Parliament and Bruegel.

CHAPTER 2

European offshore wind is challenged by a misalignment between political ambitions and actual installations

Commitment to European offshore wind

> *Currently, industry analysts agree that political targets for offshore wind for 2030/2035 will not be met.*
>
> WindEurope (2025)

Europe's wind industry has been characterised by a period of stop/go demand, blurring future investment signals and stalling manufacturing capacity growth

European offshore wind in numbers

Europe's wind industry has seen waves in awarded offshore contracts and a recent surge since 2020

78GW awarded

New installations are a result of previously awarded contracts with a delay 4-6 years (see p. 14)

25GW installed

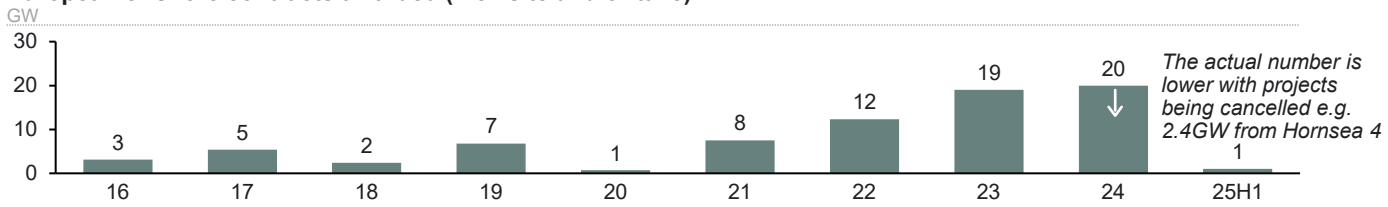
Lumpy awards of European offshore capacity leads to lumpy investments…

152bn EUR financed

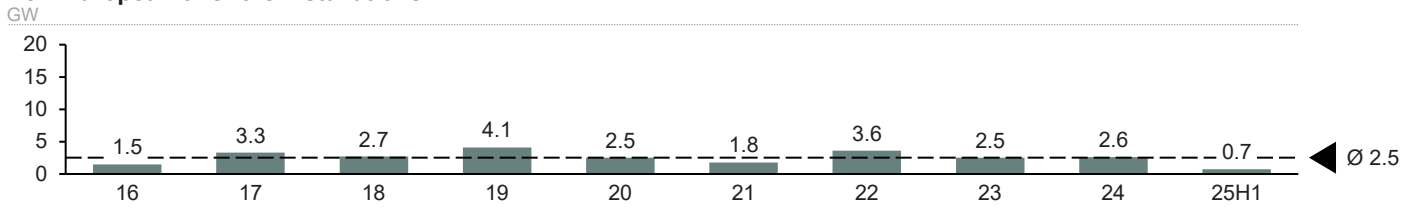
… as well as lumpy orders for wind turbine components and final turbine products.

40GW ordered

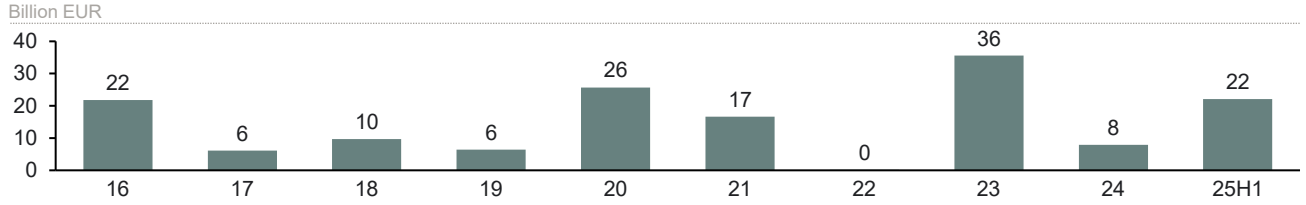
European offshore contracts awarded (incl. site and offtake)



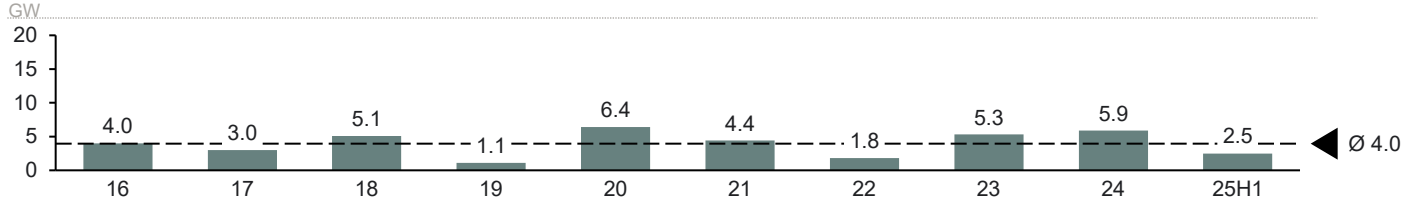
New European offshore installations



New offshore assets financed



Annual volume of offshore wind turbine orders



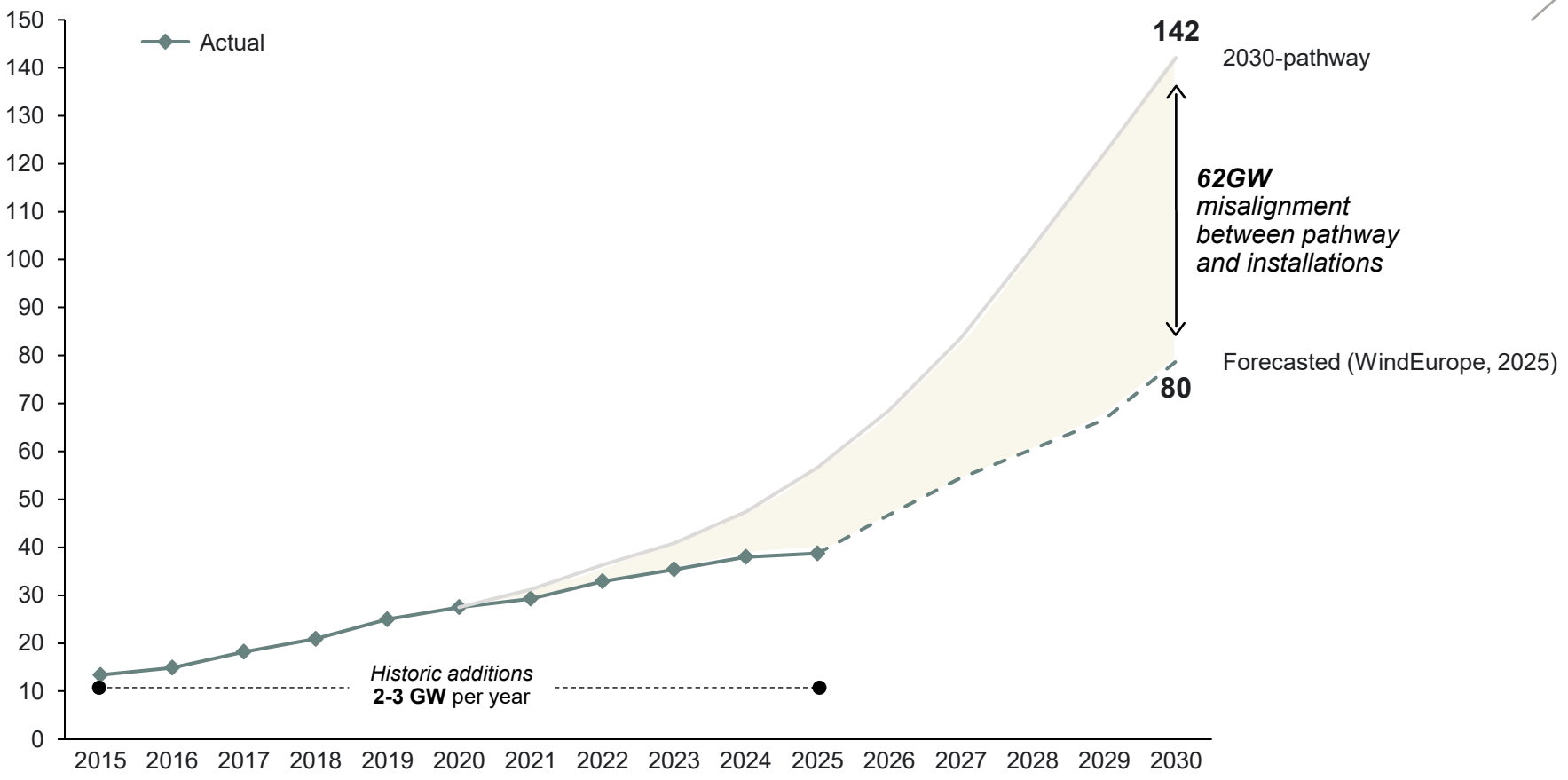
Activity in the European (EU27, UK, and Norway) offshore wind sector has seen stop/go demand since the late 2010s

- Since the late 2010s, Europe's wind sector demand has fluctuated considerably due to fluctuating auctions, cancellations and delays.
- Offshore installations have been modest and uneven (25GW total 2016-2025H1), while awarded capacity has surged since 2023, creating a growing gap between announcements (78GW total since 2016) and delivery.
- Actual installations during 2023-2025 were only half of the 12GW forecasted by WindEurope.
- Financing has been volatile: final investment decisions and capital committed fluctuated sharply year-to-year, with a marked dip during the cost spike in 2022 and a rebound in recent years.
- Turbine orders show the same whipsaw pattern with offshore orders arriving in large, lumpy tranches leaving OEMs with hard-to-plan factory utilisation.
- The lumpy stop/go demand increases production costs and adds a risk premia across the supply chain for both domestic and foreign suppliers. The erratic demand also resulted in demand peaks requiring the availability of flexible supply often from non-EU providers.

Note: Awarded offshore contracts include competitive government-run procurement rounds allocating offshore wind capacity and/or site development rights (across policy mechanisms e.g. Contract-for-Difference, feed-in premium, or negative bidding). Purely commercial offtake arrangements are not included.
Source: Implement Consulting Group based on WindEurope and 4C Offshore.

Slower than expected offshore wind build-out results in a misalignment between actual installations and the pathway to 2030 targets

European offshore capacity
GW



In 2020, ambitious European political targets and steady improvements in the price of offshore created a positive outlook for the sector. The European supply chain invested to meet the expected ramp-up in the installations.

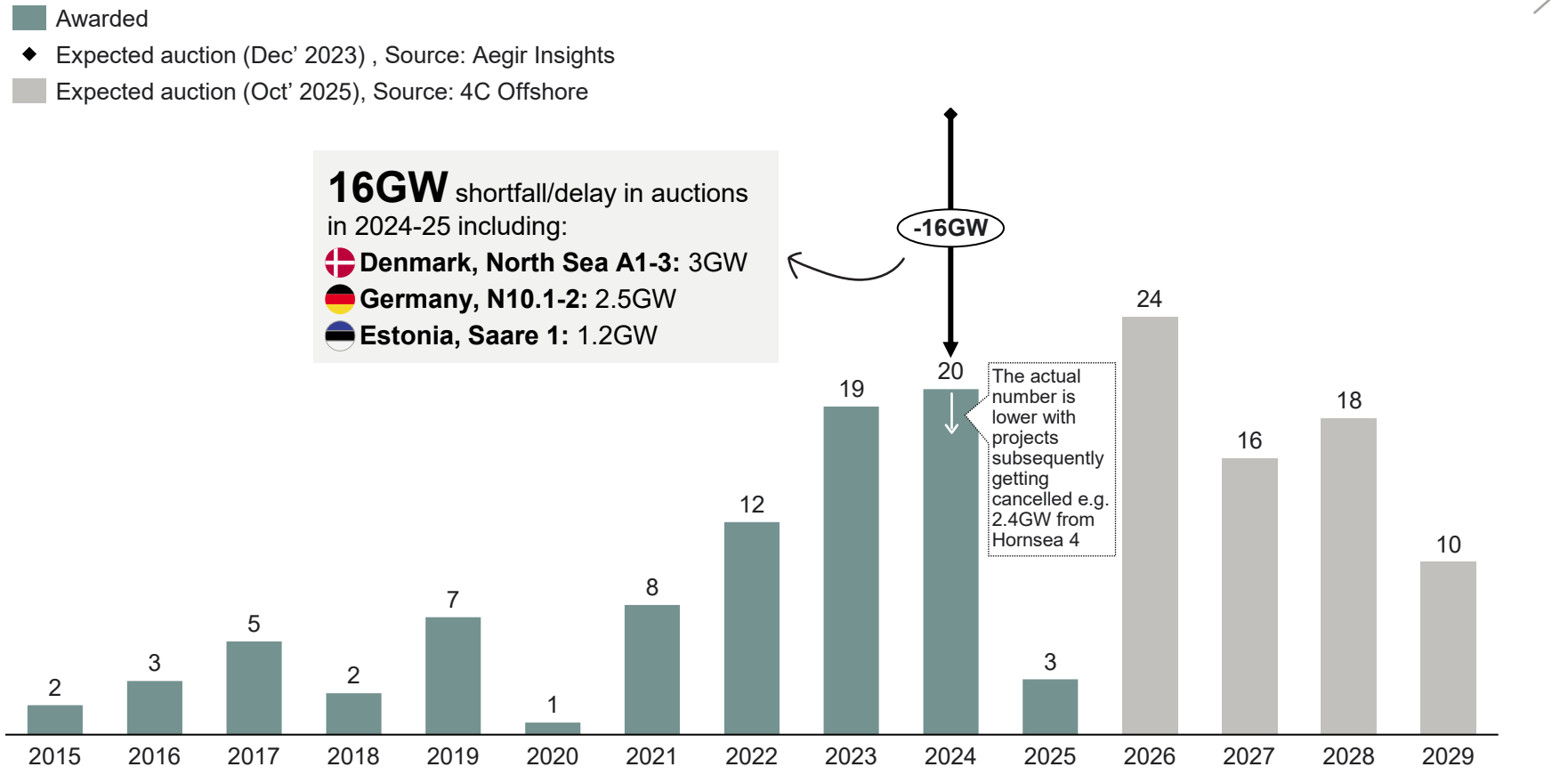
- However, the combination of COVID and the Ukrainian invasion resulted in serious shocks to costs resulting in project delays and runovers. In combination with inflexible contracts, unable to absorb the costs, this put a damper on the buildout pace.
- Actual installations have fallen significantly below expectations. Between 2021-2025, installations has been 18GW lower than expected early 2021.
- Future installations are not expected to close the gap to the 2030-pathway. Between 2020-30, expected installations is expected to leave a gap of 62GW to the 2030-target (46GW between 2026-2030 alone).
- The recent slowdown in installations has caused a temporary and short-term situation with idle capacity. Between 2021 and 2025H1, 18GW less offshore wind has been installed than expected in back in February 2021. This leaves the industry with a demand gap, unable to fill up orderbooks in current production facilities.

Note: The target pathway is presented to reflect expected offshore wind installation pipeline in 2020 and is a combination of "WindEurope's Realistic Expectations Scenario" for 2021-2025 and a possible pathway from 2026-2030 that ensure the European targets in 2030. The forecasted capacity is based on the Autumn 2025 forecast from WindEurope of actual installations.
Source: Implement Consulting Group based on WindEurope and 4C Offshore.

Project cancellations and no-bid auctions keep fuelling uncertainty about the future pipeline and needed manufacturing capacity

European offshore capacity auctioned (incl. both site and offtake)

GW



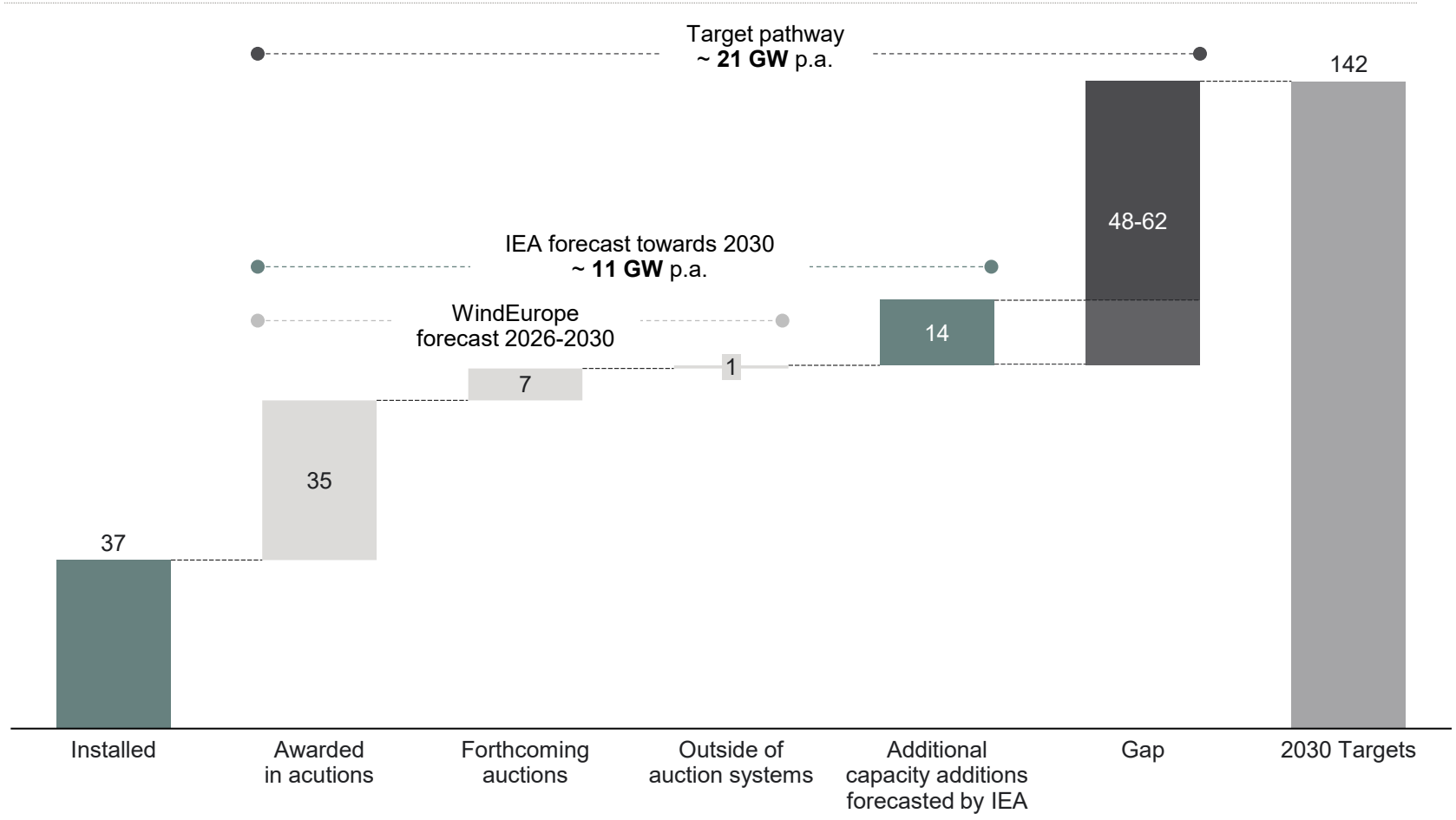
Increased uncertainty and lack of business case viability is pushing developers to cancel, postpone or simply not take part in auctions adding to uncertainty about future pipeline

- Today's offshore wind auctions are the main capacity signal to manufacturers about future installation demand. In 2024 and 2025, many of Europe's offshore wind auctions could not fill offered capacity as leading developers decided not to proceed with offers.
- In December 2023, European countries had announced 36GW of auctioned capacity in 2024, however only 20GW ended up materialising as governments were struggling to update auction designs to the new realities.
- The uncertainty surrounding the buildout worsens the investment conditions, stalls capacity expansion and slows the pace of innovation.
- Reaching the EU target of 360 GW offshore wind by 2050 will require a sustainable level of continued auctioning of around 17 GW per year in the EU alone between 2030 and 2050.

Notes: Expected auctions are the capacity of the announced auctions by that point in time e.g. further capacity might be announced at a later point or the auction might be unsuccessful. The awarded capacity in 2025 is only for the first half of 2025. Awarded offshore contracts iinclude competitive government-run procurement rounds allocating offshore wind capacity and/or site development rights, typically linked to a defined support or revenue mechanism (e.g., Contract-for-Difference, feed-in premium, or negative bidding). Purely commercial offtake arrangements are not included.
Source: Implement Consulting Group based on policy choices and outcomes for offshore wind auctions globally (2022), Aegir Insights, European Commission, WindEurope, and 4C Offshore.

Offshore wind capacity is expected to fall 48-62GW short of the political target by 2030 but could be further challenged by lack of capacity

European offshore wind capacity
GW



The IEA forecasts additions of 57 GW of European offshore wind capacity towards 2030 corresponding to new installations of more than 11 GW per year on average. Despite the strong increase, this falls short of the target of 142 GW.

- WindEurope is forecasting increased installation activity in the period 2026-30 with slightly more moderate increase of 43 GW taking into account supply chain constrains and delays.
- In 2024, WindEurope expected European production capacity to grow to 9.5 GW by end of 2025. Since then, a series of cancellations of production sites have been announced. Taking historic exports of around 1.5 GW into account means that Europe at best can produce around 40 GW for the European market towards 2030.
- Without further expansion, supply bottlenecks will be eminent, and will be further aggravated by:
  - Peak demand in individual years given Europe's historic pattern of fluctuating demand
  - Mismatch between demand and the type of supply needed, e.g. lack of capacity of XXXL monopiles and floating wind for certain projects
  - Increased auction and PPA activity
  - Limiting access to foreign sourcing in years with peak demand or in components where Europe has under-capacity

Notes: WindEurope's latest forecast from September 2025 shows 43 GW of offshore wind capacity additions in Europe towards 2030, while IEA shows 57 GW.
Source: Implement Consulting Group based on IEA and WindEurope.

Uncertainty about the magnitude of future offshore wind orders has caused many large European manufactures to pause of cancel capacity expansions

Misaligned stop/go demand, cost headwinds and geopolitical uncertainty….

Lack of political commitment: Stop/go auctions and misalignment between political ambitions and actual installations create uncertainty about the European pipeline of projects.

Cost headwinds: Rising material, financing, and labour costs are putting pressure on the commercial viability of offshore wind projects resulting in cancellations and delays of awarded projects and auctions.

Geopolitical uncertainty: Increasing political tensions especially in the US, where the offshore wind pipeline towards 2030 has almost dried out.

…has driven uncertainty about future demand and let to cancelations of planned manufacturing facilities in Europe

Company	Component	Location	Reason
Vestas	Blade factory		"Paused due to lower-than-projected demand for offshore wind in Europe." (Offshore Wind)
Siemens Gamesa Renewable Energy	Nacelle manufacturing plant		"Given the current market conditions … any such decision will require greater clarity and stability in the industry." (energynews.pro)
BSC	Monopile factory		*No formal reason for cancellation – was indicated to create 890 new jobs.*
Sif Offshore Foundations	Monopile factory ramp-up		*9-month delay from longer than anticipated training of workforce, installation of equipment etc.* (OffshoreWind)
LM Wind Power	Blades – layoff of 66% of Danish employees		"It is no longer possible to run a sustainable and profitable business" (EnergyWatch)

Uncertainty about the materialisation of the offshore wind pipeline due to declining commercial viability and lack of auctions has led to the cancellation of multiple planned production sites in Europe.

- European manufactures struggle getting a clear outlook of the future pipeline. A clear pipeline outlook is required to optimise production at existing facilities and more importantly expand with new facilities to meet future orders in time.
- Growing uncertainty combined with underutilisation of existing capacity have led several major European manufactures (e.g. Siemens Gamesa and Vestas) to delay or cancel new production sites.
- Lower capacity investments increase the risk of future bottlenecks if projects materialise. Lower capacity also slows the cost reduction from producing at scale (both in terms of innovative turbine size and larger facilities). This again negatively affects the commercial outlook for the sector in a vicious cycle.

> *For a company like ours — if interest rates go up by 3 per cent, that more than eliminates all the profit of a huge investment.*
>
> Mads Nipper, CEO at Ørsted. Financial Times (2024)

Source: Implement Consulting Group based on Offshore Wind, WindEurope and energynew.pro

CHAPTER 3

The European supply chains alone cannot meet Europe's political targets

European supply chain

> *The industry also warns of an expected under-capacity from the manufacturers of the offshore wind turbines' foundations. Foundations are largely composed of steel. Largely, for offshore wind, turbines, offshore cables, foundations, vessels and port upgrades […] are the key areas where supply chain capabilities need to develop in order to meet the offshore renewable political ambitions of the EU.*
>
> European Commission (2023)

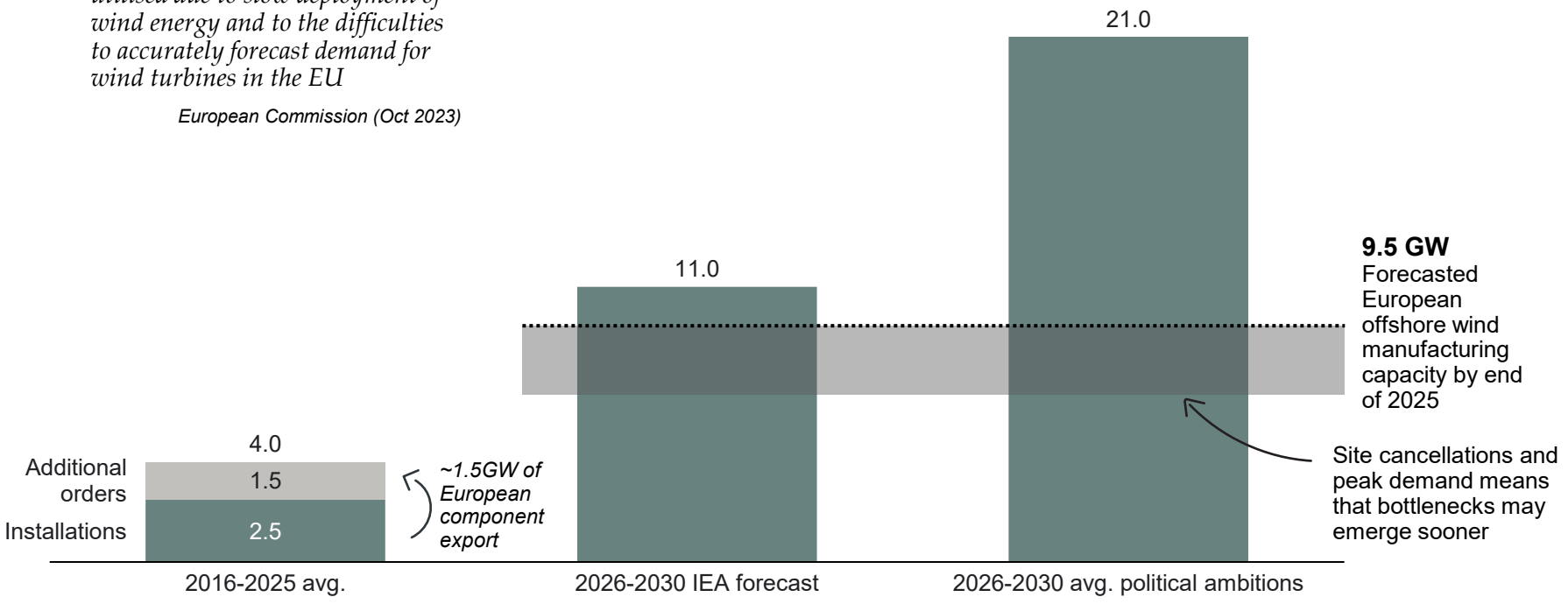
Europe's manufacturing capacity is currently underutilised, but could very soon be insufficient to accommodate the ramp-up in installations

Average European offshore wind installations
GW

The short-term underutilisation…

… is expected to soon be replaced by a situation of undercapacity

> *The industry's manufacturing facilities are currently under-utilised due to slow deployment of wind energy and to the difficulties to accurately forecast demand for wind turbines in the EU*
>
> *European Commission (Oct 2023)*



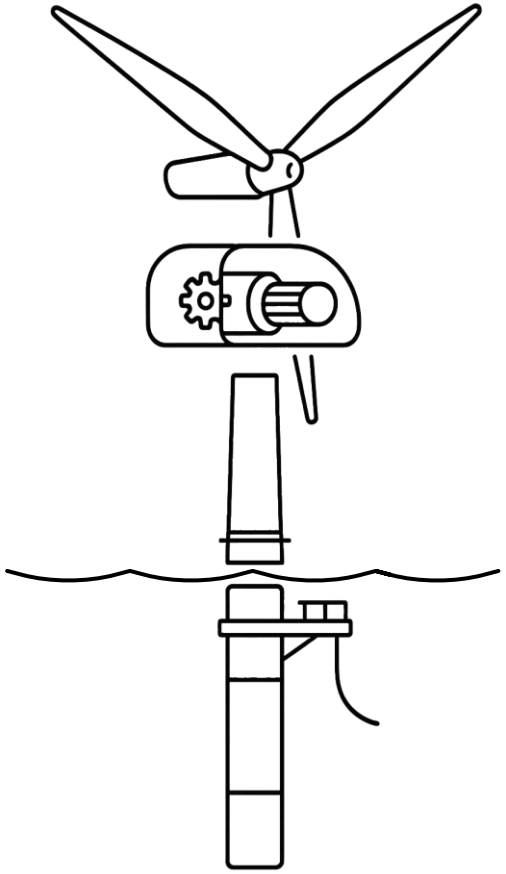
The offshore wind supply chain in Europe is currently underutilised due to slower build-out, delays and cancellations of some projects in the EU and UK but could soon face bottlenecks

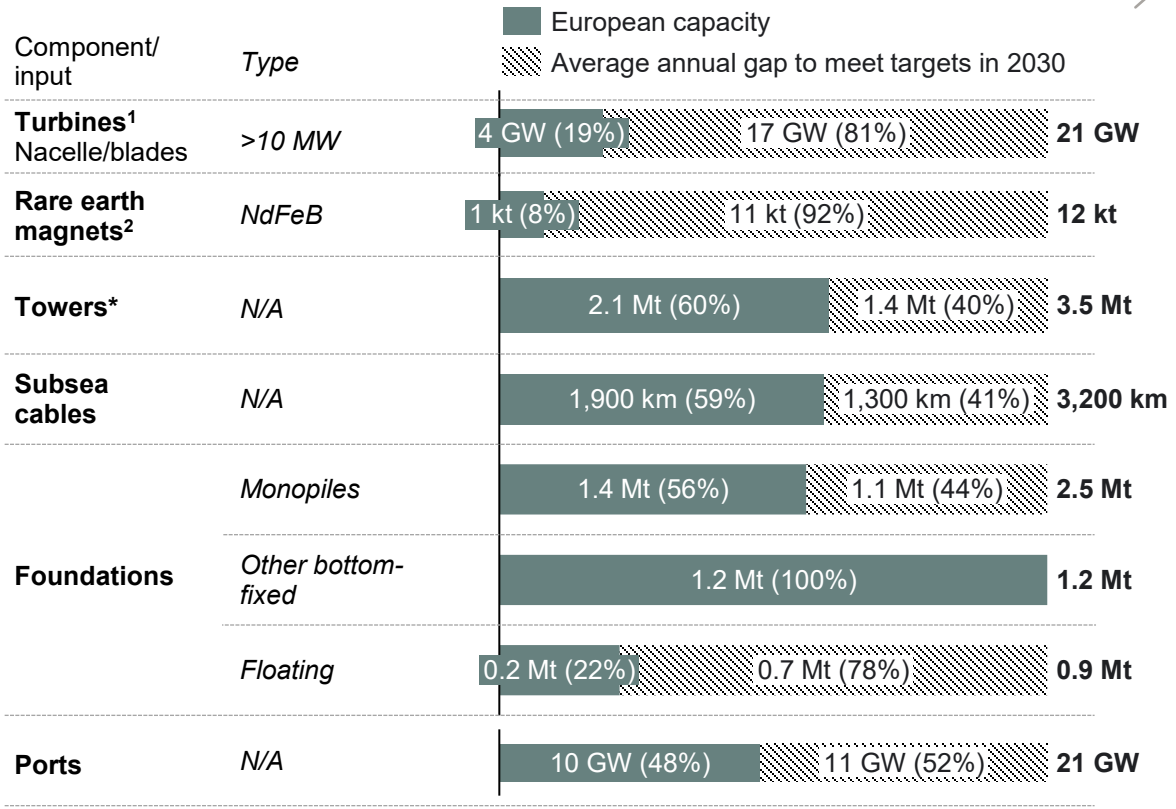
- Most of European offshore wind capacity was build to accommodate the accelerated buildout in Europe and the US, signalled by the political targets and further fuelled by the increasing amounts of auctioned capacity since 2020.
- In recent years, much of this manufacturing capacity has been underutilised as delays push installation of awarded capacity into the future and projects are cancelled in both Europe e.g. Hornsea 4 and the US (IEA has revised down US offshore capacity from 8GW in 2026 to 6GW in 2030). The uncertainty has slowed investments in new manufacturing capacity.
- According to WindEurope, the wind industry has announced € 13bn in investments in factories, ports and vessels from 2022 to 2024 with the hope of increasing Europe's manufacturing capacity to 9.5 GW of offshore wind by end 2025.
- Even with optimistic capacity assumptions (i.e. not accounting for the 1.5GW annual export, cancellations of planned manufacturing capacity, and bottlenecks in certain components) the 9.5GW is still well below the 21GW annual buildout needed to meet 2030-targets or even the 11GW from IEA's latest forecast.

Notes: Expected auctions are the capacity of the announced auctions by that point in time e.g. further capacity might be announced at a later point or the auction might be unsuccessful.
Source: Implement Consulting Group based on policy choices and outcomes for offshore wind auctions globally (2022), Aegir Insights, European Commission, EnergyWatch, WindEurope, and 4C Offshore.

Europe lacks production capacities across most main offshore wind components

European supply chain capacities and future demands





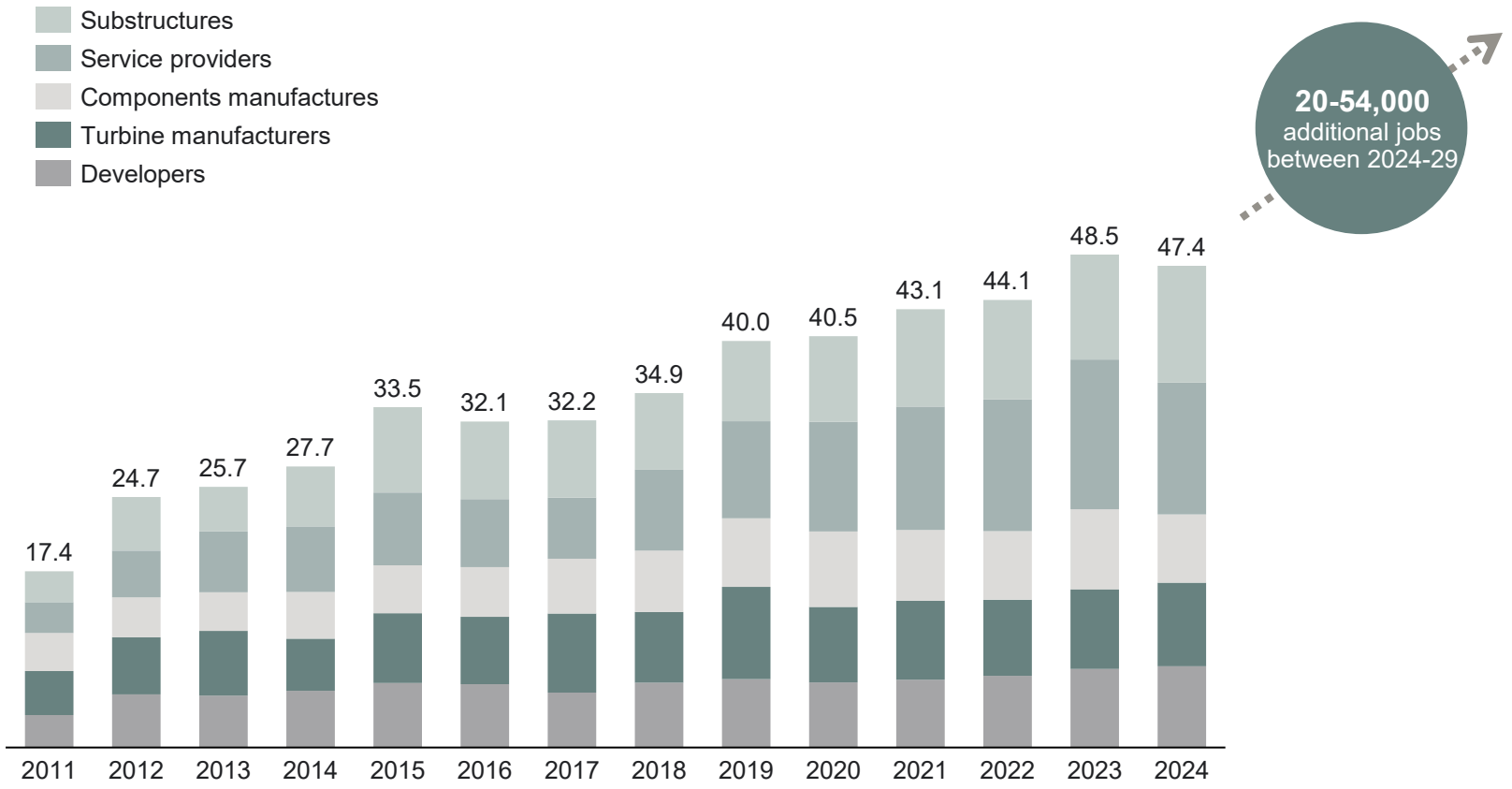
European suppliers cannot meet future demand for OSW components without massively scaling up domestic supply chain capacity. Long lead times and poor investment conditions for new production capacity mean that the EU will still need to import key components from the rest of the world to expand its offshore wind sector.

- Current European manufacturing capacity is inadequate to deliver the forecasted growth and insufficient to deliver on the targets for 2030.
- Turbines (nacelle and blades) makes up ~50% of the total component cost. Europe can meet most target demand for sub-10 MW turbines but has very limited capacity in the fast-growing >10 MW class, which will dominate new offshore additions towards 2030. Europe is also highly import-dependent for rare earth magnets.
- EU's new tariffs on steel will affect the sourcing of the most steel-heavy components such as towers and foundations, where monopiles account for 80% of foundations in EU. Monopiles is central component accounting for ~15% of the turbine cost, and the industry is already experiencing waiting periods of up to 3-4 years.
- Europe has 56% of monopile capacity to meet 2030-target. Without supply chain investments, Europe will stay import-dependent for these key components. Chapter 5 of the report takes a closer look at the need for imports of monopiles.

Notes: *Applies to both onshore and offshore. *Gap to meet demands* is defined as demands in Rystad Energy's *2030 Targets scenario,* in which 2030 targets are met. 1) Assumes all new additions of turbines in 2030 will be >10 MW. 2) ~In annual terms, if Europe installs 21 GW of offshore wind energy in 2030 and we use an average NdFeB magnet intensity of ~570 kg/MW (a blended geared/direct-drive assumption from IEA/NREL/OEM ranges), that year has a magnet need of ~33 kt (58,000 MW × 0.57 t/MW ≈ 33 kt).
Source: Implement Consulting Group based on Rystad, IEA, NREL, OEM, Guide to an Offshore Wind Farm, and WindEurope.

Introducing additional uncertainty jeopardises 47,000 current European jobs in the OSW industry and more importantly up to 54,000 new jobs over the next five years

Direct employment in the offshore wind sector
Thousand jobs



The European offshore wind industry is a large sector that has been steadily growing adding 30,000 employees between 2011 and 2024 and could create an additional 54,000 over the next 4-5 years.

- European offshore wind is a large manufacturing sector employing many Europeans throughout the construction, developing and servicing of turbines. In 2024, the offshore industry employed almost 48.000 people generating a lot of economic activity. For each GW of offshore wind installed in Europe, the industry generates EUR 4.4 billion of value added to the European economy.
- Ramping up the pace of installation and production of offshore wind in Europe will naturally also grow the domestic industry. According to WindEurope, meeting the European targets for wind could add a total of 230,000 additional jobs (both offshore and onshore) across the supply chain.
- According to FLORES, 20,000-54,000 new jobs could be created in the offshore sector alone between 2024 and 2029. Uncertainty about the speed of the buildout and need for people and capacity, jeopardises both the existing and future European jobs.

Notes: The additional jobs created if Europe meets its 2030 political targets is based on the overall job creation for the wind industry and scaled by the required increase in annual installations for offshore relative to onshore and scaled by the overall sectors ratio between direct and total employment (includes direct, indirect, and induced jobs).
Source: Implement Consulting Group based on ETIP Wind, European Commission and

CHAPTER 4

Europe is a global leader in offshore wind benefiting from global trade

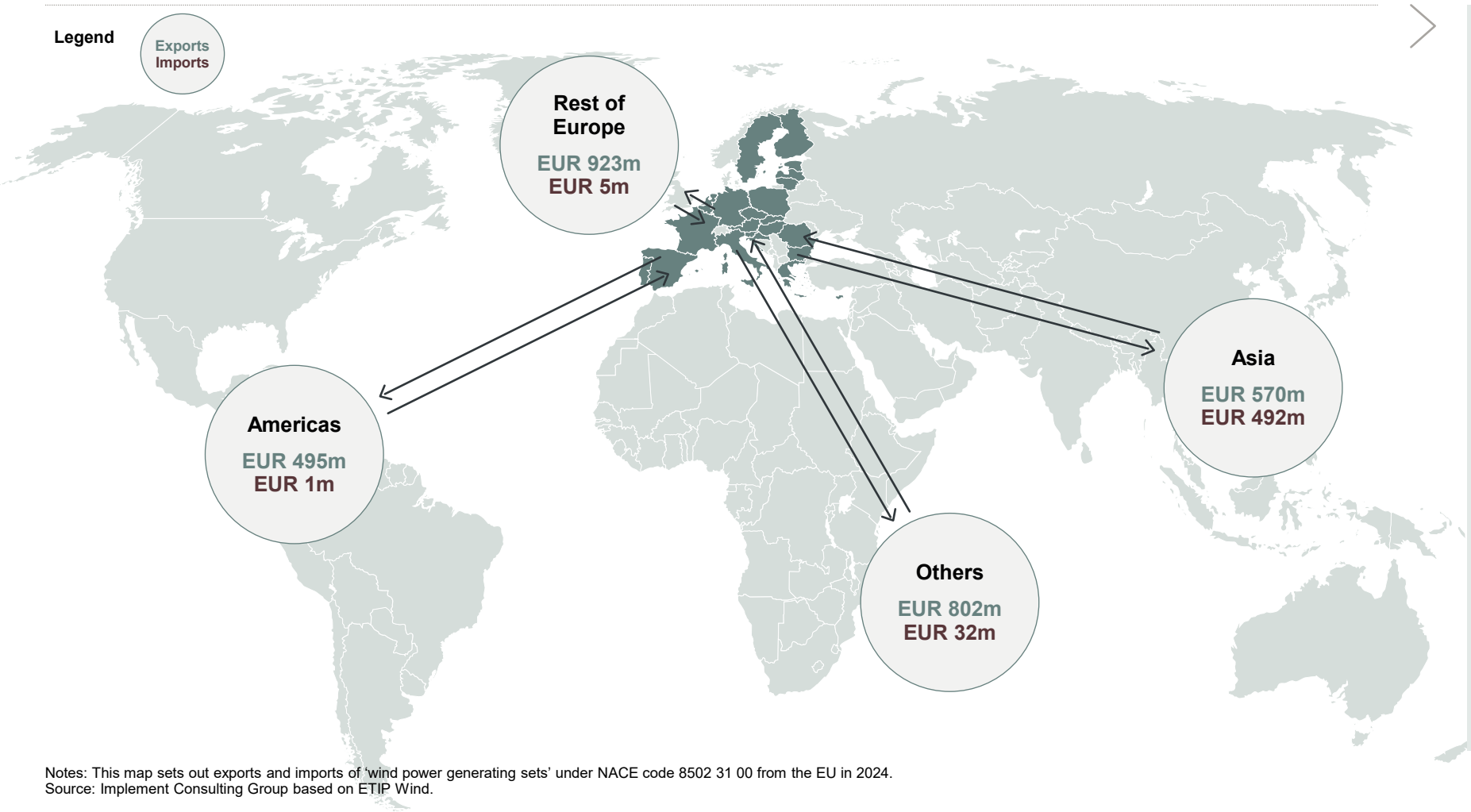
Europe’s role in the global offshore wind market

> *92.7% of offshore wind turbines destined for European projects are being manufactured by companies headquartered in Europe. In the global market, around 50% of turbines are being manufactured by European-headquartered companies.*

Norwegian Offshore Wind (2025)

The EU has a strong global position in wind with a trade surplus of 2.3 billion EUR of wind turbines in 2024 and leading innovation in many segments

EU exports and imports of wind turbines components in 2024
EUR Bn



EU companies are big global exporters of offshore wind projects, building on long and deep expertise. The offshore wind industry is also importing parts and components to strengthen parts of the supply chain.

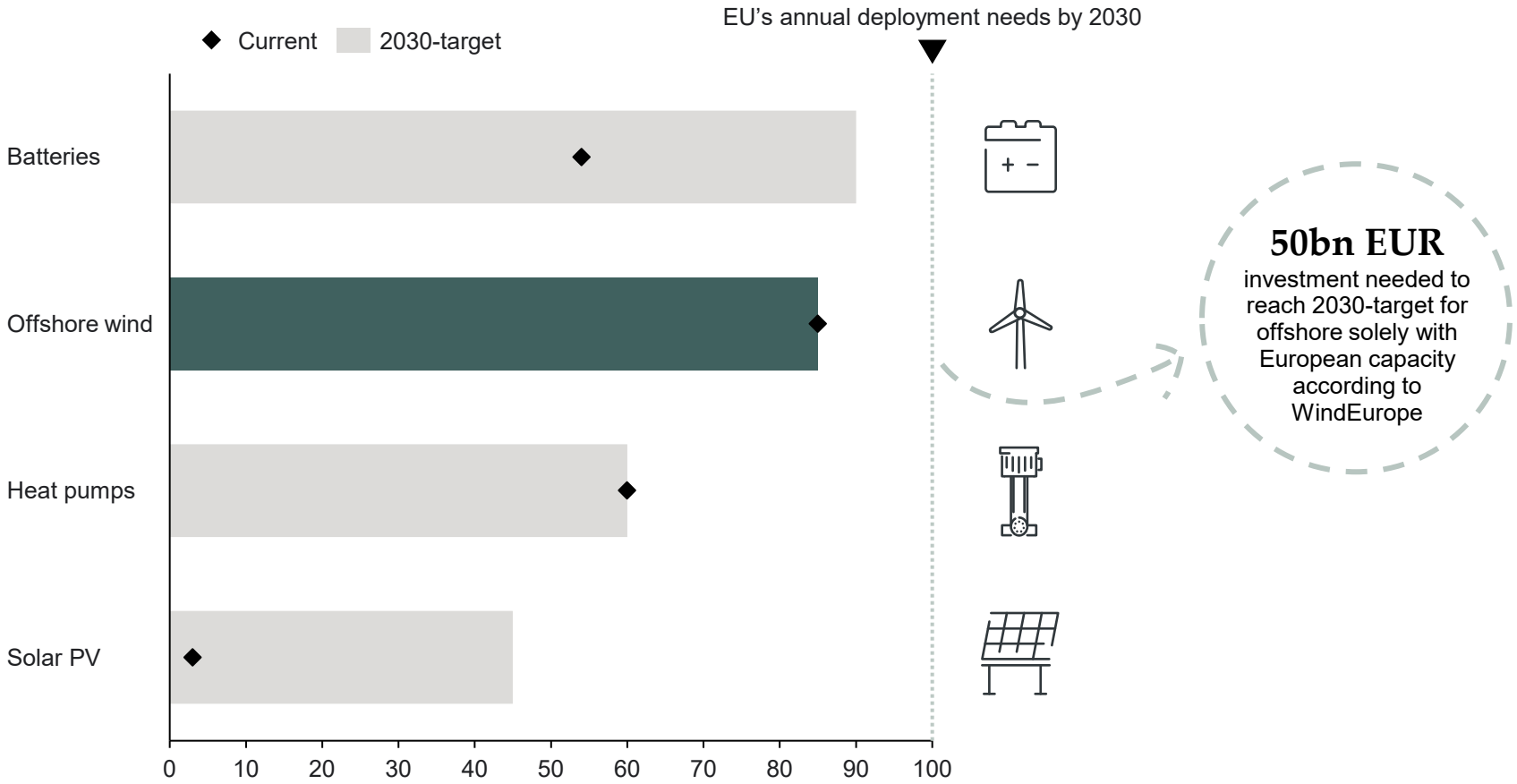
- Europe remains a powerhouse in wind technology and know-how, reflected in its leadership in high-value inventions. The EU's share of global top-quality wind inventions in 2019–2021 was around 58%, versus 11% for the US and 15% for China.
- European wind turbine manufacturers own and operate 40 manufacturing facilities or R&D centres outside of Europe. Mostly in China (11), India (11) and the US (7). This is in addition to the 55 manufacturing facilities or R&D centres they operate in Europe.
- The EU OSW industry is benefitting from open trade and is a net exporter of wind turbine components exporting EUR 2.3bn more than it imported.
- European imports of various materials and components for its wind manufacturing industry strengthens overall resilience and ability to deliver.

Notes: This map sets out exports and imports of 'wind power generating sets' under NACE code 8502 31 00 from the EU in 2024.
Source: Implement Consulting Group based on ETIP Wind.

The European Commission's strategy for the offshore wind industry recognises a continued role of imports

Targeted share of EU manufacturing capacity in EU annual deployment needs in 2030 – Net-Zero Industry Act

Percent



EU's Net-Zero Industry Act recognizes that imports remain necessary and effective for European offshore wind. Ramping up the supply chain capacity to meet 100% of EU's annual deployment need could require an investment of €50 billion.

- In 2024, the European Commission introduced the Net Zero Industry Act (NZIA), aiming to boost EU wind turbine manufacturing capacity to 36 GW by 2030 (combined offshore and onshore). In the strategy.
- EU recognises the roll of foreign imports and seeks to continue sourcing 85% of the offshore wind manufacturing from EU suppliers in 2030, i.e. keeping a constant share of 15% for components sourced outside EU to alleviate capacity bottleneck. The targeted blended sourcing model allows European OSW projects to keep sourcing from a competitive and diversified supply chain, aligning with EU's goal of de-risking (not decoupling) its supply chains.
- Building the capacity required to be fully self-sufficient is expected to be costly. WindEurope estimate that it would require 50bn EUR investments towards 2030 to build the manufacturing capacity to be fully self supplied in offshore wind alone.

Source: Implement Consulting Group based on European Commission and WindEurope

European policies aim to support offshore wind industry, but at the same time introduces new trade and sourcing uncertainty

Europe has supported the OSW industry through numerous policy initiatives…

Selected EU policies aimed to boost wind power

Nov 2020: EU offshore wind strategy sets 300GW target by 2050

May 2022: REPowerEU raise renewable energy target to 45% by 2030

Jan 2023: EU Wind Power Action plan aims to improve conditions

Jun 2024: Cross-border offshore investment guidance framework

Dec 2024: Offshore wind target increased to 360GW in 2050

Jun 2024: Net Zero Industry Act puts wind as a critical net-zero technology, included non-price criteria in auctions as a key initiative to support The Green Deal Industrial Plan four main pillars:

- Predictable and simplified regulatory environment
- Faster access to funding
- Enhancing skills
- Open trade for resilient supply chains

.... but has at the same time invoked a number of policies that add new challenges to the industry

Selected EU policies that challenge European OSW build-out

Mar 2022: France's Offshore Wind Industry Pact sets a 50% target of local content in wind farms by 2035

Feb 2023: Denmark suspends "open-door" scheme over state-aid concerns, freezing a large pipeline of projects and adding risk.

Jun 2024: EU prolonged its steel safeguard to 2026H2, keeping tariff-rate quotas with a 25% duty.

Oct 2022: EU revenue cap at 180 €/MWh. National roll-outs/extensions created PPA and merchant-revenue uncertainty, chilling new offshore FIDs.

May 2023: CBAM adds reporting and carbon costs from 2026 on steel and electricity, lifting OSW component and grid costs

Jun 2024: Net Zero Industry Act brings non-price resilience and sustainability criteria into renewables auctions from late 2025

Oct 2025: As replacement for the safeguard, EU proposes to increase stell tariff to 50%, quota reduced by 47%, and a melt and pour requirement to inform the origin of raw steel.

EU industrial policies like the Wind Power Action Plan aims to accelerate the deployment of wind energy to meet the EU's 2030 renewable energy targets by streamlining permitting, designing better auctions, and providing financial support for the supply chain.

- Similarly, the Net Zero Industry Act (NZIA) aims at making the EU "the home of clean technologies manufacturing and green jobs" among other things via open trade to ensure resilient supply chains.

The EU is currently responding to geopolitical changes in ways that could work against its pillar of open trade for resilient supply chains

- Europe is changing the playing field for many of the main inputs used for offshore wind such as steel, which makes up around 80% of the total mass of an offshore wind turbine.
- CBAM is expected to increase the price of steel by 10-35% which would raise the cost of offshore wind by up to 1 EUR/MWh.
- The recently proposed doubling of the tariff on steel exceeding the quota (being reduced by 47%) to 50%, will have an impact on the price of steel products in Europe.

Source: Implement Consulting Group based on EMBER, PIB, European Commission JRC (2024)

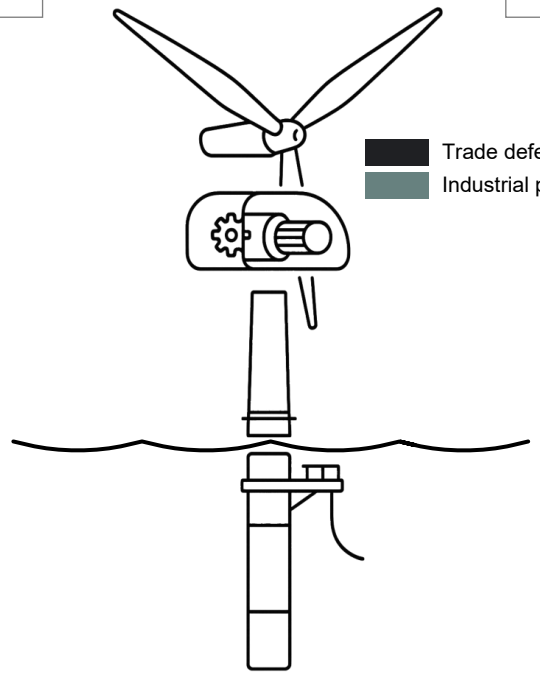
European wind industry is already protected through various trade and industrial policies

Jun 2022: The EU applies anti-subsidy duties on Egyptian glass fibre reinforcements.

Jul 2023: The EU applies anti-dumping duties on Chinese glass fibre reinforcements

May 2023: CBAM adds reporting and carbon costs from 2026 on steel and electricity, lifting OSW component and grid costs

Mar 2022: France's Offshore Wind Industry Pact sets a 50% target of local content in wind farms by 2035



Jun 2024: EU prolonged its steel safeguard to 2026H2, keeping tariff-rate quotas with a 25% duty.

Dec 2021: EU imposes anti-dumping duties on wind-turbine steel towers imported from China.

Jun 2024: Net Zero Industry Act brings non-price resilience and sustainability criteria into renewables auctions from late 2025

Jun 2020: EU anti-subsidy duties on glass fibre woven fabrics from China and Egypt, extended to Turkey and Morocco.

Oct 2025: As replacement for the safeguard, EU proposes to increase stell tariff to 50%, quota reduced by 47%, and a melt and pour requirement to inform the origin of raw steel.

Many inputs to the offshore wind industry are now protected through trade defence and industry policies.

- Duties on glass fibre imports increase the cost of producing blades in the EU and can be particularly problematic since the EU is lacking glass fibre capacity.[1]
- Steel towers are subject to trade defence duties and steel tariffs will affect both towers and foundations
- CBAM, NZIA and national local content requirements are also impacting the cost levels for EU wind manufacturing.
- While each of the individual elements may only have a small impact, the sum of protection is adding up.

These measures adds significant costs on key inputs for the offshore wind industry and affect downstream production of components. Higher costs is further challenging the offshore wind business. This can lead to:

- Slower offshore wind build-out in the EU which will negatively impact the activity and investment levels in the European wind industry
- Delocalisation of European production of these inputs outside the EU further weakening Europe's supply chain.

Notes: 1) According to the European Commission, the manufacturing of wind blades is at risk, as the industrial capacity to supply the necessary glass and carbon fibre corresponds to an estimated 65% of the current EU wind energy market, cf. SWD(2023) 68 final.
Source: Implement Consulting Group based on European Commission

CHAPTER 5

Foreign sourcing in key components like monopiles can support the European buildout

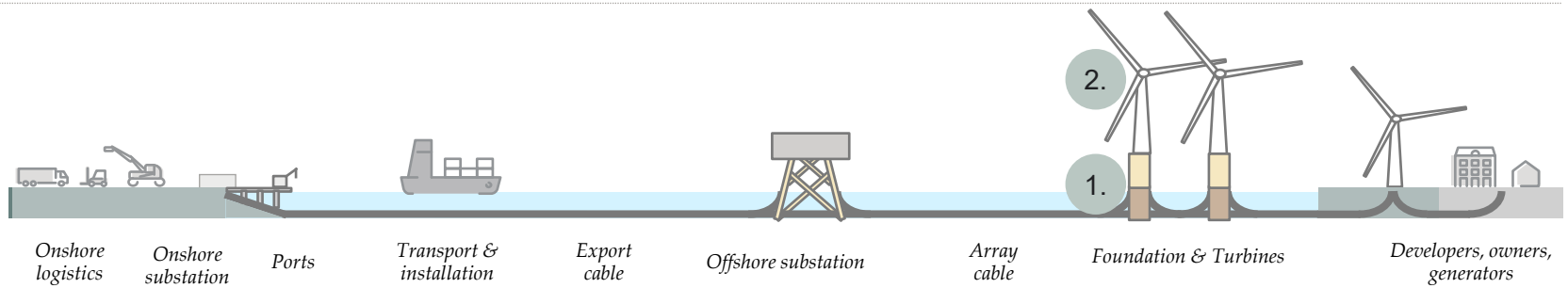
In-depth monopile analysis

> *Despite the policy and manufacturing progress, we are still seeing delays in the wider supply chain. This includes waiting periods of 3-4 years in some cases for offshore foundations.*

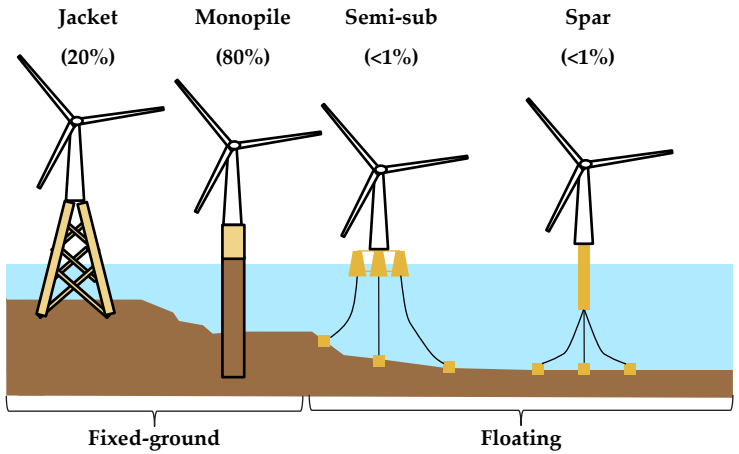
WindEurope (2024)

Offshore wind turbines are getting larger with the majority having fixed-ground monopile foundations

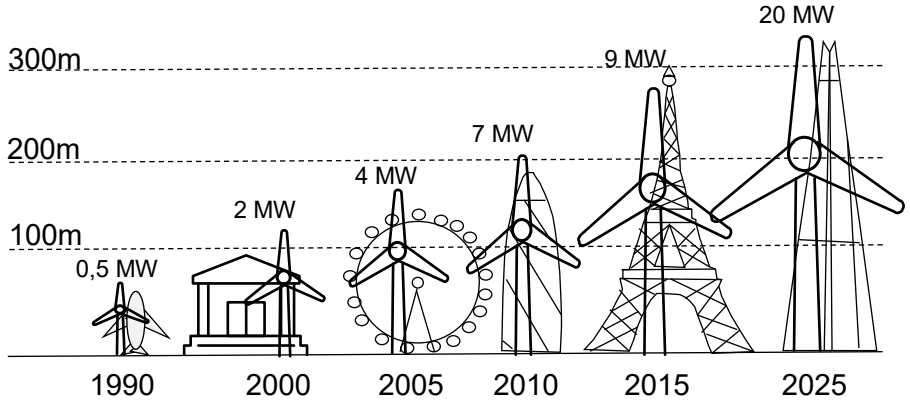
The main elements in a generic offshore wind farm



1. Example types of foundation with monopiles as the foundation used most common (80%)
(% of operational assets)



2. Turbines have evolved rapidly over the last 30 years growing from 0.5 MW to 20+ MW.



An offshore wind farm consists of 10 core elements, with the largest final components being the turbines and the foundations

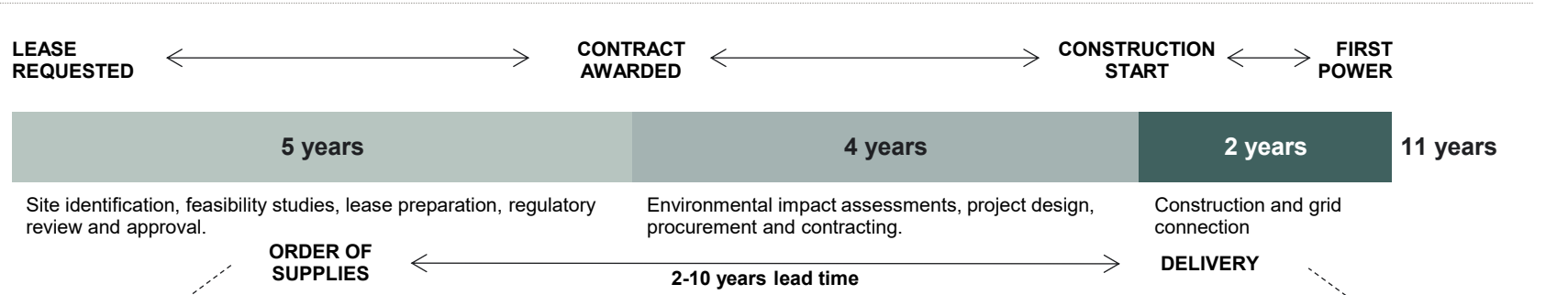
- Each main element has its own supply chain and the construction of an offshore wind farm is thus dependent on the interaction of several complex supply chains.
- Foundations are large steel structures that provide a stable platform for the turbine. They are fixed to the seabed 99% of the time (80% being monopiles), although more innovative floating designs are coming to the market.
- Turbines are the power generating assets and have developed significantly over the last 30 years, increasing in power output but also size. This has enabled projects to be developed in far deeper waters.
- This rapid innovation has consequences for the supply chain, as it requires most of remaining nine elements to scale (e.g. electrical equipment is less affected by size).
- The increasing size of turbines has critically increased the diameter, weight, and length of monopiles, with the next frontier of monopiles exceeding 12 meters in diameter. Larger monopile dimensions allow installations in deeper waters previously requiring more expensive jacket foundations.

Source: Implement Consulting Group based on GWEC.

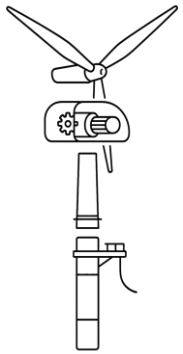
Developing an offshore wind farm takes 10–12 years and involves sourcing from many suppliers, making it extra vulnerable to delays that can ripple through the project

Offshore wind lead time and the supply chain[1]

Years



OSW developers secure orders of key parts like turbines and foundations at different times during the contracting process due to the differing lead times and priority of these parts. Given the long planning cycles the diversified supply partnerships help mitigate schedule risk and avoid cascading delays across projects.



Component	*Supplier location*	**Component manufacturing based on production site location** Tower, nacelle, foundation, cables, etc. *Non-exhaustive*
Turbines	*European*	Vestas, Siemens Gamesa Renewable Energy, GE
	Non-European	Goldwind, Mingyang Wind Power 明阳风电, Envision, Shanghai Electric 上海电气
Foundations (monopiles)	*European*	Sif, EEW Group, Steelwind, SeAH Wind
	Non-European	DAJIN Offshore, Haili 海力风电 Wind Power Stock code: 301155, CITIC HIC, CWHI

Building an offshore wind farm typically takes between 10-12 years from planning to first power and involves a large range of suppliers

- The European offshore wind farms with first power in 2025 has on average taken 11 years since requesting a lease.
- Due to the long lead times of many components (e.g. HVDC, turbines, foundations, etc) developers often anticipate auction outcomes and initiate procurement commitments pre-results to avoid delays and cost increases. To negate risks, developers often use framework agreements to secure parts several years in advance. The long decision cycle means developers lock-in current capacity to fill future needs i.e. will assess current manufacturing capacity against 2029 construction need.
- An offshore wind project involves a large range of suppliers from logistics specialists to manufacturers to service providers. The turbine alone is composed of 6 major raw materials with each requiring a different supplier: steel, cast iron, copper, epoxy resin, glass fibre, and the permanent magnet. A foundation is composed entirely of steel with very minor additions (e.g. corrosive coatings, etc).
- For a wind farm to be delivered on time, it requires many different component suppliers and raw material suppliers to delivering on time.

Notes: 1) Based on project lead times for projects completed (first power) in 2025. Project lead times have increased by four years since 2021 due to regulatory uncertainty (state-ownership models in projects, local content, and grid build-out plans) accompanied with delays in the supply chain. GE Vernova is an American company but supplies offshore wind turbines from Europe. CS Wind and SeAH Wind are South Korean companies with European manufacturing sites.
Source: Implement Consulting Group based on 4C Offshore.

Monopile suppliers are competing on reliability, available capacity, innovation capabilities, quality, and price competitiveness

Main considerations when selecting monopole suppliers

Price	…must offer monopiles at a competitive price to ensure overall project profitability	*Choosing the right supplier becomes increasingly important with…* →	Increased LCOE, as keeping prices competitive and low becomes more important in winning auctions and ensuring low prices
Delivery	… must provide assurance of timely delivery in order to minimise delays in the construction phase – especially for monopiles that risk clogging up the later construction phases		Longer time to first power, as it will be increasingly important to reduce potential delay issues that could result in fines or reduced payments. Currently, the waiting period is up to 3-4 years in some cases for offshore foundations
Capacity	… must have monopile manufacturing capacity to meet the demands of the project within the given timeline		Risk of medium-term manufacturing undercapacity, as it will be increasingly important to ensure available capacity. The long decision cycles implies that developers consider manufacture's current capacity for meeting projects ~4 years in the future
Innovation	… must demonstrate the necessary capabilities to manufacture the larger monopiles required for increasingly large wind turbines (+15MW)		Increasing requirements to turbines sizes in auctions and fewer manufactures with the necessary capabilities, as there will be increased competition for suppliers who can deliver
Quality	… must produce high-quality components that ensure safety and lower maintenance costs		Higher technical requirements for offshore wind turbines (i.e. larger, heavier and build in deeper waters), which reduces the margin for error for foundations.

Offshore wind developers are sourcing monopiles based on key criteria such as delivery reliability, available capacity, innovation capabilities, quality, and price competitiveness

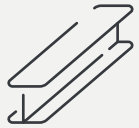
- Developers need to select suppliers that balance low prices, can deliver on time, and have capacity to produce the necessary component sophistication with high quality.
- These considerations become increasingly important in the current business environment where manufacturing capacity is limited, particularly for large wind turbines and foundations, where the waiting period has been up to 3-4 year.
- Choosing the right supplier will help the developers:
  - **Reduce project delays -** Timely delivery of components and services.
  - **Lower costs -** Substantial cost savings through streamlined processes.
  - **Increased Reliability and Quality -** Higher quality components and reliable delivery.
  - **Optimized Resource Utilization -** Efficient use of materials and logistics.

Source: Implement Consulting Group

The monopile supply chain in Europe will become a bottleneck if ambitious targets for 2030 are to be met

Monopile manufacturing value chain

Stage



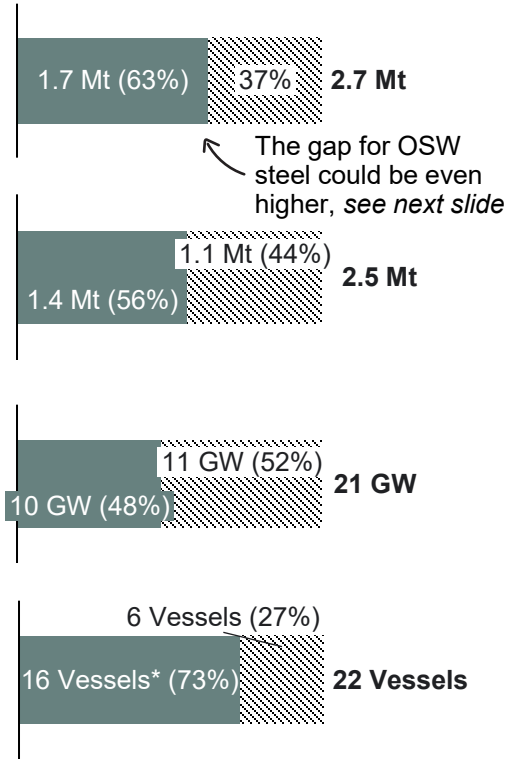
1) Steel supplier - Heavy-gauge steel plates, often up to 140 mm thick and with unit weights over 42 tonnes, are cut and pre-machined.

2) Monopile manufacturer - Rolling steel plates into cans, welding, assembling full monopiles, incl. inspections and quality assurance.

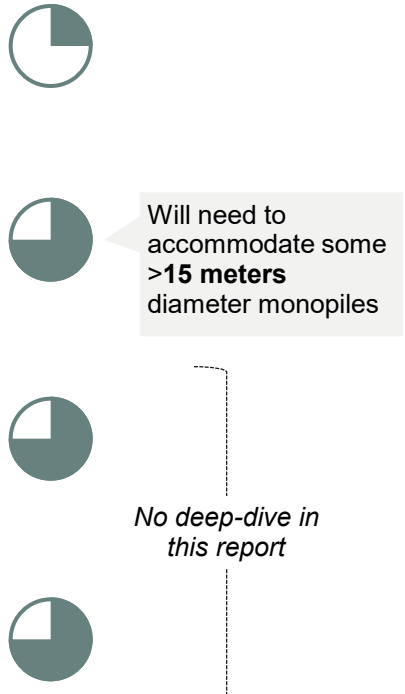
3) Port & Logistics Operator - Transport from fabrication yard to marshalling port, temporary storage, and loading onto installation vessels.

4) Offshore Installation Contractor - Offshore transport, piling monopiles into seabed, transition piece installation, and commissioning handover.

European capacity



Innovation need toward 2030



Monopile manufacturers source high quality specialised steel that may pose bottleneck issues in the build-out to 2030 targets

- Reaching the built-out target by 2030 will require an annual supply of up to 3.3 Mt of heavy steel plate, getting components through suitable ports, and deploying enough XXL installation vessels.
- **Steel plate:** European mills can cover most tonnage, but capacity for very thick, wide, high-grade plate is tight (see next page). Secure, diversified supply chains help ensure steel availability at scale for priority energy projects.
- **Monopile manufacturing:** Current monopile factory capacity is only around 56% of the capacity needed towards the 2030 target and diameter capability for >12 m piles is not available in Europe today. Expansions face long lead times, making full catch-up by 2030 challenging.
- **Ports & logistics**: Only a handful of marshalling ports have the capacity for monopiles of the size required by future demand.
- **Offshore installation vessels:** The fleet covers roughly three-quarters of 2030 needs, and modern >XL monopile vessels are few, with few shipyard slots.

Note: *Latest overall estimate from WindEurope puts the vessel fleet at 16 vessels in 2021, with a projection to increase to ~22 in 2025.
Source: Implement Consulting Group based on Rystad Energy, WindEurope and Spinergie.

The combination of concentrated European steel supply and steel tariffs increases risk of shortages, delays and price hikes for monopiles

Steel

Monopile

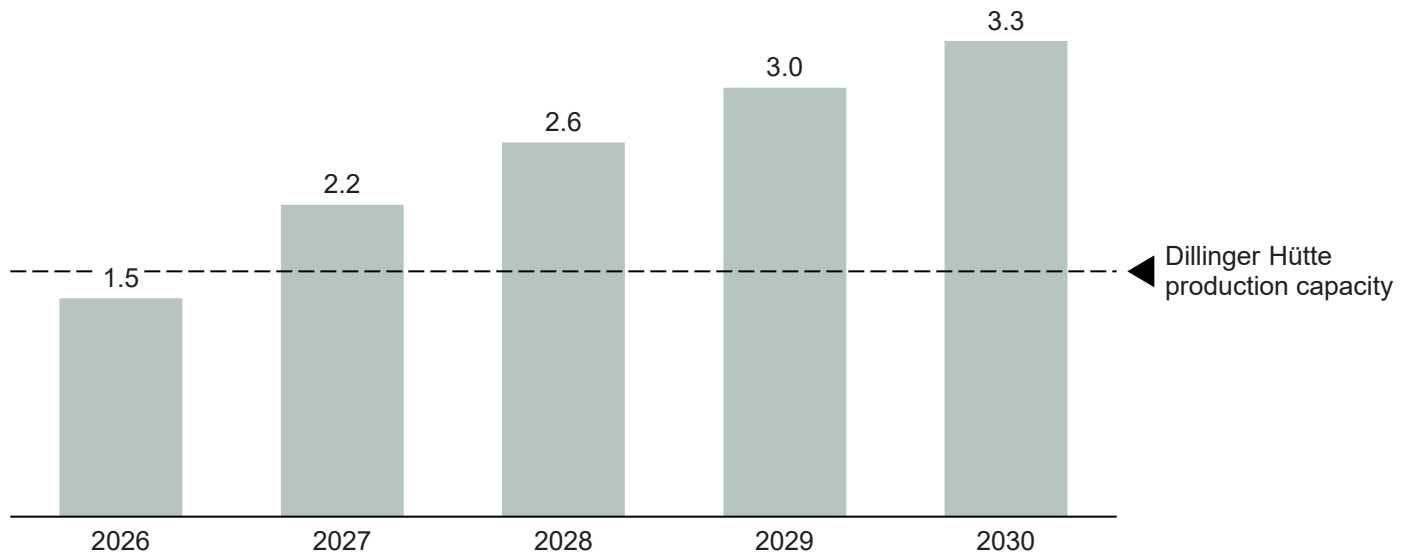
Port

Installation

European monopile and jacket steel demand to reach target path

Million tonnes

Dillinger Hütte is the main European supplier of specialised steel for monopiles and the only producer of steel neededd for XXL monopiles domestically. In 2024, Dillinger produced 1.6 million tonnes heavy steel.

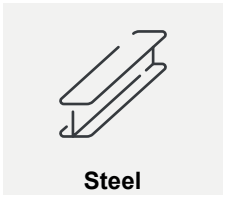


Europe will need 12.5 million tonnes of steel for monopiles between 2026 and 2030 with current European capacity standing at less than 2 million tonnes per year

- Steel is the main cost component of monopiles. In 2024, the cost of steel made up around 55% of total operational costs for SIF, one of Europe's largest monopile producers.[1]
- Dillinger Hütte is the main European company capable of delivering the specialised steel appropriate for the manufacturing of XXL monopiles. Dillinger Hütte currently have a capacity of around 1.7 million tons per year.
- Meeting the 2030 target require a production of 3.3 millions tons per year in 2030, which leaves a gap of 1.5 million tonnes compared to current capacity.
- Limiting foreign sourcing/competition of steel through tariffs in combination with a concentrated domestic supply could therefore lead to potential higher prices, less innovation, and bottlenecks.
- McCloskey estimates that the steel safeguards announced in October will reduce Europe's annual import volume of heavy plate (category 7) by 63%.

Note: Steel plates used for monopiles are specialised high-strength structural steels, such as S355ML and S420ML. Apart from Dillinger, a few other European steel suppliers (e.g. ArcelorMittal) are capable of manufacturing steel plates meeting the requirements for offshore monopiles (XXL monopiles typically use plates >400mm width, >120mm thickness), however they only produces steel for monopiles to a very limited extend. 1) The cost of steel input for monopile production was calculated based on SIF's annual report from 2024 accounting for a 3% scrap/production waste allowance and using a steel price estimate of 1,300 EUR per ton.
Source: Implement Consulting Group based on SIF, Rystad Energy, Eurometal and Spinergie.

European monopile manufacturers are currently able to produce up to 11.5m diameter monopiles



Main monopile manufacturing suppliers to the EU market

The largest installed monopile diameter in Europe is 10.6m installed in UK in 2025

Monopile manufacturer	Current diameter (m)	Future ambition diameter (m)	Production capacity, 2025
Dajin[1]	16.0	N/A	500.000 t of steel per year
SiF	11.5	15.0	500.000 t of steel per year
EEW	10.5	11.5	200.000 t of steel per year
Haizea	11.5	N/A	150.000 t of steel per year
SeAH	11.5	15.5	240.000 t of steel per year
Steelwind Nordenham	10.5	11.5	150.000 t of steel per year
Windar		12.0	150.000 t of steel per year
CS Wind Offshore[2]		13.0	*Currently stopped production*
Titan Wind		14.0	*Not yet operational*

The European monopile producers are currently capable of producing monopiles of up to 11.5 meter in diameter.

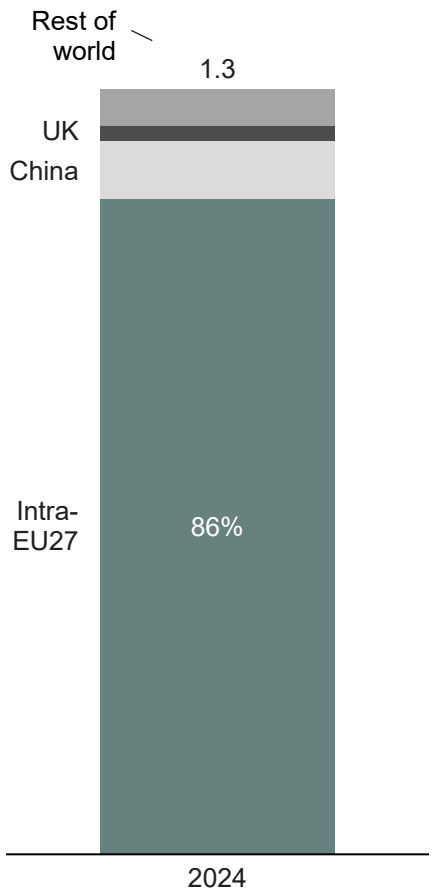
- As turbine ratings and water depths rise, Europe needs larger-diameter monopiles at higher volumes. Current diameter capability for European producers ranges from 10.5m to 11.5m m, with announced upgrades to 11.5–m at several EU sites and up to 15.5m in the UK plant to serve 15+ MW turbines.
- The only current provider in the European market with capabilities to provide 16m diameter monopiles is the Chinese manufacturer Dajin.
- As around 10% of the new installations towards 2030 will require XXXL monopiles (>12m), delivering 2030 volumes at larger diameters hinges on imports and/or significant expansion of European production capacity with new production lines and ports capable of producing and handling these large diameters.

Note: 1) Dajin is one of several Asian manufacturers within this market and Dajin is active in exporting to Europe. 2) CS Wind Offshore has a production capacity of 100,000 tons per year, but currently has no production of monopiles as it is looking into a long period of idle capacity. According to industry experts the production site has halted an is up for sale.
Source: Implement Consulting Group based on Rystad Energy and own analysis.

In 2024 the market for monopiles in EU was dominated by domestic suppliers with imports from outside the EU only making up a small share

Imports of structures and parts of structures, of iron or steel, solely or principally of sheet (incl. monopiles)

Mega tonnes (Mt), 2024



Monopile manufacturer (by site)	Production (Tonnes of steel annually)
SiF	500.000
EEW	200.000
Haizea	150.000
Steelwind Nordenham	150.000
Windar	150.000
CS Wind Offshore[1]	*Currently stopped production*
Titan Wind	*Not operational*
Total EU	**1.150.000 t of steel per year**
SeAH	240.000
Dajin	500.000

Annual orders are often only around 50-60% of theoretical production capacity

Max capacity

Annual European orders (2022-24 avg.)

The European monopile market consists of seven large EU players and two non-EU players

- The European monopile market is concentrated, with seven large EU manufacturers as well as two non-EU players – SeAH from the UK and Dajin from China. SeAH and CS Wind both have South Korean headquarters.
- The EU producers are located at or near deep sea ports in Germany, the Netherlands, Spain, Denmark. One new entrant is not yet operational (*Titan Wind*).
- The total current capacity of the EU players is around 1.2 Mt and 1.4 Mt including the UK producer. However, capacity is already constrained around 50-60% of this level due to smaller-than-maximum monopile sizes and project-based production with idle periods.
- New plants and expansions are underway.

Foreign suppliers represent a small share of the EU market for monopiles

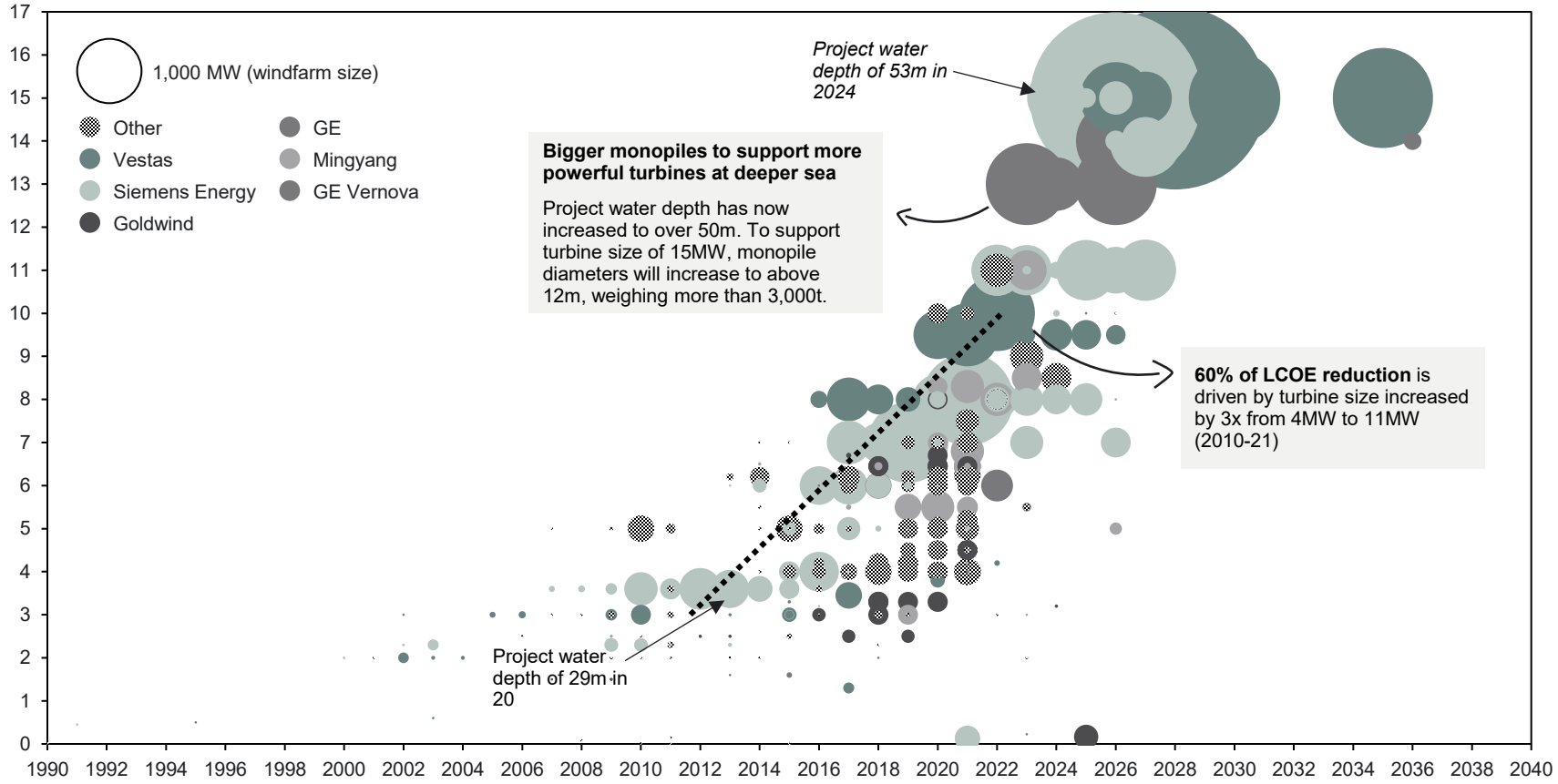
- European monopile installations are visible as intra-EU trade. Competitors from other countries are also present in the market and play a role in alleviating supply chain shortcomings.
- Intra-EU trade of monopiles was around 1.1 Mt in 2024, while imports from outside the EU made up 0.2 Mt.

Notes: Imports of monopiles approximated under CN code "7308.90.59 - Structures and parts of structures, of iron or steel, solely or principally of sheet". SeAH and CS Wind are both have owners from South Korea.
1) CS Wind Offshore has a production capacity of 100,000 tons per year but currently has no production of monopiles as it is looking into a long period of idle capacity. According to industry experts the production site has halted an is up for sale.
Source: Implement Economics based on Eurostat and industry analysis.

Monopiles grow with turbine size and water depth and in 2030 more than 10% of European turbines will require monopile sizes that are currently only built outside Europe

Development of turbine sizes in European offshore wind projects

MW



Cost reduction of offshore wind is driven by larger turbines. At least 10% of monopiles in 2030 capable of holding the largest turbines will be more 12 meters in diameter and these are currently only built outside Europe.

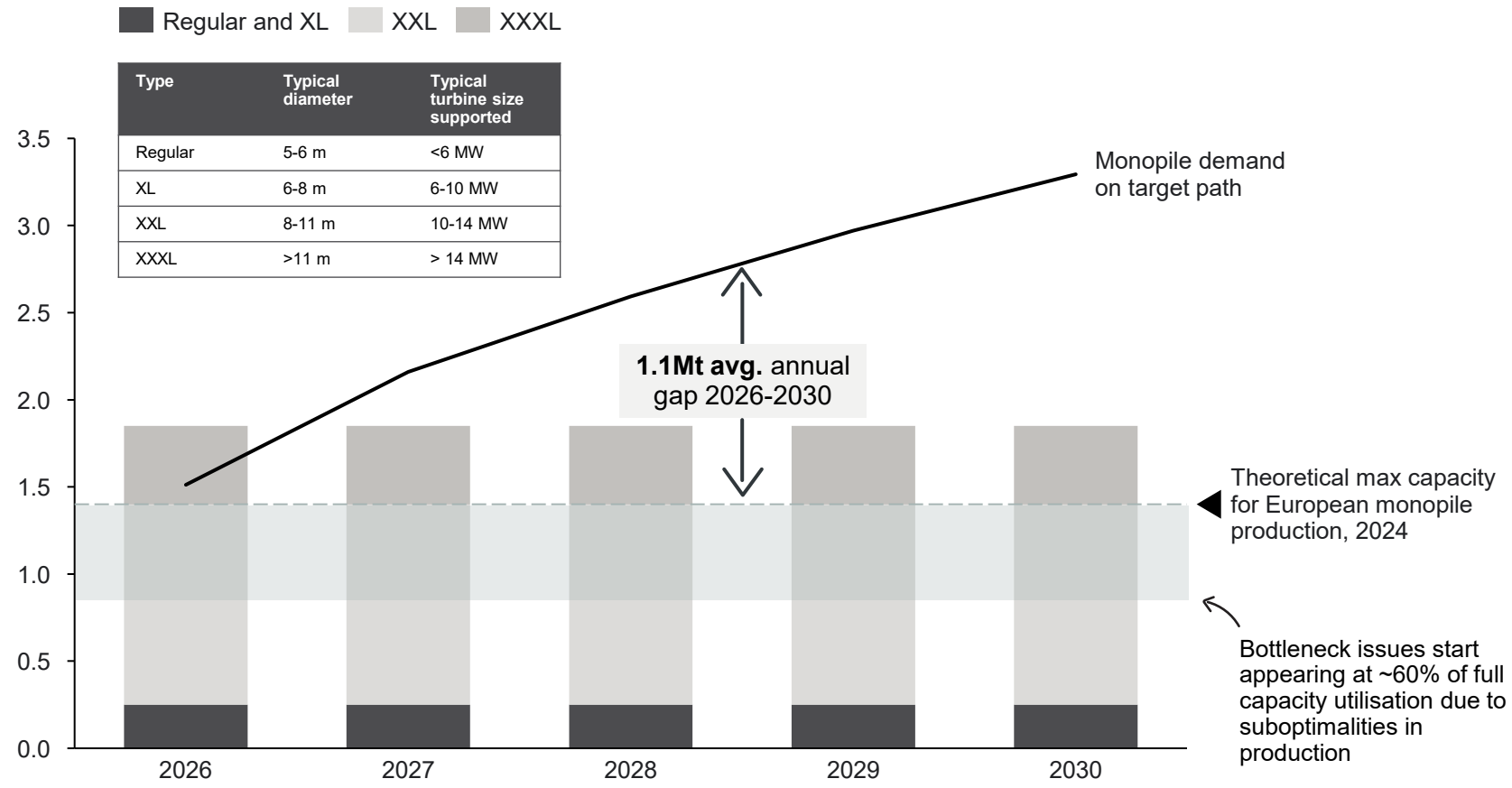
- Reductions in the LCOE of offshore wind over the last 30 years has been driven by increasing turbine size. Increasing size has allowed projects to venture to deeper waters, where wind speeds are greater.
- As a result, monopiles needed to increase in diameter, length, and weight to meet the demands of deeper waters and larger turbines. The monopile diameter on average follows the turbine size by a factor of 1.5, i.e. a 12m monopile for a 18MW turbine.
- According to Spinergie, by 2030, it is projected that monopiles weighing above 3000t will constitute 10% of new installations.
- There are no monopile manufacturers in Europe currently capable of producing monopiles with weights above 3000t and diameters above 12m.[1] However, almost all European manufacturers have announced factory expansions to accommodate larger monopiles with the first factory coming online in 2027.

Note: 1) Based on current capacity. Windar Renovables plans to install several new production lines at their site on the bank of the Avilés estuary in Asturias with the capacity to manufacture monopiles of up to 12.5 metres in diameter, 3,500 tonnes and 0 metres in length. The Chinese manufacturer Titan Wind is investing to construct a new monopile plant in Cuxhaven, Germany producing monopiles with a diameter of up to 14 metres, a length of 140 metres, and a weight of 3,500 tonnes
Source: Implement Consulting Group based on 4C Offshore, Offshorewind.bix; Spinergie, Windar Renovables website; Titan Wind website.

Current European monopile manufacturing capacity is expected to fall short by at least 1.9 million tonnes in 2030 if Europe is to produce monopiles to meet targets

Monopile demand and production capacities

Mega tonnes (Mt)



Current European monopile production capacity can only meet 60% of required monopile tonnage to meet targets towards 2030

- As Europe accelerates its offshore wind build-out, the availability of monopiles, which remains the dominant foundation type, will determine how fast projects can proceed.
- European maximum capacity is estimated at around 1.4 Mt in 2024 incl. UK, with potential expansions lifting this to about 1.8 Mt from 2026. However, the actual capacity will already be constrained around 50-60% of this level (0.9Mt) due to suboptimal production from e.g. smaller-than-maximum monopile sizes and project-based production with idle periods.
- To meet targets, demand would need to rise sharply from around 1.5 Mt in 2026 to just over 3.3 Mt by 2030, exceeding existing capacity already in 2026.
- With the current European monopile production capacities, local-only production would meet only around 60% of 2030 demand, implying a shortfall of 1.9 million tonnes in 2030 alone or 1.1Mt on average. XXXL monopiles with >12m diameter are likely to be the main bottleneck.
- Without faster capacity additions or diversified sourcing, monopiles will be a structural bottleneck to the offshore buildout.

Notes: The *Monopile demand on target path* is based on i) applying Rystad's component model to WindEurope's 2030 Targets Scenario, ii) assuming a theoretical ramp in offshore additions rather than project-specific timelines, iii) that monopiles remain the dominant European foundation type, and iv) that turbine ratings rise into the >12 MW class which lifts steel tonnage per unit toward 2030.
Source: Implement Consulting Group based on Rystad Energy and WindEurope.

New port capacity required to accommodate monopiles could take 6-10 years due to constraints in suitable sites extensive permitting processes, and environmental hurdles

Monopile manufacturing sites in Europe

Monopile manufacturing sites are often located close to deep sea ports – especially XXL monopiles that are too large for road transport

6-10 years

Time to build new deep-sea monopile ports

Building additional port capacity takes 6-10 years due to constraints in suitable land/sites extensive permitting processes, and environmental hurdles.

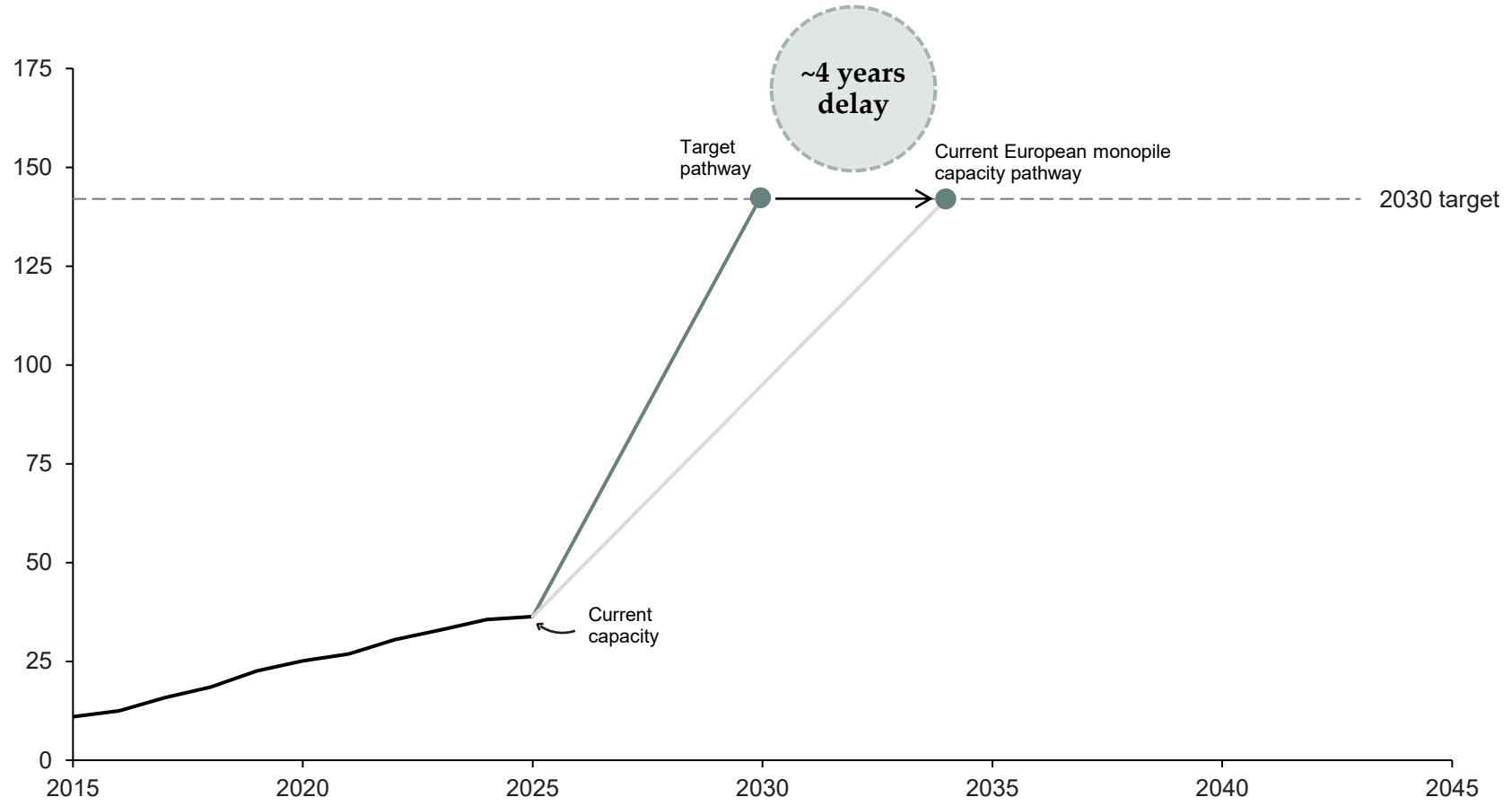
- Due to the weight of monopiles, manufacturing sites are placed in or close to deep sea port, especially for XXL monopiles (~3,000 t) as they are far too large for road transport.
- Existing and planned deep sea port capacity development in Europe is 10 GW in 2025. The lead times for port expansions is at a minimum 3 years, but current permitting and environmental processes is extending lead times to 6 years and in the worst cases up to 10 years.
- European ports are a major bottleneck post-2030 for European monopile manufactures and the overall buildout as annual new capacity is expected to reach 15 GW per year. This leaves a gap that Europe cannot close under the current circumstances/timeframe without relying on monopile imports. While Europe is scaling, interim diversified sourcing prevents cost spikes, project queueing, and auction failures which protects long-term EU industrial base.

Source: Implement Consulting Group based on WindEurope, Rystad Energy and own analysis.

Relying solely on Europe's current monopile capacity to meet the 2030-target would delay the buildout by at least four years

European offshore wind installed capacity

GW



Relying solely on European supply would delay Europe's build out by at least 4 years and increase the cost.

- Europe aims for 142 GW of cumulative offshore wind by 2030, which requires a rapid, sustained ramp-up in manufacturing, installation vessels, ports and grid connections.
- Actual build has reached only 37 GW in 2025H1, so meeting the 2030 ambition would mean adding around 100 GW in five years.
- With reliance solely on current European manufacturing and installation capacity, cumulative build can only climb much more slowly, hitting 142 GW only in the early–mid 2030s.
- Such a constraint would tighten bottlenecks across turbines, foundations, ports and grid, lengthen project queues and push up prices through scarcity premia and schedule risk.
- Achieving 2030 goals requires both a rapid expansion of European capacity and diversified sourcing from abroad. Failing this, Europe would face a delay of 4+ years and potentially additional costs.
- Bottlenecks may also occur elsewhere in the supply chain, potentially delaying the build-out further.

Notes: *Current European monopile capacity pathway* is computed based on current annual European monopile capacity of 1.4 Mt against the overall need of 12.5 Mt to meet 2030 targets.
Source: Implement Consulting Group based on WindEurope, Vestas and Rystad Energy.

CHAPTER 6

EU offshore wind goals are at risk if protectionist measures would stifle competition, capacity and flexibility

Conclusion

> *On the local content requirements France should tread carefully. It is good the requirements are not legally binding – that would risk leading to higher costs and slowing down investment. Ultimately what attracts investments is visibility on future wind volumes.*

Giles Dickson, CEO of WindEurope (2022)

CONCLUSION

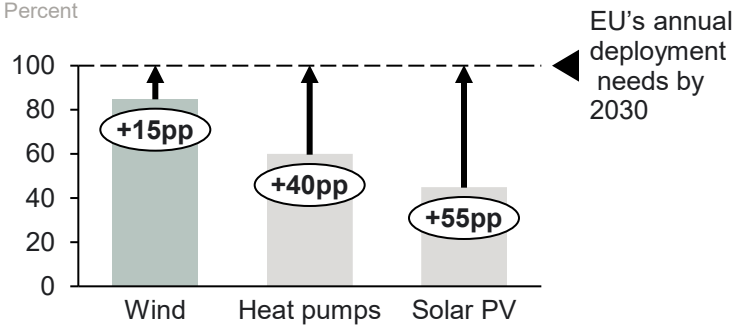
Europe has a strong foundation for reaching its offshore wind targets but risks further challenging the industry outlook by creating sourcing bottlenecks in key components

1 Europe has a strong position in offshore wind but cannot fully power the political ambitions for European offshore wind on its own

- Europe has 26% of global manufacturing capacity in offshore wind, with a net export of 2.3 bn EUR of turbines in 2024. The domestic industry delivers around 90% of European capacity.
- Europe cannot meet its 142 GW target by 2030-target solely through local manufacturing. Europe's target entails installing 21GW towards 2030 and Europe's offshore capacity stands at 9.5 GW per year. Potential capacity bottlenecks are especially pronounced in foundations, ports, magnets and large turbines.
- Ramping up European manufacturing capacity to 20 GW annually would take at least 4-5 years and up 10 years for some segments like deep-sea ports.

Targeted share of EU manufacturing capacity in EU annual deployment needs in 2030 – Net-Zero Industry Act

Percent

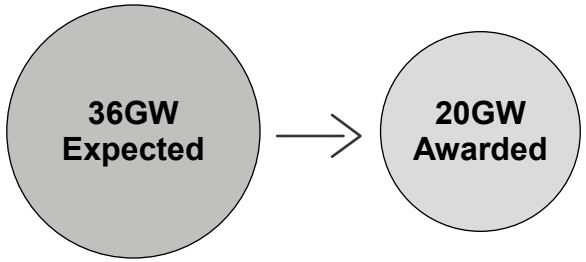


2 Headwinds and stop/go signals challenge the outlook and could lead to higher costs and future undercapacity

- Between 2020-24, the cost of European offshore wind has increased by 31%. Long-term offshore costs are however expected to fall below pre-crisis level, driven by more efficient manufacturing and larger turbines.
- The shock has resulted in current underutilised manufacturing capacity, as projects have been delayed or cancelled, and a weakened long-term outlook. In 2024, only 20GW capacity was awarded in Europe compared to an expected 36GW due to delays and no-bid auctions.
- The weakened outlook and lower ramp-up in investments increases the risk that Europe will face a undercapacity problem in the future. Already in in 2026-27, Europe could be close to its capacity limit.

European offshore wind auctions in 2024

GW

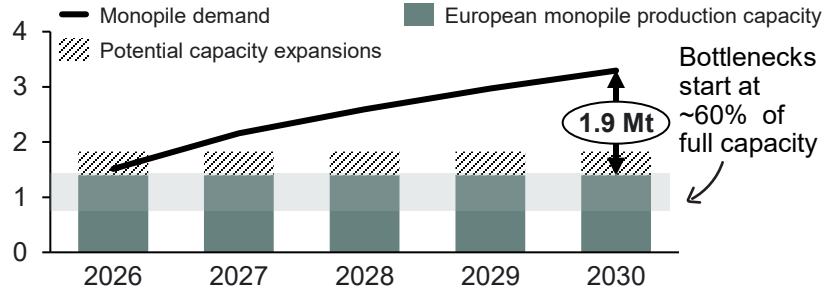


3 Limiting outside sourcing could accelerate the undercapacity problem further in key sourced components like monopiles

- Going forward Europe is expected to have bottlenecks in certain segments of the offshore wind supply chain, e.g. monopiles and ports. Europe is lacking 60% monopile capacity to reach the 2030-target with the waiting period already being up to 3-4 years
- Europe's new stance on trade and industrial policies is intended to support EU competitiveness in certain areas, but may have adverse impacts on others, incl. the OSW value chain's ability to source key inputs.
- Limiting outside sourcing accelerates bottlenecks in key sourced inputs with impacts on the entire industry's outlook. Reduced cost competitiveness will also challenge business plans and reduce interest in future OSW auctions and capacity investments.

European monopile demand to meet 2030 installation target and production capacities

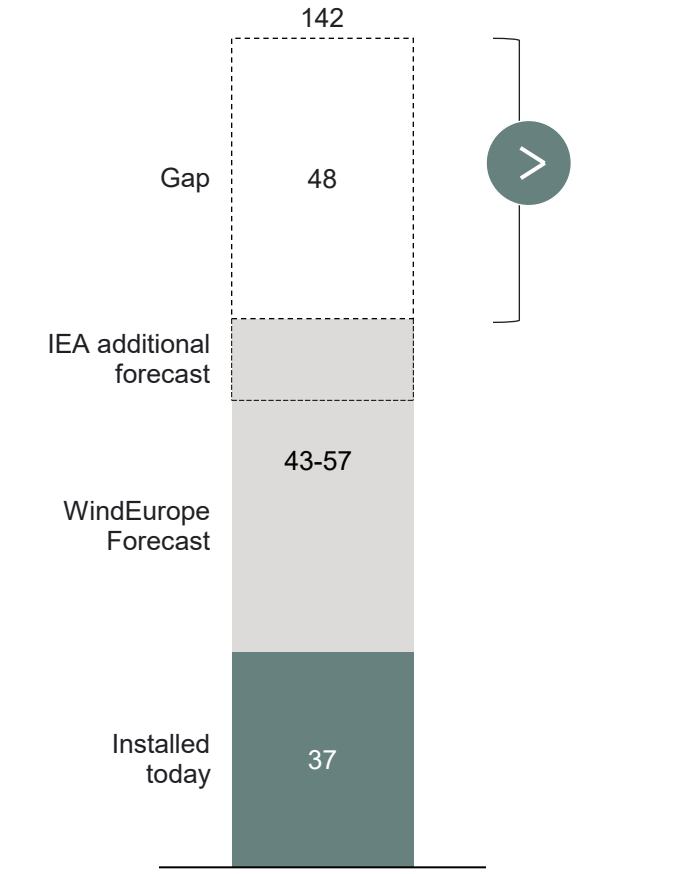
Million tonnes



Source: Implement Consulting Group based on European Commission and WindEurope

Policy choices will determine the outcome of Europe's offshore wind build-out

European offshore wind capacity in 2030
GW



Call for action - Removing barriers for the European OSW expansion

Permitting and delivery sprint
Set clear, enforceable timelines for permits (e.g., a cap for environmental permits and grid/port approvals) and use a single digital one-stop shop in each country. Pre-designate offshore zones/corridors to shorten studies, and allow parallel reviews for foundations, cables and ports. Link permits to auction awards with agreed start dates, so projects move from award to construction without years of waiting.

Predictable and stable demand
Publish an auction calendar with minimum annual volumes and use CfDs that adjust for steel prices, inflation and interest rates. Keep non-price and local-content rules realistic and allow temporary flexibility when EU capacity is short. Let developers switch turbine class or monopile size within an agreed technical range without restarting permitting, so designs can follow innovation without breaking the business case.

Relieve bottlenecks and allow the best solutions
Allow open market access to imports of e.g. XXXL monopiles, heavy plate and magnets to alleviate undercapacity in segments and avoid cascading delay and stagnation across the European industry. An open global trade approach also helps the continued massive export of the European OSW industry.

Not meeting EU's targets for offshore wind capacity in 2030, will negatively impact…

Independence and sovereignty

Falling short of the OSW target increases reliance on imported fossil fuels during peaks, weakening the energy pillar of Europe's security strategy.

Clean and cost competitive energy

Higher and more volatile electricity prices erode the business case for energy-intensive industry, data centres and AI computing in a period, where electricity demand is set to rise. One recent study estimates that if European countries meet their solar and wind targets, electricity prices could fall by more than a quarter by 2030 – and become less volatile.

Offshore wind industry in Europe

The loss of 16GW of auctioned capacity in 2024 to 2025, risk costing Europe it's first-mover advantage. The European wind industry today has a EUR 2.3 bn trade surplus and employees 50,000 people in offshore. However, a gloomy future outlook towards 2030 and beyond could slow innovation and factory upgrades, which threatens Europe's position on the global frontier and the 20,000-54,000 additional jobs that could be realised in the sector towards 2030.

Meet our experts

You are always welcome to reach out to our experts behind the report to access more information and insights.

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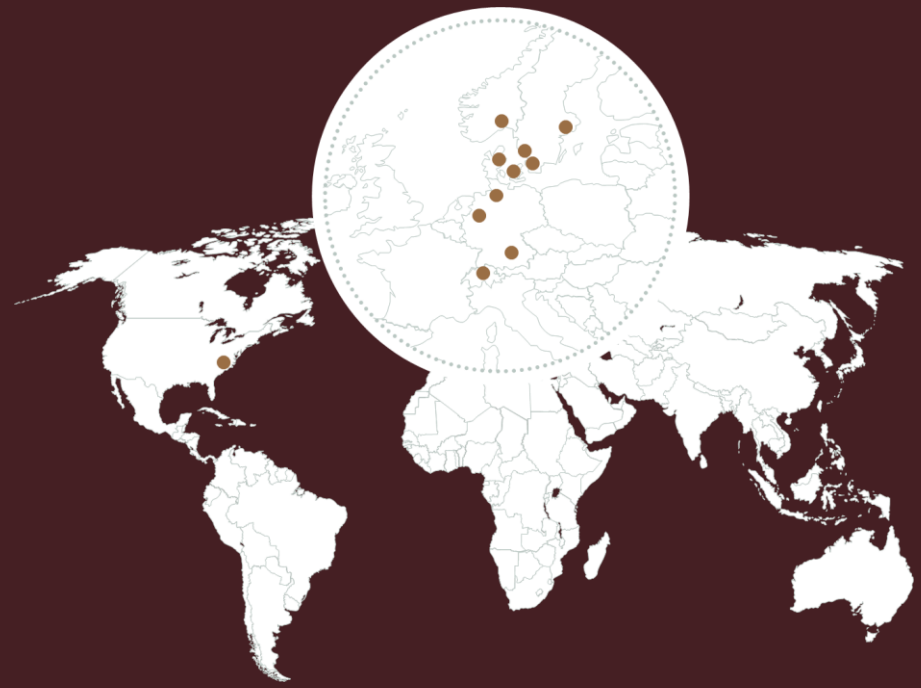

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