Beyond the Storm

What it would take to unlock the potential of the European offshore wind and deliver on European build-out ambitions

Implement Consulting Group, November 2024

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Preface

This second report explores actions for offshore wind stakeholders in renewing and delivering on the offshore wind build-out ambitions toward 2030 and 2050.

It follows our analysis **"Storm in Shallow Waters"** questioning the realism of the EU offshore wind build-out targets, looking at the key challenges facing European offshore wind and proposing alternative pathways for the offshore wind build-out realizing targets.

It is evident that achieving the wind build-out ambitions will require authorities, investors, developers, OEMs, and sub-suppliers to reevaluate the way ahead.

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 and requires immediate actions to restart growth in the industry.

This report explores ways to unlock the European offshore industry from the current gridlock of high inflation, increasing risk, and surging costs. Large transformations are needed to readjust to new realities and getting back to a viable pathway.

A report of Implement Consulting Group

'Beyond the Storm' is produced by Implement Consulting Group (ICG). ICG 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 deepest gratitude to the + 60 CxOs and experts of leading companies across the offshore value chain whose invaluable insights have informed this study. Your deep industry knowledge, market understanding, and visionary contributions are shaping a sustainable future.

Disclaimer

This overview is not exhaustive but rather reflects our focus and insights into the industry. We have distilled our observations into three key recommendations. It is important to note that this analysis is based on a snapshot of the current situation, which is subject to continuous change.

Achieving the goal of reaching the European offshore wind build-out targets requires decisive actions across the wind industry value chain

The challenges faced...

Cost shock and lack of profitability

Since 2019, suppliers and OEMs have experienced a **40% increase in raw material prices** implying that margins have contracted significantly.

Break-even point for developers was driven up by **increases in interest rates, capital costs, input prices, and supply chain bottlenecks reducing profitability**, resulting in delayed and cancelled projects. This was parallel to lower strike prices and in some cases negative auction prices.

Lack of investor confidence and financing across the value chain

Since 2022, **investor confidence in offshore wind has declined** significantly, exacerbated by delayed and cancelled projects. It must be restored fitting a new outlook characterized by **an abundant risk environment, higher material and capital costs, and supply chain challenges.**

Achieving the EU 2030 build-out target of 163GW will necessitate a 4.8-fold increase in capacity over a mere seven years, corresponding to a 25% annual growth in capacity. This reflects an **8-doubling in the yearly delivery capacity from 2023-2030.**

To meet that target, European suppliers **must ramp-up capacity** between 150% and 560%, leading to further **supply chain bottlenecks** (e.g., nacelles and vessels are currently facing supply challenges).

Regulatory delays, supply chain bottlenecks, and the innovation race

Regulatory uncertainty is unnecessarily high and the permitting process often long, increasing investors' risk and required return. **This inefficiency is reducing developers and suppliers' business cases.**

Ensuring a profitable supply chain remains a significant challenge. Lengthy processes and project delays contribute to prolonged order-to-cash cycles, presenting a critical issue that must be overcome. Without addressing these challenges, the risk is that a n unprofitable supply chain will not be able to attract financing to undertake necessary capacity investments. Developers need to rethink the signals and incentives they cascade down the value chain to alleviate costly bottlenecks.

...and the way forward

1. European countries need to create **regulatory and policy measures** that provide the needed **predictability, security, and long-term reduction in the cost of capital.**

2. There is a need of rethinking collaboration models and competition. The industry needs become more collaborative and coordinated to succeed, whether through **horizontal and vertical partnerships or public-private partnerships.**

3. The industry should address the supply chain and capacity building challenge by pursuing **modularization, standardization, and industrialisation** to enable scalability and cost efficiency.

Sources: Implement Consulting Groups whitepaper: Storm in Shallow Waters

1 The European offshore wind industry will not meet the EU 2030 political targets

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There is a disconnect between political ambition and the reality of the industry. More honesty is needed on what is realistic.

- OEM

CxO Survey, Implement Consulting Group

(Aug 2024)

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European countries have set ambitious build-out targets aiming to reach a total installed capacity of 163 GW by 2030 – this will in all likeliness not happen

Ambition

- The European countries aimed to install 129 GW new offshore wind capacity reaching a total of 163GW in 2030. This is an expansion of 380% in seven years.
- The build-out will contribute to the EU's expected increase of 60% in electricity consumption between 2023 and 2030 and will require around 350 billion EUR of capital. Additionally, large investments in offshore grid connections and reinforcements in onshore grid are required.

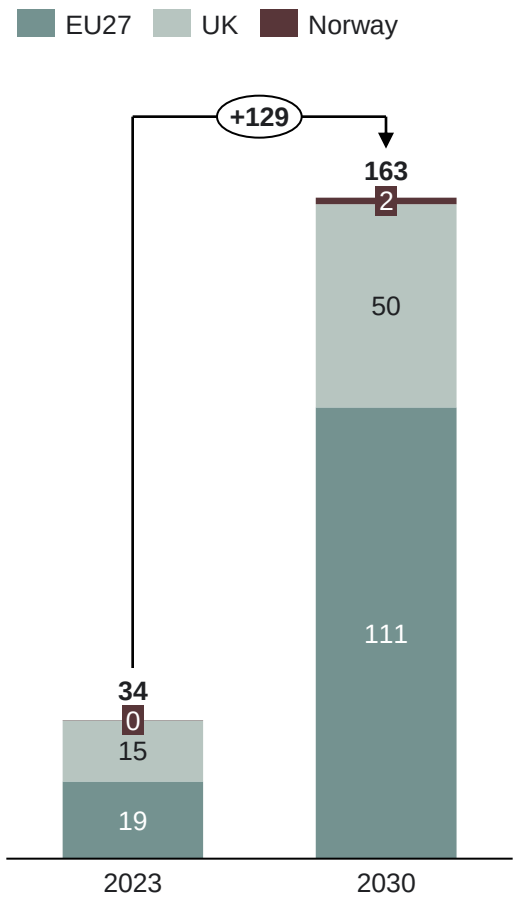
The Storm of 2022 and 2023

- During 2022 and 2023 the pace of the European offshore wind build-out plummeted and in some countries came to a complete stop, such as in Denmark.
- The trigger was a "perfect storm" of several unfavourable and destabilising factors due to a mix of the energy crises, Russia's invasion of Ukraine, and the aftermath effects of the COVID-19 pandemic.

Implications

- It has become obvious that many European tendering processes, auction designs as well as developers' and sub-suppliers' business models were not resilient for a situation with a significant increase in inflation and interest rates.
- Developers' capital costs rose due to higher risk-free rates and larger risk premiums, while suppliers faced rising input costs, resulting in negative margins and higher prices for developers.
- The rising inflation combined with auctions that exposed developers to inflation risk and supply chain problems, calls for a thorough assessment as to whether this is just a 2-year adverse market development or something structural.

Capacity build-out
GW



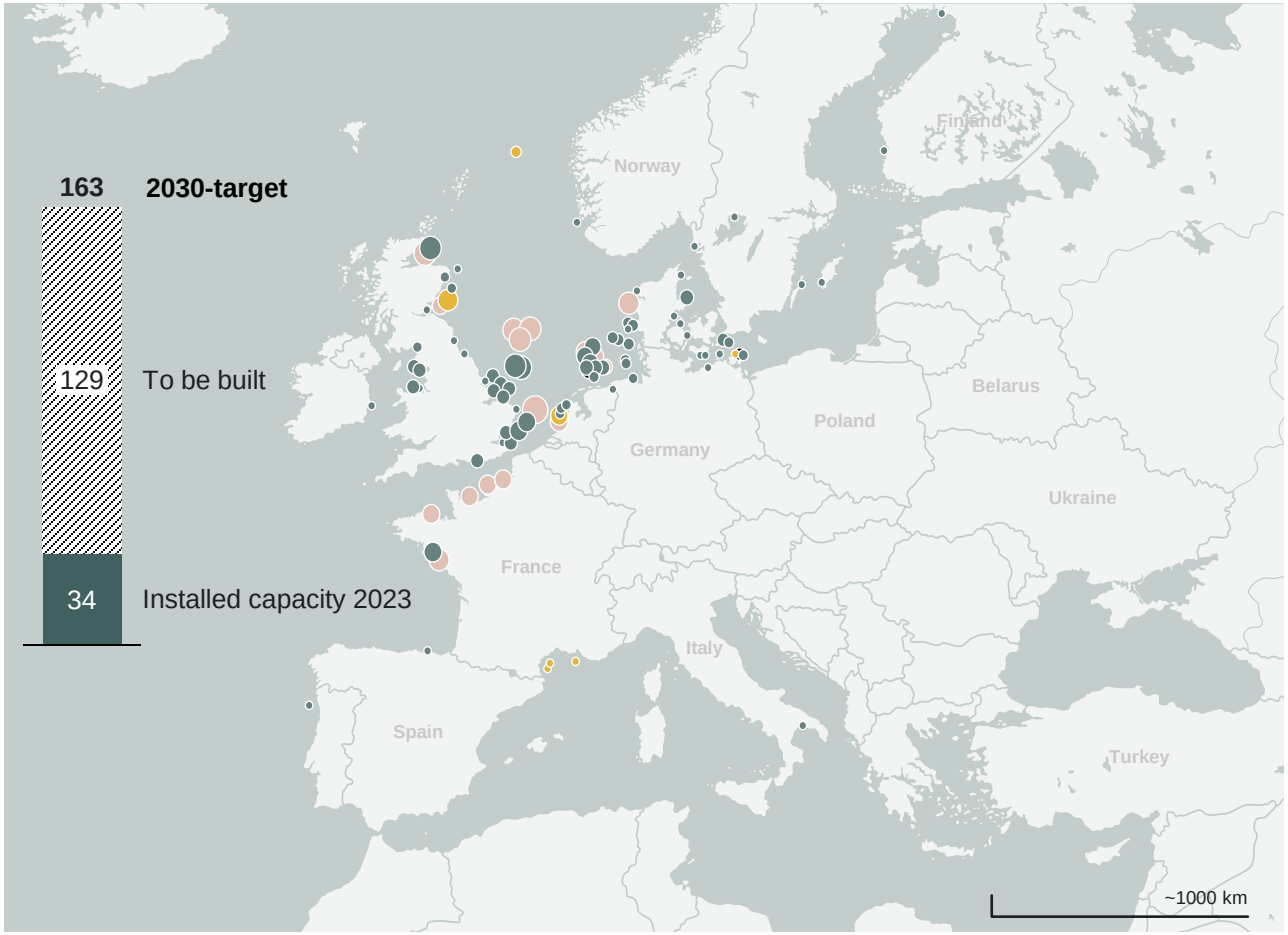
Key challenges to current 2030 target

- ❑ Tender processes, auction designs, and supply chain resilience all proved vulnerable to inflationary pressures and supply chain disruptions, raising questions about the robustness of Europe's green energy transition framework.
- ❑ Europe's reaction to those disturbances will shape the industry's future, determining whether it can indeed achieve its 2030 targets.
- ❑ Europe's offshore wind strategy serves as a broader lesson in the necessity of resilient, adaptive green energy policies capable of withstanding global volatility.
- ❑ The current industry and policy challenges highlight the need for stronger, more flexible frameworks to ensure Europe's green energy goals remain achievable in the face of global instability.

Source: Implement Consulting Group based on WindEurope, European Commission, and Statista.

Current European policy targets require a 131 GW expansion corresponding to a yearly growth of 400% – primarily in the North Sea

European offshore capacity and policy targets



Europe's current offshore wind

- **34,166** MW connected to the grid
- **6,340** turbines connected
- **135** wind farms
- **13** countries

Status

Online
Partially online
Under construction

Country details

	MW connected	Turbines connected
United Kingdom	14,744	2,768
Germany	8,464	1,566
Netherlands	4,739	670
Denmark	2,652	672
Belgium	2,261	399
France	482	81
Sweden	192	80
Norway	101	13
Finland	71	19
Italy	30	10
Ireland	25	7
Portugal	25	3
Spain	5	1

Updated: 10/08/2023

(Over-) ambitious build-out 2030 targets

The European offshore industry is mainly concentrated around the North Sea both in terms of numbers and size of the wind farms. As of end 2023, total capacity connected to the grid is 34 GW of which 43% is connected in the UK (15 GW)

Toward 2030, European build-out will continue in the North Sea due to good wind conditions, shallow waters, and increasing infrastructure connection points.

The European Green Deal aims to make Europe climate neutral by 2050, which requires 450GW of offshore wind by 2050 on top of 760 GW of onshore wind.

According to WindEurope, the most cost-effective deployment of the 450GW around Europe is:

- 212 GW in the North Sea
- 85 GW in the Atlantic
- 83 GW in the Baltic
- 70 GW in the Mediterranean and other Southern European waters

Source: Implement Consulting Group based on National and European targets and WindEurope.

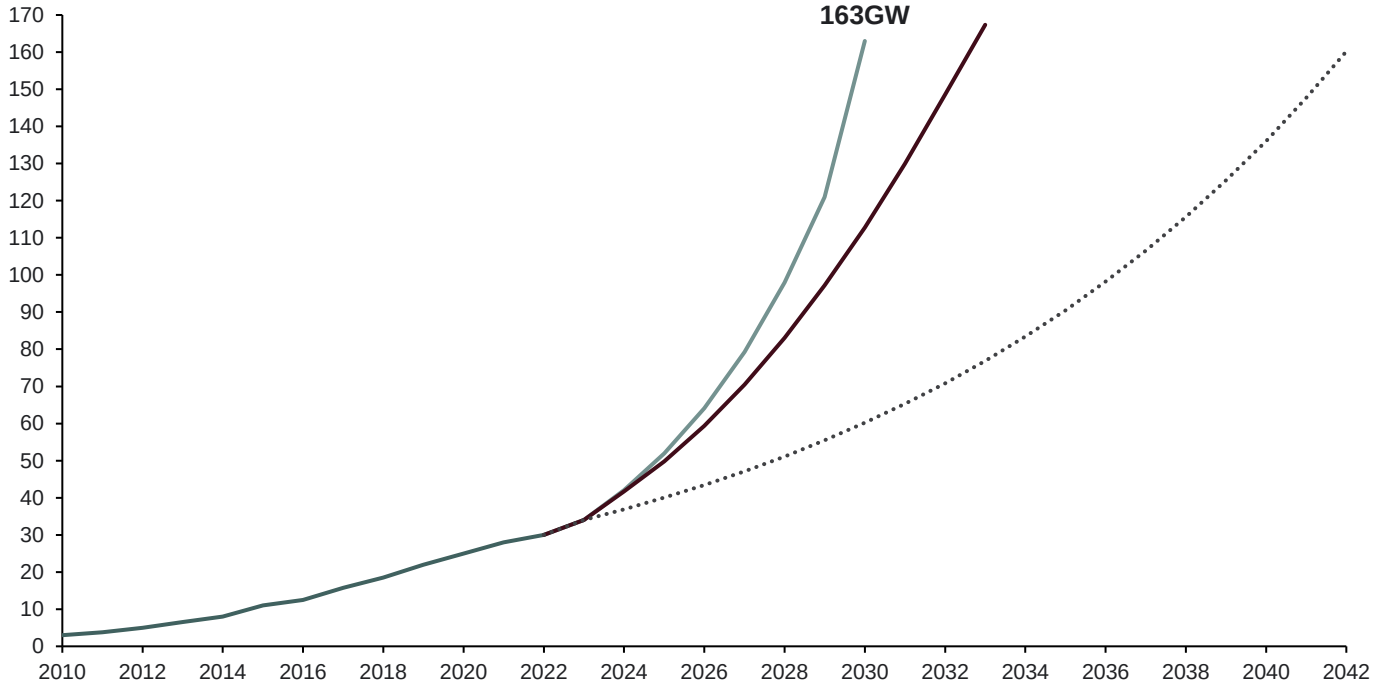
The European offshore wind industry will miss the 2030 targets by 12.5 years if business as usual continues, however an alternative pathway causing only three years delay may be possible

Installed European offshore capacity
GW

Pathway I (Target Pathway): No delay however an extra cost of 200 billion EUR

Pathway II (Alternative Pathway): Delay of 3 years but a bankable capacity expansion pace

Pathway III (Business as Usual Pathway): Delay of 12.5 years if Europe fails to reaccelerate pace



Closing gap requires
- Allocation of capital
- Acceleration in build-out

450GW
2050-target

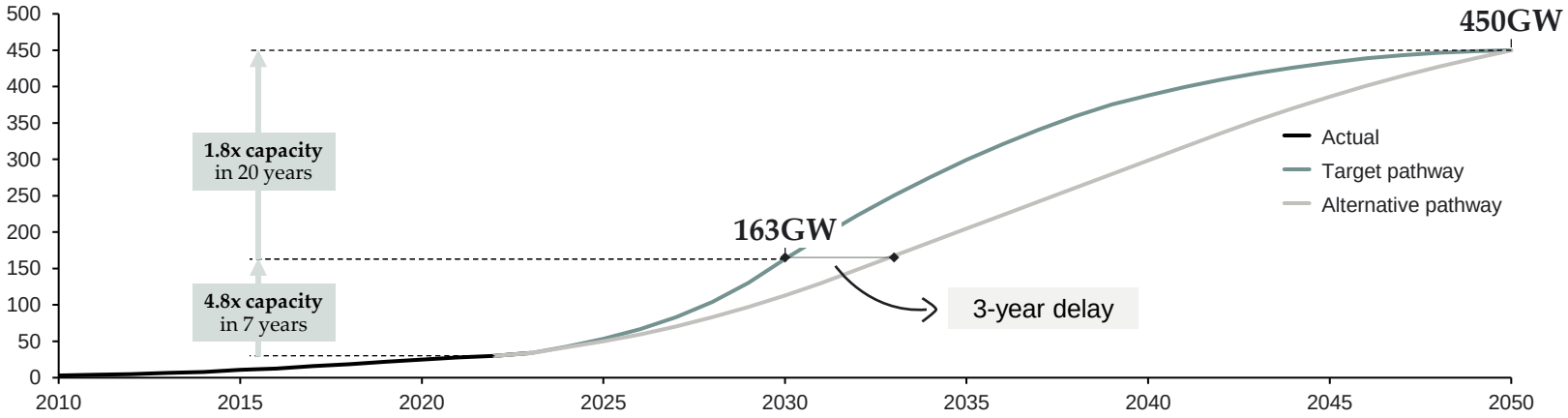
Note: The Business-as-usual (2020-23) scenario assumes that the growth rate of the European build-out in 2020-2023 (8.5% per year) continues in the future the growth rate was higher, at 18% per year for 2015-2020.
Source: Implement Consulting Group based on National and European targets, WindEurope and Bloomberg.

Need for a high-speed transformation

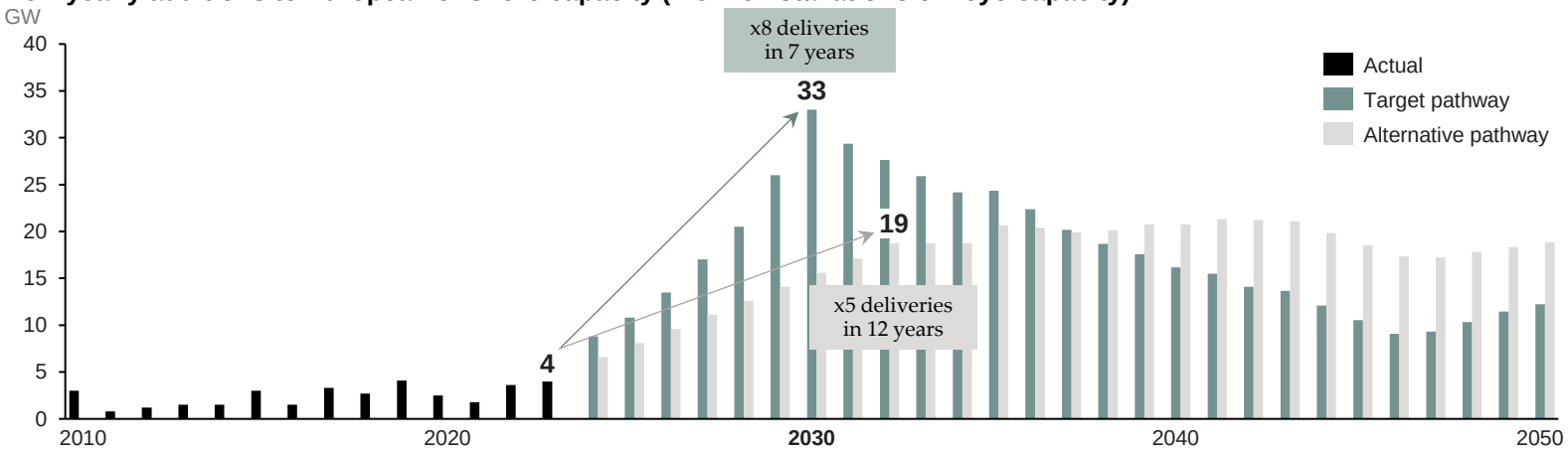
- To reach the 1.5C temperature target of the Paris Agreement, ambitious capacity targets are a requirement. In Europe, the 2030 capacity target is 163GW, which requires:
  - A historically large **reallocation of capital** to the European offshore wind industry, ~350 billion EUR
  - A significant **acceleration in installation speed**
- It is **crucial to ensure a sustainable investment environment throughout the entire European value chain** to attract the necessary capital and speed up installation to reach the 2030 target.
- Therefore, **this report has three main messages to the European governments and industry about reducing uncertainty and restore reliability in the offshore ecosystem**. These messages are presented in the following Chapters.

Achieving the 2030 build-out target of 163GW will necessitate a 4.8-fold increase in capacity over a mere 7 years, corresponding to a 25% annual growth in capacity

Installed European offshore capacity
GW



New yearly additions to European offshore capacity (incl. reinstallations of 25yo capacity)
GW



Note: The Target pathway assumes a steady growth rate (of 23.5% per year) until 2030 that satisfies the 163GW target. From 2030 the target pathway is assumed to gradually fade out from the peak 2030 delivery until 2050.
For the Alternative pathway is a suggestive pathway where yearly, new installations grows by 1.5GW per year until it plateaus from 2032-2041, whereafter it gradually declines by 1GW per year.
Source: Implement Consulting Group based on National and European targets, ORE Catapult and WindEurope.

What achieving the 2030 targets requires

- To reach the 2030-target, capacity would have to increase by a **factor 4.8x in only 7 years**.
- This requires yearly additions to capacity to grow by 25% per year towards 2030, which amounts to an **8-doubling in the new yearly delivered capacity from 2023 to 2030.**
- It **entails building** out manufacturing **capacity at an unprecedented rate.**
- Further, accelerating the supply chain capacity until 2030 would result in **overcapacity towards 2050** as shown by the spike and subsequent drop in the additions/the green bars in the bottom chart.
- A build-out pathway, **which is stable, cost-efficient, and creates the necessary investor confidence** to undertake the needed investments throughout the value chain.
- A forward guiding **steady-state approach will only delay the 2030-target of 163GW with three years.**

2 How should we use the three extra years to avoid further delays in offshore build-out?

If the industry starts playing together and not against, the industry will succeed in the next 5 – 10 years.

- OEM

CxO Survey, Implement Consulting Group

(Aug 2024)

There are several key areas that require focus and joint action to better utilize the three extra years given by the alternative pathway

In an increasingly uncertain world, the offshore industry has yet another layer of uncertainty associated with changing regulations, supply chain constraints, and volatile energy prices, to mention a few.

Thus, **predictability has become critically important** for industry actors to be able to make the major financial decisions that the offshore industry entails.

After a series of interviews with CxOs in the Offshore Wind Industry, we **have identified three key themes as the most important for the industry:**

1. **Accelerating regulatory and financial measures** enables greater capacity predictability and financial forecasting
2. **Collaboration and industry coordination** improves knowledge- and risk-sharing across players
3. **Supply chain and capacity building** mitigates/avoids further delays in build-out and enables standardization.

At the table on the right, we indicate the involvement needed of each value chain actor to restore the industry confidence and development pace.

Area	OEMs	Developers	Regulators
1. Accelerating regulatory and financial measures			
a. Streamlining the regulatory process	✗	✗	✓
b. Global capacity planning and common goals	/	/	✓
c. Accept sustainable levels of electricity prices	/	/	✓
d. Increasing cost efficiency	✓	✓	✗
2. Collaboration and industry coordination			
a. Cross-country collaboration (EU sector deal)	/	/	✓
b. Joint industry projects to share risk	✓	✓	/
c. Public-private collaboration	✓	✓	✓
3. Supply chain and capacity building			
a. Unlock supply chain capacity (e.g., impact of Chinese suppliers)	✓	✓	✓
b. Standardize across value chain	✓	✓	✓
c. Industrialization in “turbine race”	✓	✓	✗

✓ Involved / Partially involved ✗ Not involved

3 Accelerating regulatory and financial measures

Regulatory frameworks change all the time due to political motivations, but the industry needs consistency and long-term perspectives.

- Developer

CxO Survey, Implement Consulting Group (Aug 2024)

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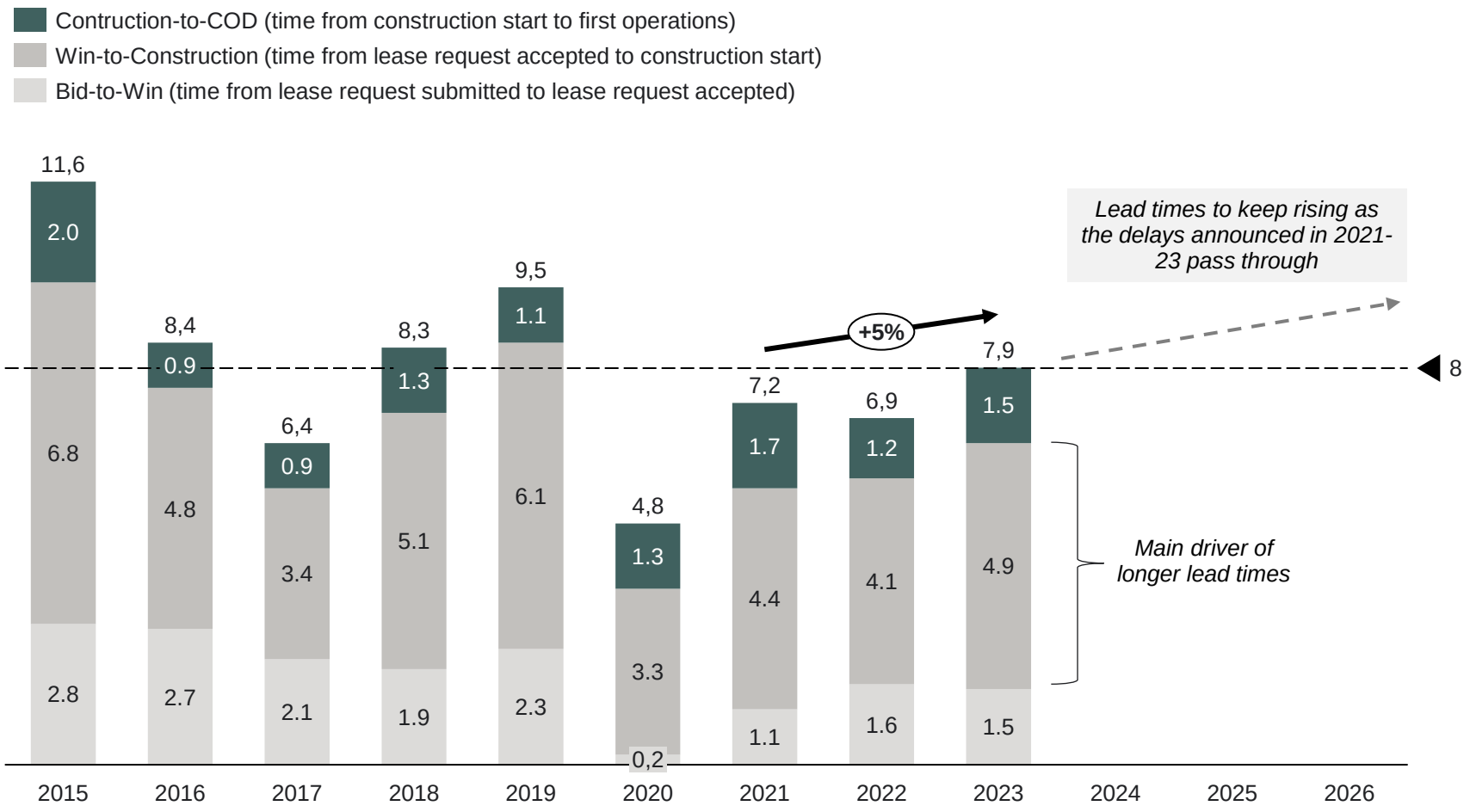
EU Member States must streamline the regulatory process and create greater certainty to local market players to enable a faster development and delivery on projects

Time from lease to commercial operation date (COD)[1]
Years



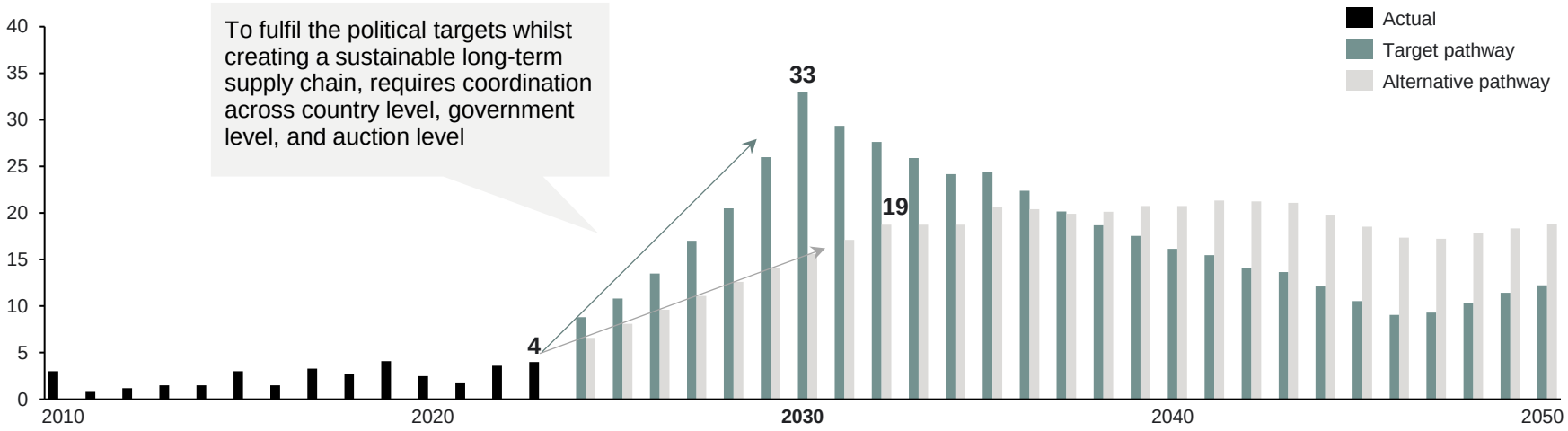
Notes: 1) Capacity weighted years on lead times of European offshore wind porjects
Source: Implement Consulting Group based on 4C Offshore.

European project lead times are long – and rising

- Out of the 8 years needed between bid and COD, most of it, 4.5 years are spent on project development (lease request accepted to construction start).To address the long lead times of offshore wind projects in Europe, specific measures need to be implemented:
- Regulators should establish a **centralized European body to facilitate streamlined, standardized permitting criteria and processes across all member states**, ensuring consistency and transparency in applications. This centralization would mitigate the complexity and transaction costs associated with applying in multiple countries.
- Additionally, **collaboration on transmission asset planning should be enhanced.** This **could involve coordinated investment and strategic planning between countries, particularly within regions like the North Sea**, to ensure efficient grid connections.
- Furthermore, accelerating the permitting process could be achieved through coordinated reforms, such **as introducing fast-track permitting schemes for projects that meet predefined criteria,** thereby reducing the time from lease request acceptance to construction start.

By creating European capacity planning and common goals, the industry will be able to align and coordinate supply and demand, creating the needed predictability, security, and long-term commitment required

European offshore wind yearly additions to reach the political targets
GW



Proposals to enable the alternative pathway solution

Purpose

Alignment and implementation of European capacity and goals should be designed to facilitate and support offshore wind investments through effective governance and planning.

It will ensure coordination across Member States and the UK and Norway creating an effective auction framework for reaching Europe's net-zero targets.

Principles

Unlike the North Sea Energy Cooperation, this collaborative ecosystem should be for all of Europe's regulators and industry players to underline and organise how the joint capacity planning can be done e.g. organising the different auctions to effectively prepare the supply chain and investments. (Different to a wind sector deal that is discussed later in the report which focuses also on innovation, industrialisation etc.).

Coordination

Will enhance international collaboration and market stability for offshore wind investments. Help coordinates shared research and procurement efforts, harmonize administrative processes, and advise on auction strategies to manage supply and demand.

This will foster a balanced and predictable market, supporting long-term growth and stability in the industry.

Note: The Target pathway assumes a steady growth rate (of 23.5% per year) until 2030 that satisfies the 163GW target. From 2030 the target pathway is assumed to gradually fade out from the peak 2030 delivery until 2050.
For the Alternative pathway is a suggestive pathway where yearly, new installations grows by 1.5GW per year until it plateaus from 2032-2041, whereafter it gradually declines by 1GW per year.
Source: Implement Consulting Group based on National and European targets, ORE Catapult and WindEurope.

Upsides of alternative pathway

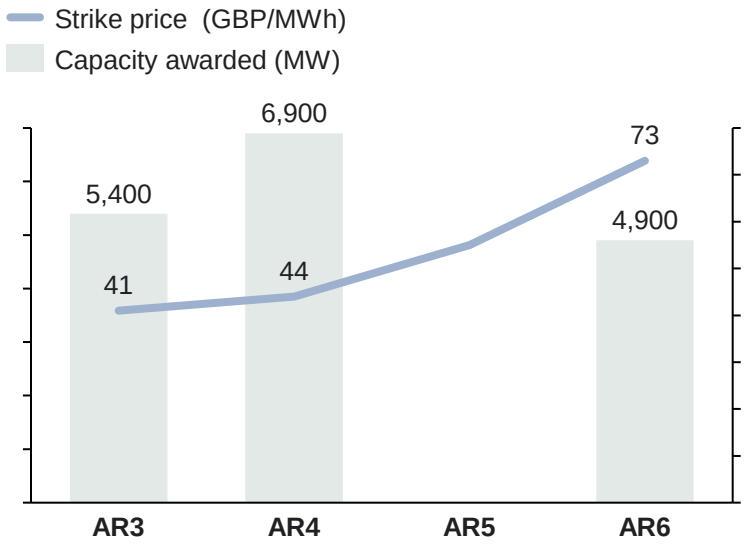
- **Reduced capital costs:** Coordinated auctions should ensure the developers bid cannot compete for the same equipment and components ensuring in the long-term capital costs will decrease.
- **Supply chain capacity development:** Suppliers should invest in their capacity knowing there is a long-term supply, enabling them to prepare for larger demands in the future.
- **Long-term auction supply:** Unlike the North Sea Energy Cooperation, a stronger coordinated approach to auctions should provide the confidence to investors to make investments into projects and the supply chain.

> *It is not apparent that the North Sea Energy Cooperation is in practice or working within the industry as there **seems to be continued incoordination between auctions, regulations, and regulators***
>
> Developer, CxO survey
> Implement Consulting Group (Aug 2024)

Sustainable and predictable revenue levels are pivotal to the offshore wind development and pace of capacity build-out

Finding the optimal strike price

After unsuccessful AR5, UK government increased budget and strike price of Offshore Wind in AR6

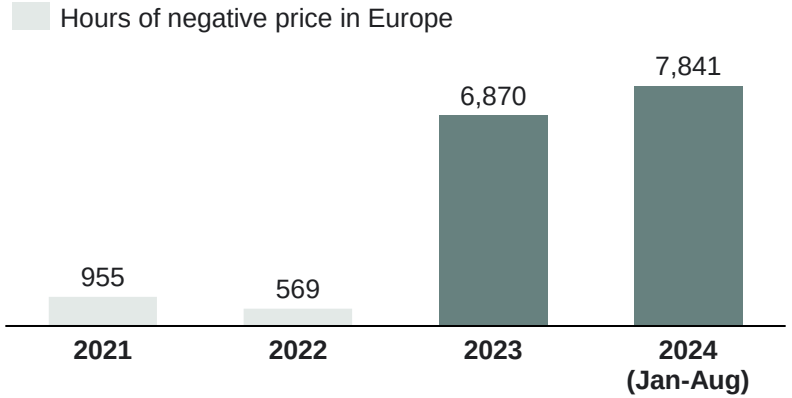


- Strike price was increased by 66% to 73 GBP/MWh
- Budget was increased by 530 mGBP to 1,560 mGBP

By not investing 1 billion GBP in 2023, the UK government delayed the development offshore wind by 1 year, putting more pressure on its 2030 target

Managing negative power prices

With the high penetration of renewables in the grid, in 2023 and 2024, Europe saw an increase in hours of negative prices



- By 2030 the share of renewables is expected to increase to from 46% to 67%, leading to further price cannibalization and increase in negative price events.
- Negative price events have direct impact into offshore wind business cases, impacting revenues and, potentially, hindering the pace of capacity build-out and slowing the energy transition

The growing share of renewables in the grid combined with lack of storage flexibility increases the change of curtailment of OFW production, with direct impact into revenues.

Key actions to achieve sustainable price levels

- ❑ Regulators should provide sustainable and consistent strike prices and CfD levels to mitigate development disruptions and avoid delays towards national and European OFW targets.
- ❑ Despite AR5 hiccup, the UK CfD model has a successful track-record and should still be seen as a sustainable and preferred auction design when compared to “right-to-delver” auctions, which trigger “negative bidding” (e.g. NL and DE)
- ❑ Developers can mitigate negative prices by increasing focus on revenue optimization and balancing investment portfolio with energy storage and flexibility solutions
- ❑ Stable offtake agreements, in the form of PPAs, with P2X or similar industrial consumers should also be a focus for developers aiming to avoid negative pricing and mitigate revenue risk(s).

Note: AR: Allocation Round of the UK Government's Contracts for Difference (CfD) scheme
Source: The future of European competitiveness and ICIS (ICIS: Independent Commodity Intelligence Services)

4 Collaboration and industry coordination

The industry needs to move away from squeezing the market and more to making it sustainable in the long-term.

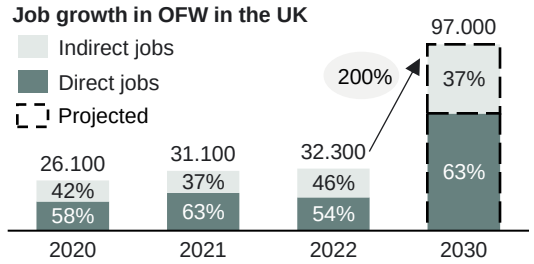
- Key component manufacturer

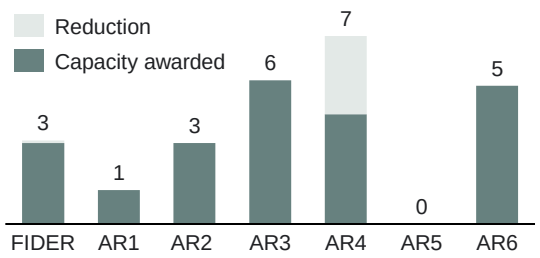
CxO Survey, Implement Consulting Group (Aug 2024)

A strong and coordinated European wind sector deal would secure public policy and private initiatives that would boost access to funding, enhancement of skills, and the support required for a resilient supply chain

Challenges at EU level to be addressed by learnings from the UK OFW Sector Deal

Current challenges to overcome	Aims of an EU sector deal	Positive effect (the UK example)
1 **Lack of workforce** The industry lacks skilled workers (e.g. electrical engineers) to deliver on the project pipeline	The sector deal should foster the development of jobs across various segments including construction, maintenance, operations, and supply chain.	**Job growth in OFW in the UK**
2 **Capacity** Capacity build-out has slowed due to a lack of, and poorly designed auction schemes	The deal should substantially increase the offshore wind capacity through streamline and supportive regulations and policies with the aim of reaching OFW targets in 2030 and 2050.	**UK offshore wind capacity development**
3 **Supply chain** The supply chain has struggled to expand its capacity and is dealing with changing requirements due to innovation.	The deal should promote the development of domestic supply chain with the hope of strengthening local content supply by 2030, backed by public and private financing.	**Regional offshore wind clusters in development**





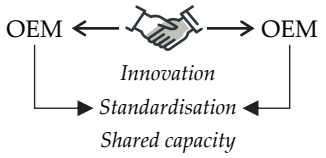
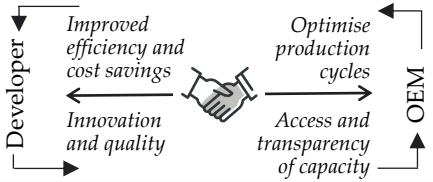
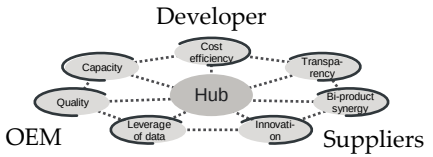
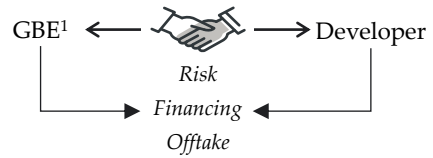
As part of the UK sector deal, 8 clusters were announced to advance collaboration between developers and regional supply chains, the public sector and education bodies. The two highlighted have already received ~111 mEUR in investments.

Challenges and opportunities of an effective EU-wide sector deal

- The UK Offshore Wind Sector Deal offers a valuable blueprint for an EU sector deal, illustrating how strategic policy frameworks can catalyze growth in renewable energy by **fostering collaboration to accelerate offshore wind development, boost investment, and create jobs.**
- **European Wind Power Action Plan**[1] is a first public step; however, it needs to be successfully implemented and enhanced by the commitment of private wind companies.
- There is need of **strong political commitment to prioritize offshore wind at the EU level**, along with harmonized regulations to streamline permitting processes and improve the industry's developments pace.
- **Investment in workforce development is essential** to ensure a skilled and diverse labor pool that can support the burgeoning industry.

Note: 1) European Wind Power Action Plan, European Commission
Sources: Implement Consulting Group analysis based on Offshore Wind Industry Council, UK Government, and 4C Offshore

Building new partnerships vertically and horizontally across the value chain could leverage resources, risk, and capital to enable OFW projects during market uncertainty

Possible partnership models	Target challenges	Description	Example
1 Vertical supply chain integration	• **Upstream supply chain shortages** due to global volatility.	• Simplify the upstream supply chain by creating strategic direct partnerships or acquiring key technology and/or material suppliers. This way, grow transparency and level of control over the supply chain to improve operational and resource efficiency.	
2 Partnerships with competitors (JV)	• **Upstream and downstream supply chain bottlenecks** due to low levels of standardisation pressuring suppliers to prioritise fast innovation over quality, large-scale production.	• Create strategic partnerships with other OEMs or developers to tackle common challenges by pooling resources to address them, such as specific component shortage or standardization challenges in downstream supply chain.	
3 Partnerships across the industry (JV)	• **Rapid innovation driven by pressure** from developers and **competition to create larger wind turbine models** puts OEMs in a prisoner's dilemma, resulting in lack of return on investment and ability to improve project economics.	• To address the prisoner's dilemma there needs to be partnerships on how to standardize and approach innovations for components with higher levels of innovation, like blades, towers and foundations.	
4 Regional hubs	• **European OEMs are highly dependent on China for components** and easily affected by global disruptions in supply chain.	• Cooperate with regulators and industry to foster conditions for scaling offshore wind energy production in local hubs by pooling resources, creating incentives and developing infrastructure to boost manufacturing capacity without disrupting global supply chains.	
5 Public-Private	• **Allocation of risk, CAPEX constraints, and revenue uncertainty** often hinder OFW projects taking FID and entering COD.	• Working with public partners can improve risk sharing and financing models, strengthening business cases for OFW projects while reducing reliance on external, risk-averse investors for CAPEX.	

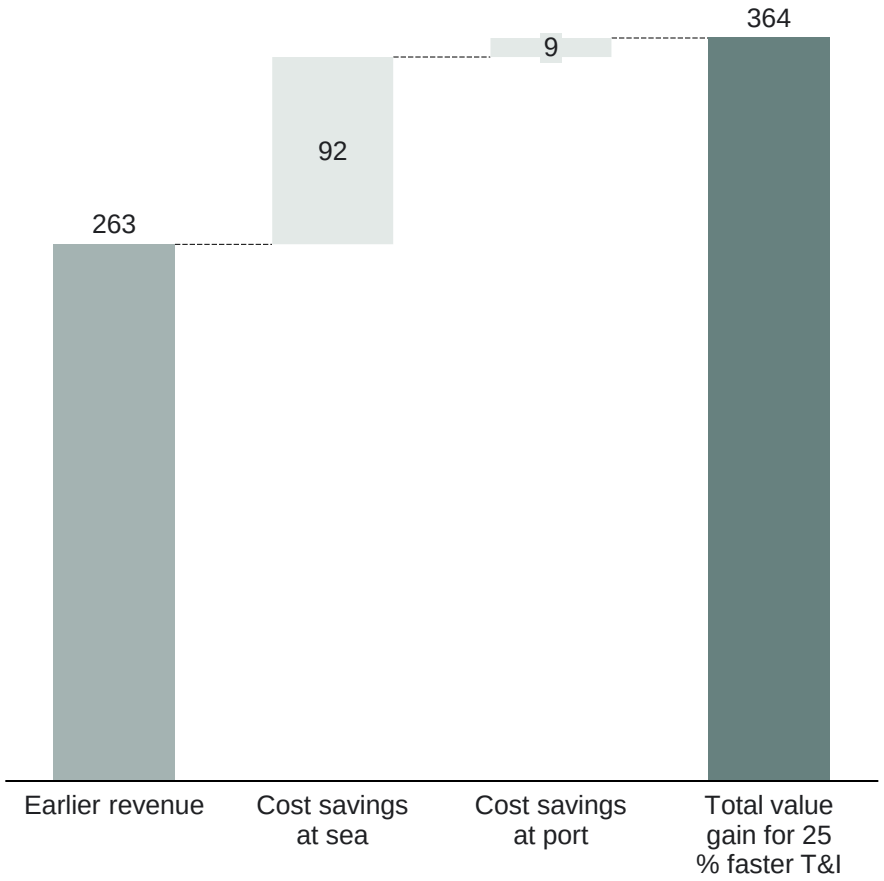
Strategic partnerships could provide significant upsides

- ❑ **OEMs and component suppliers should engage in supply chain integration to reduce risks** through risk-sharing models and obtaining higher levels of security in supply and offtake.
- ❑ Partnerships across the industry can:
  - **unlock new business opportunities** by enabling the scaling of production in local hubs.
  - **increase level of control** over the supply chain and mitigate potential bottlenecks
  - **Streamline resource pooling**, improving operational and resource efficiency
- ❑ By partnering with public institutions, developers can increase their negotiating power when dealing with policymakers and public stakeholders
- ❑ Achieve higher levels of standardisation through partnerships across the industry

Notes: 1) GBE stands for Great British Energy
Sources: Implement Consulting Group analysis; interviews with industry CxOs

By collaborating across the value chain, CAPEX and construction time can be optimised, making projects more cost efficient, enabling a more profitable business case

Estimated value gain for 25% faster transport and installation (T&I)[1] for a 1 GW fixed-bottom wind farm, 150km from port
mUSD



Value gain is driven by:

- **Earlier revenue:** With 25% faster T&I the commercial operation date has the potential to be 100-150 days sooner, ensuring the developer gains revenue from operations earlies, by approximately 263 million USD
- **Cost savings at sea:** With 100-120 days less time at sea the day rates for vessels, mission equipment, crew, and other costs are reduced significantly, by approximately 92 million USD.
- **Cost savings at port:** with 15-20 fewer days at port (reducing the cost of port leases and tariffs) due to larger vessel capacities and faster installation, developers can save approximately 9 million USD.

Therefore, by marginal increases in T&I efficiencies, developers can reduce their OPEX.

Actions and collaboration needed to enable cost efficiency

- ❑ Regulators should facilitate an environment that promotes better collaboration between actors during transport and installation
- ❑ Suppliers should provide new technologies that speed up the transportation and installation of foundations, turbines, cables, and substations, and,
- ❑ Developers should utilise these new technologies in their projects to optimize the business case.

Challenges and Opportunities

- ❑ Faster transportation and installation is significant on a developer's business case, but can also benefit installation providers and port operators
- ❑ A closer collaboration in the value chain can enable the risk mitigation of new technologies, avoiding negative impacts on business cases

Notes: 1) A generalised model based on several assumptions. Model based on a fictious 1 GW fixed-bottom wind farm, 150km from marshalling port.
Source: Implement Consulting Group analysis

5 Supply chain and capacity building

If the supply chain won't invest in expanding their capacities, then Chinese supply will be used to fill the gaps. This then raises the question of how to create a level playing field.

- OEM

CxO Survey, Implement Consulting Group (Aug 2024)

Multiple levers will have to be utilized to unlock the required supply chain capacity investments to deliver on targeted build-out ambitions

The challenge at hand…

Increased uncertainty on market outlook (supply-demand)

Long lead times and high capex environment driving investment risks

Capacity bottlenecks driving cost increases and business case failures

Levers to unlock supply chain capacity	Key challenges	Key focus	Examples
1 Supply chain partnerships	• **High Capex** environment with technical and business case uncertainty • **Timeline misalignment** – long lead items/services and project uncertainty	Develop supply chain partnerships to… • **Leverage project portfolio** to secure demand and business case certainty • **Improved capacity utilization** and **risk sharing**	Last year, the German utility company RWE entered into a strategic partnership with the Belgian marine contractor Jan De Nul to secure a fleet of installation vessels dedicated to RWE's extensive offshore wind project portfolio.
2 Digital Supply Chain Management	• Limited **visibility and data transparency** across supply chain • Inefficient **manual processes leading** to delays and errors • Difficulty in **predicting and** responding to supply chain disruptions	Implement advanced analytics to… • Forecast demand, optimize inventory levels and manage supply chain risks. • Anticipate and mitigate potential disruptions	By leveraging cutting-edge technologies such as cloud computing, AI, and IoT, Shoreline Wind's platform provides real-time visibility and data transparency across the entire supply chain.
3 Peak shave with Chinese supply chain	• **Limited or lack of capacity** with established supply chain (Europe) • **Cost increases** due to supply constraints – challenging business case feasibility	Opening for Chinese supply to… • Peak shave at times of no European capacity (capacity buffer, not priority) • Ensure business case cost optimization • Increase supply chain competitiveness	This year, German asset manager Luxcara lined up Chinese manufacturer Mingyang to provide turbines for a German project, claiming that it selected the "*best available offers and capacities*".
4 Standardization and modularization	• **Shortened life cycles** of products and investments – non-FID or profitability level under pressure • **Increased lead times, risks and costs** of customized components / services – limited leverage of scale	Increased standardization to… • Increase scalability and viability of capacity expansions • Extend lifetime of existing capacity and capabilities	This year, Energy Cluster Denmark has developed a new partnership between European OEMs Vestas and Siemens Gamesa to standardise tower transportation equipment for offshore wind turbines. This is expected to improve use of scarce assets.

Potential upsides from supply chain collaboration

- ❑ **Reduced 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.
- ❑ **Enhanced Scalability**
  Rapid capacity expansion to meet demand.
- ❑ **Improved Risk Management**
  Proactive disruption mitigation.
- ❑ **Optimized Resource Utilization**
  Efficient use of materials and logistics.

Source: GWEC, Global Wind Report 2024, , Implement Analysis

The industry should address the innovation challenge by pursuing modularisation and standardisation to enable scalability and further cost efficiencies

Introducing modularisation and standardisation to increase scalability and efficiency of the supply chain

OEMs need to consider ways of **optimising** existing technologies for design and production of wind turbines to regain control of costs and to be able to capitalise on R&D investments.

One way of doing that is through **modularisation,** either at a component level or for the whole turbine. This involves breaking down a complex system into smaller, manageable modules that can be independently developed, produced, and managed.

In the wind turbine industry, this requires **standardisation** and separately producing key components like nacelles, blades, towers, and control systems. These pre-assembled modules are then transported to the installation site for final assembly, allowing for scalable, flexible, and efficient production and deployment.

Some OEMs are pursuing modularisation to obtain a range of benefits such as faster rates of assembly and deployments. However, it requires a joint effort both across OEMs and other players in the value chain to standardise **across the industry** and achieve the complementary benefits of standardisation and modularisation.

A four-step approach to standardising in the Offshore Wind Industry

To capitalise on the potential from modularisation and standardisation, the industry should use a step-by-step approach without compromising the commercial opportunities and uniqueness of individual companies:

1 Foundational standardisation

Identify non-innovative components (e.g., fasteners, bolts, basic structural elements) to standardise without affecting competitive advantages, to incentivize early adoption

2 Process standardisation

Standardise essential processes to improve operational efficiency and consistency (e.g., quality control, installation protocols)

3 Semi-innovative components

Expand standardization to include more complex components that incorporate some level of innovation but are widely used (e.g., control systems, monitoring equipment)

4 Integrated system standardisation

Standardize entire systems and interfaces to ensure compatibility and interoperability across different manufacturers and developers (e.g., grid connection interfaces, data communication protocols)

Potential upsides of modularisation and standardisation

- **Cost control:** Enabling mass production of standardised components, lowering production costs through economies of scale
- **Supply chain optimisation:** Standardised practices can enable the supply chain to reduce lead times, improve efficiency, and ensure quality

Need for partnerships

- **The approach requires partnerships across the industry** to collaborate on developing, publishing, and incentivizing standards.

Sources: DNV, 2022: Floating wind: Turning ambition into action; Vestas (2021): https://www.vestas.com/en/media/blog/technology/the-next-step-in-our-modularisation-journey; Porsche Consulting: Modularization in Industrial Goods; Implement Consulting Group (2021): Modularisation as a winning formula; GWEC Global Wind Report (2024)

Industrialisation and limitation of specification changes are needed to reduce costs and the time of delivering projects

LEVER	CHARACTERISTICS	CONDITIONS FOR THE LEVER TO WORK
Increase industrialisation	• **Predictability, profitability, and scalability –** Standardisation of requirements and modularising components enhance certainty, optimise costs, extend investment depreciation, and increase scalability. • Industry-wide standards	• Business cases remain positive without growing turbines • Standards and modular approaches can be agreed and implemented across the industry
Limit specification changes	• **Requirement lock-in –** Certainty for suppliers that developers' requirements will not change, leading to planning certainty.	• Governments commit to predictable policies • Innovation will not be significantly hampered by committing to specifications mid-term

EXAMPLES FROM OTHER INDUSTRIES

Examples from other industries

Military supply chains at times of crisis

- **Standardisation of products,** for example artillery ammunition supply, demonstrating synergies of alliances and standardisation to mitigate supply chain risks and vulnerabilities.

Automotive's e-mobility roll-out

- **Industrialisation around a very limited number of series** to reduce complexity to its minimum.
- Focus on **modular and standardised components**, enabling faster production ramp-up and greater design flexibility.

Potential gains from industrialisation

- ❑ **Increased industrialisation enables further reduced production costs** for the developers, translating to cost reduction for developers.
- ❑ **Increase in production output** leading to fewer bottlenecks in the supply chain.
- ❑ **Reduced specification complexity l**eading to reduced lead time.
- ❑ **Simplified installation and reduced installation cost.**
- ❑ Standard components reducing complexity in maintenance and **helping in reducing O&M costs further.**

Sources: Implement Analysis, EERA JP Wind; NCBI: Supply chain management in times of crisis: a systematic review; EVEngineering: "Advanced e-mobility relies on data sharing and standardization"

Meet our experts in renewables

Reach out to our experts behind the report to access more information and insights.

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Implement Consulting Group

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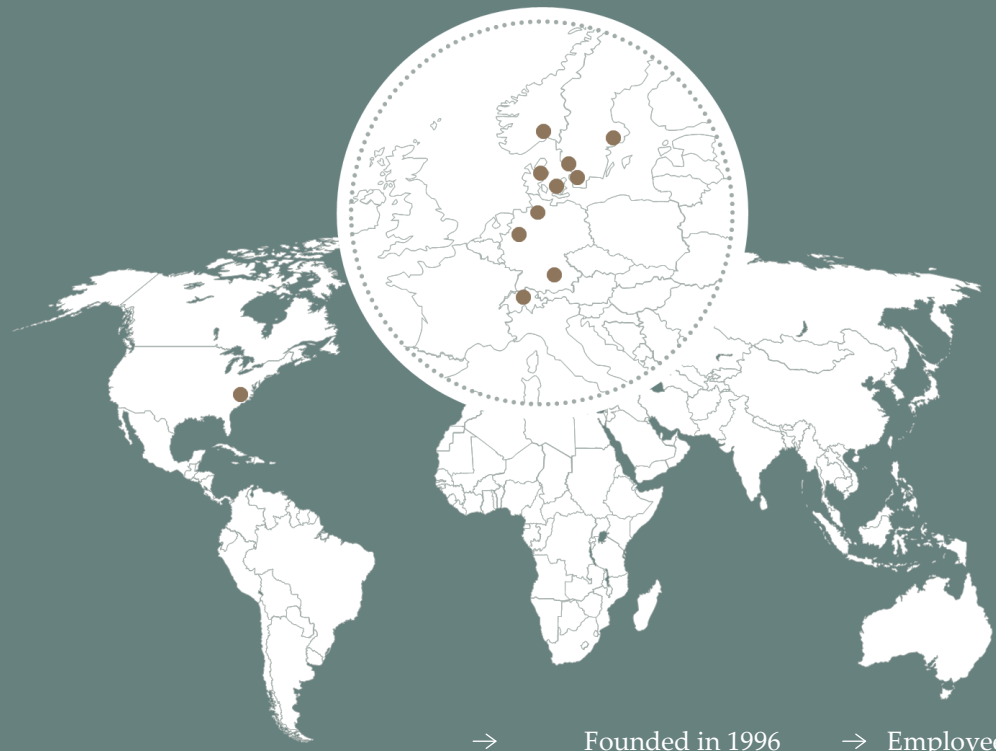

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