Wind Power: 2030 and beyond

Challenges and opportunities for offshore wind

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Global Wind Energy Council

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Where are we today?

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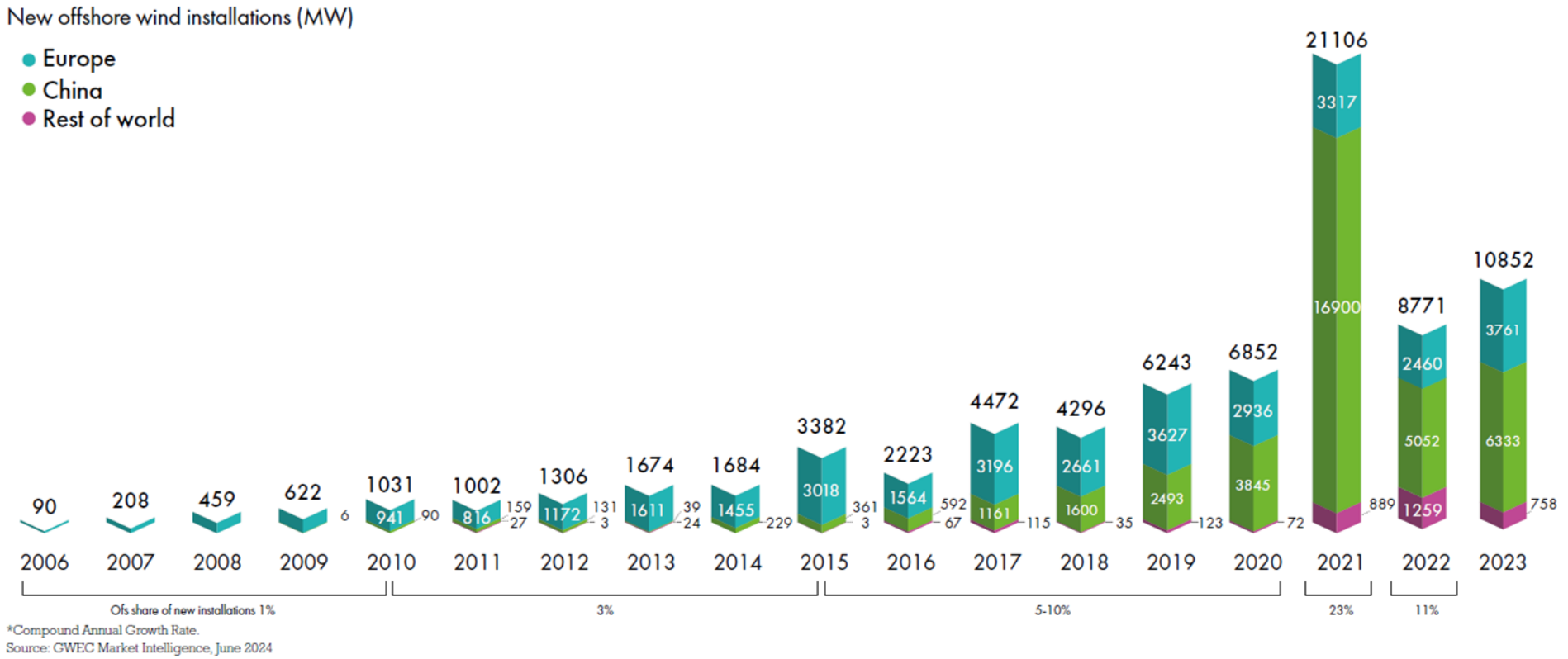
2023 was the 2nd-highest year in offshore wind history



*Compound Annual Growth Rate.
Source: GWEC Market Intelligence, June 2024

- **10.9 GW** of new offshore wind was added to the grid worldwide last year, bringing the total offshore wind capacity to **75.2 GW** by the end of 2023.
- **China** led the world in annual offshore wind development for the sixth year in a row with **6.3 GW** added in 2023, followed by **Europe** (**3.8 GW**).
- Outside of China and Europe, three other markets commissioned new offshore wind capacity last year: **Taiwan** (China, 692 MW), **Japan** (140 MW) and **South Korea** (4.2 MW).

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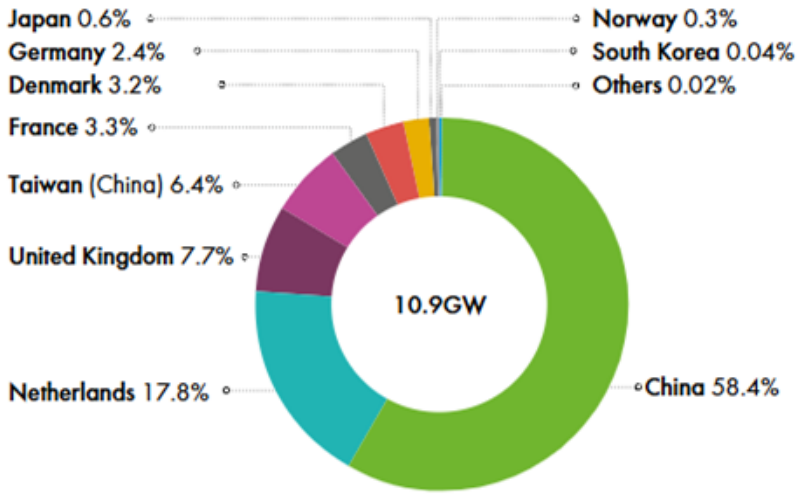
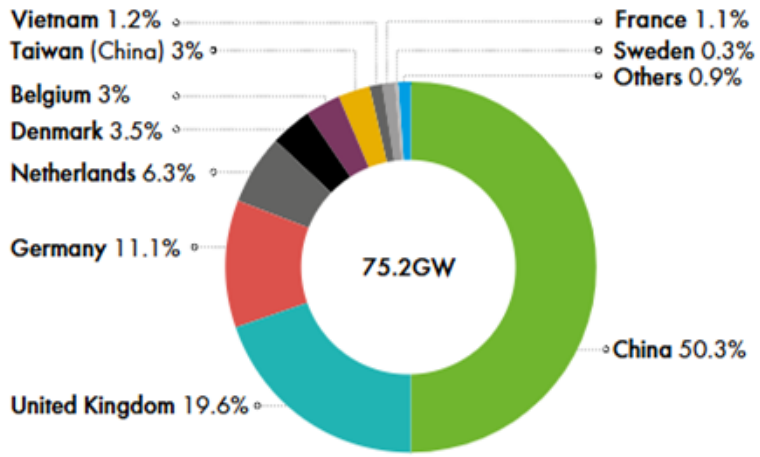
APAC and Europe dominated offshore wind installations

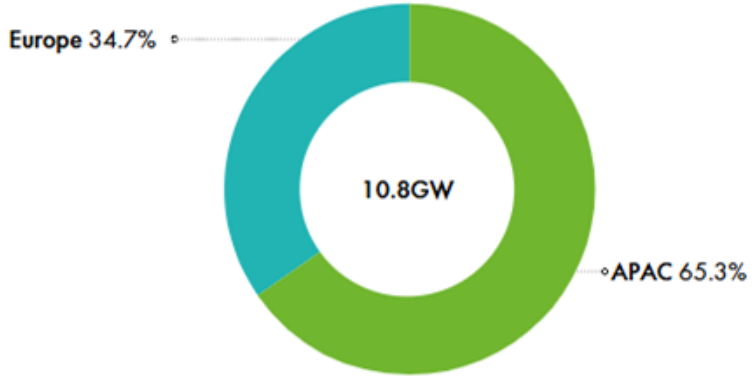
New offshore wind installations by market



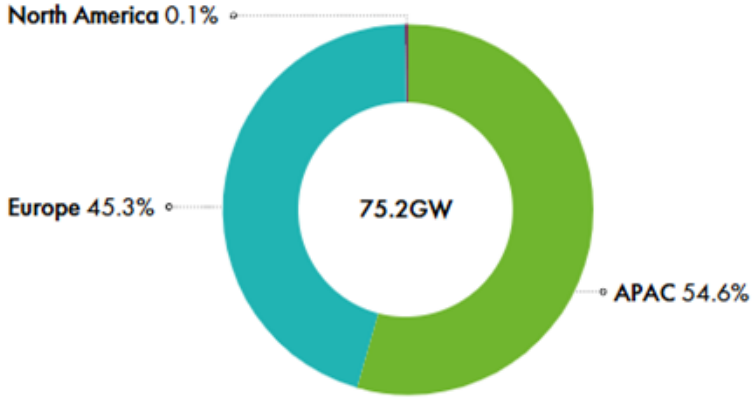
Total offshore wind installations by market



New offshore wind installations by region



Total offshore wind installations by region



Source: GWEC Market Intelligence, June 2024

- **41 GW** and **34 GW** of new offshore wind capacity were in operation in **APAC** and **Europe** respectively by end of 2023. The two regions combined made up **99.9%** of total global offshore wind installations.
- Outside of APAC and Europe, **North America** had 42 MW of offshore wind in operation at the end of 2023, with all installations located in the US.

In total offshore wind installations, **China** has further consolidated its Leading position last year with **nearly 38 GW** installed – 3.7 GW (11%) higher than Europe.

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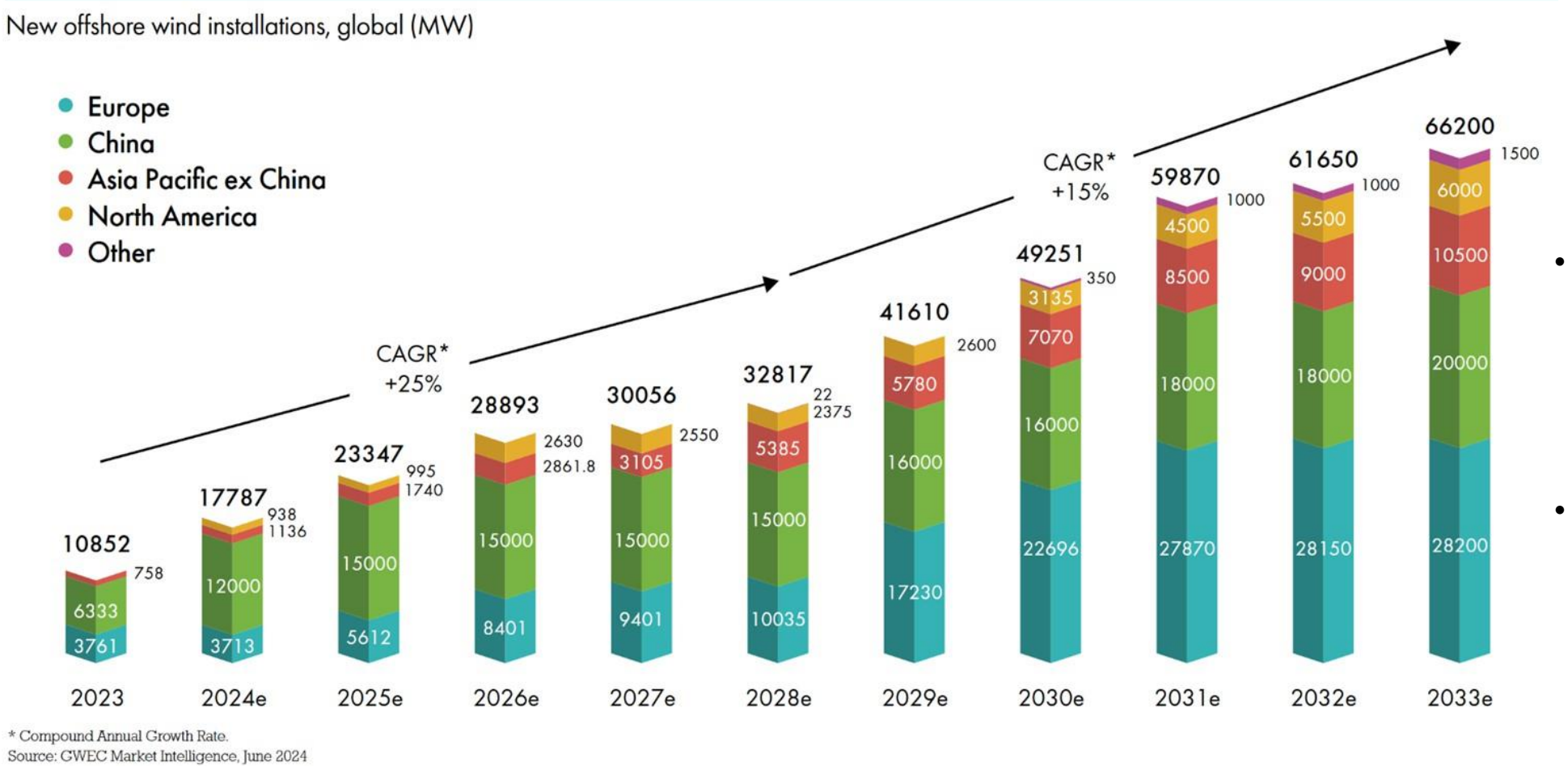
10 Year Outlook: Global offshore wind market expected to grow 20% on average each year



* Compound Annual Growth Rate.
Source: GWEC Market Intelligence, June 2024

- **Global offshore wind market outlook remains resolutely promising,** although GWEC downgraded its outlook for total additions in 2024–2028 by 10% compared with 2023 projection considering the near-term challenges.
- By **2033**, **annual offshore wind installations** are expected to reach **66 GW**, bringing the offshore wind share of new wind power installations from today's **9%** to at least **25%**.
- GWEC's rolling ten year outlook to 2033 shows that, with the right frameworks in place, **annual installations can triple by 2028** and be on course to **deploy 410 GW by 2033**, bringing **total capacity to 487GW** of offshore wind by the end of that year.

UPDATED GLOBAL OFFSHORE WIND OUTLOOK 2024-2028

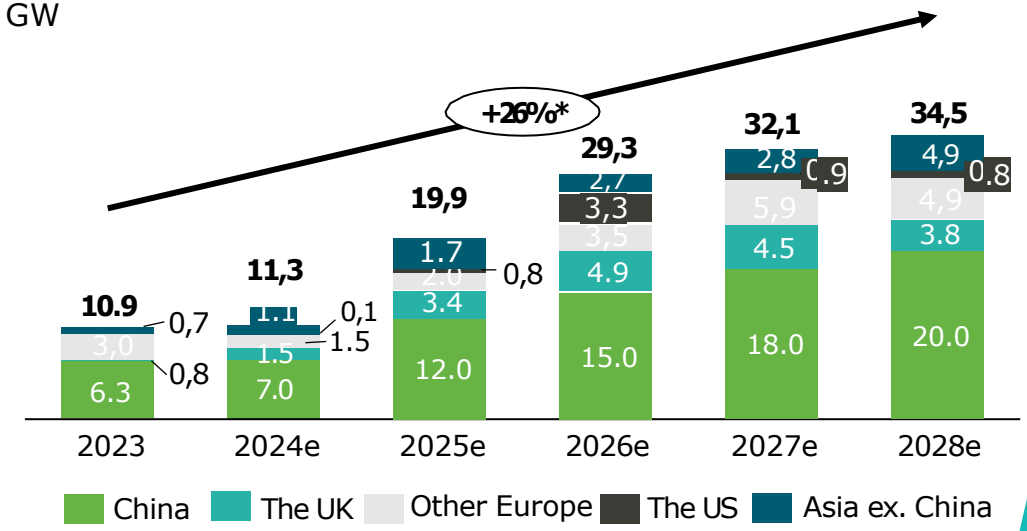
- For Europe, we downgraded the five-year forecast by 6.6 GW due to delays caused by high inflations and constraints related to supply chain and grid connection.

- For the US, GWEC downgraded our projection in 2024-2028 by 41% compared with our Q1 2024 Outlook. This is primarily driven by the uncertainty likely to be created by the newly elected Trump administration. Facing the ongoing macroeconomic challenges, the US offshore wind supply chain remains vulnerable at present. The extra tariff that President Trump wants to impose on imported goods even from both allies and adversaries is likely to increase the project CAPEX and in turn slow down the US offshore wind development and construction. In our current policy scenario, maximum 6 GW of offshore wind capacity from six projects will be added in 2024-2028. Those projects include South Fork Wind, Vineyard 1, Revolution Wind, CVOW, Empire 1 and Sunrise.

- Our near-term offshore wind market outlook (2024–2028), built using a bottom-up approach, is based on GWEC Market Intelligence's global offshore wind project database, which covers projects currently under construction, global auction results and announced offshore wind tenders worldwide. For the medium-term market outlook (2029–2033), a top-down approach was used alongside existing project pipelines. For details, please download GWEC's **Global Offshore Wind Report 2023**.

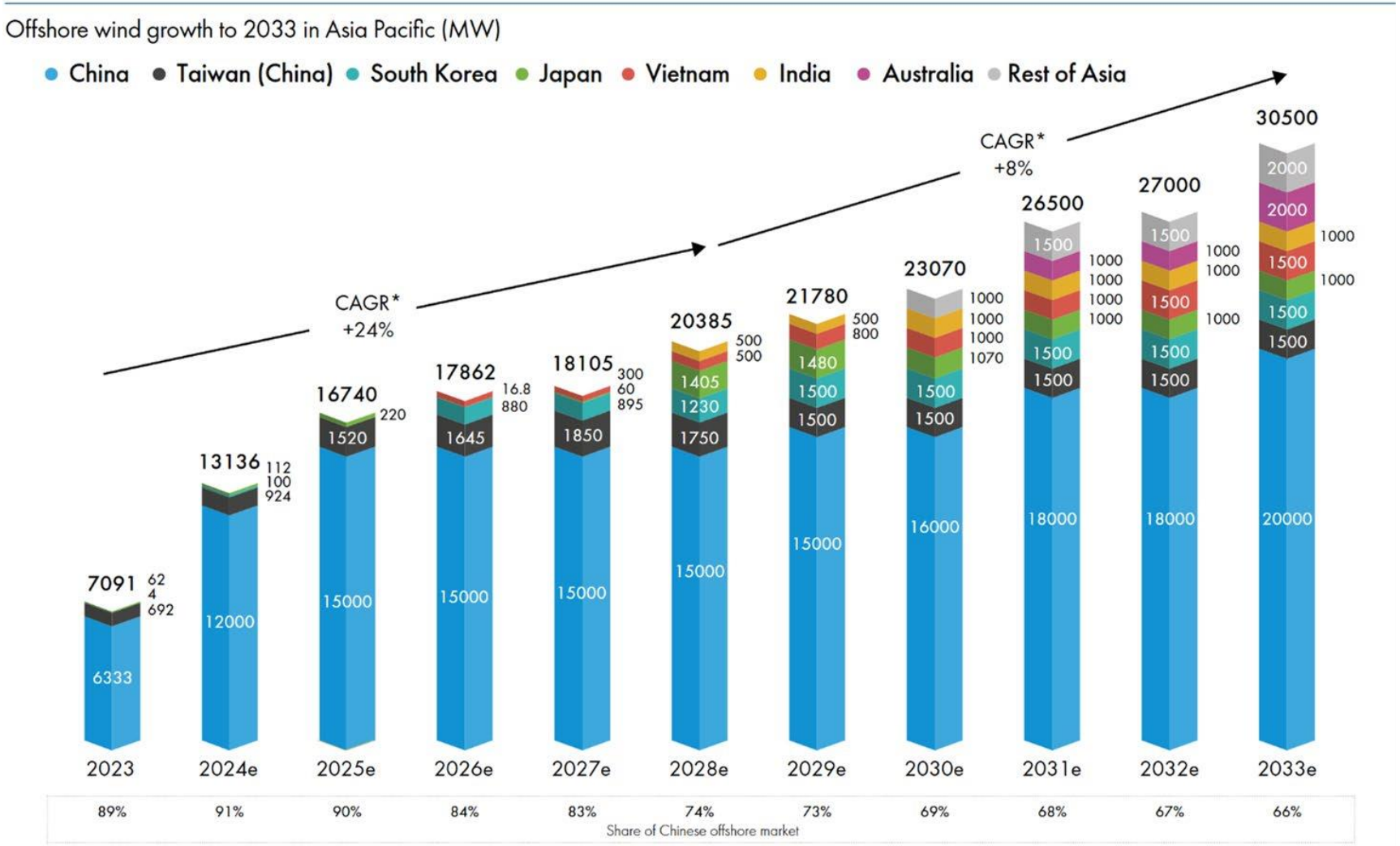
Total new global offshore wind installations 2024e to 2028e

GW



*Compound Annual Growth Rate
Source: GWEC Market Intelligence

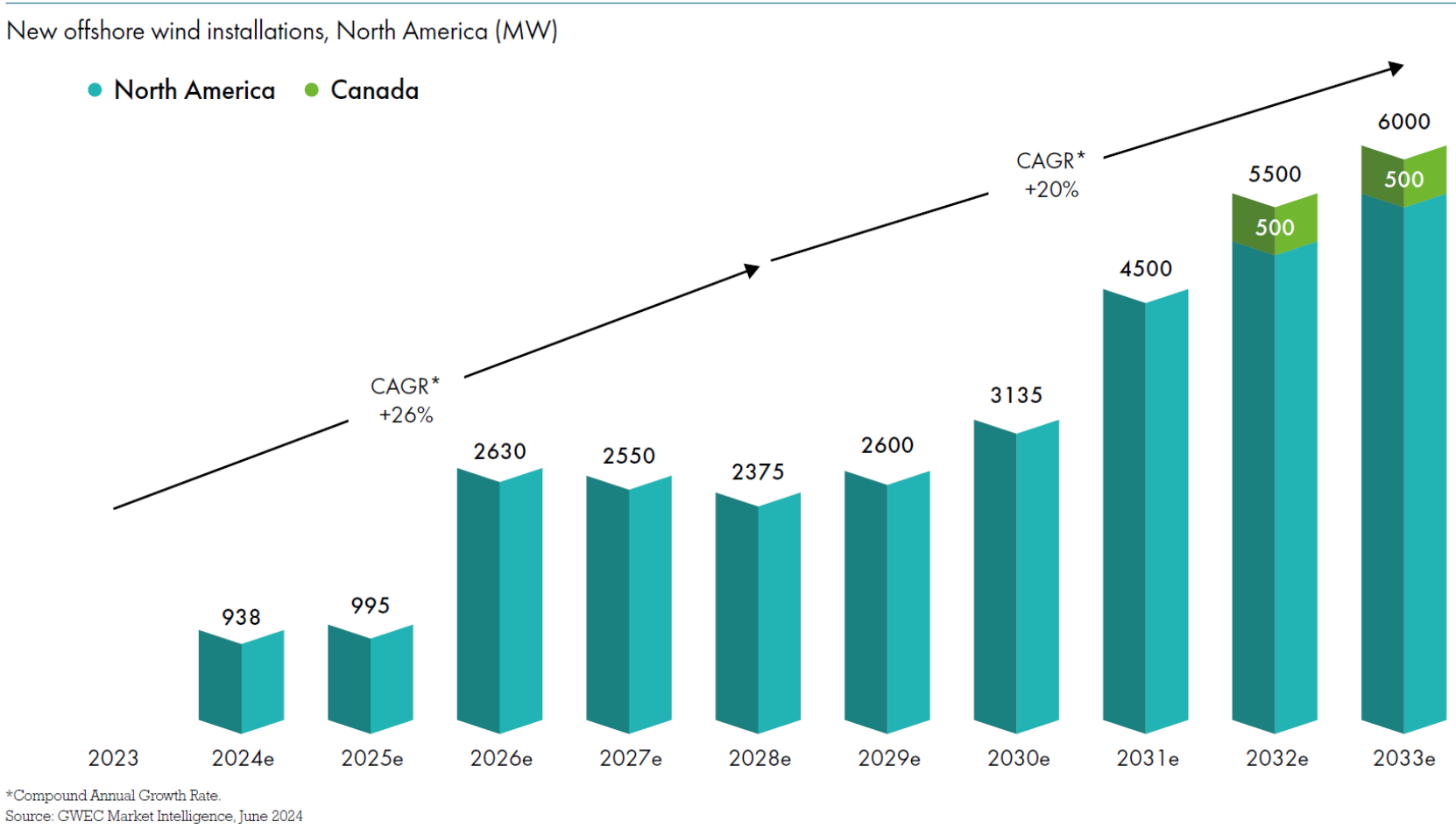
52% of the predicted global offshore wind additions in 2024–2033 will come from the APAC region



*Compound Annual Growth Rate. Source: GWEC Market Intelligence, June 2024

- **APAC's leading position is unlikely to be challenged in the next decade** considering the strong growth expected in China as well as burgeoning new Asian markets.
- **China** will continue to be the largest market in APAC in the near-term, but its market share will drop to 66% in 2033 from 91% in 2024, which is primarily due to expected growth in **South Korea**, **Japan** and **emerging markets** towards the end of the forecast period.

The US offshore wind market is facing the growing pain at present, but state governments and developers remain committed for the moment?



*Compound Annual Growth Rate.
Source: GWEC Market Intelligence, June 2024

- **The US** only had 42 MW of offshore wind capacity in operation by 2023, but four projects with a combined capacity of **4.3 GW** were under construction as of May 2024.
- **2023** was also **a turbulent year** for the US offshore wind industry. 13 fixed-bottom offshore projects off the US east coast, totalling nearly 12 GW, were all affected by such challenges. Of these, **nine projects**, totalling **7.7 GW**, had either had their offtake agreements terminated or had the whole project development ceased by January this year.
- **15 GW** offshore wind is expected to be built by **2030**, making it the **third-largest** offshore wind market worldwide.

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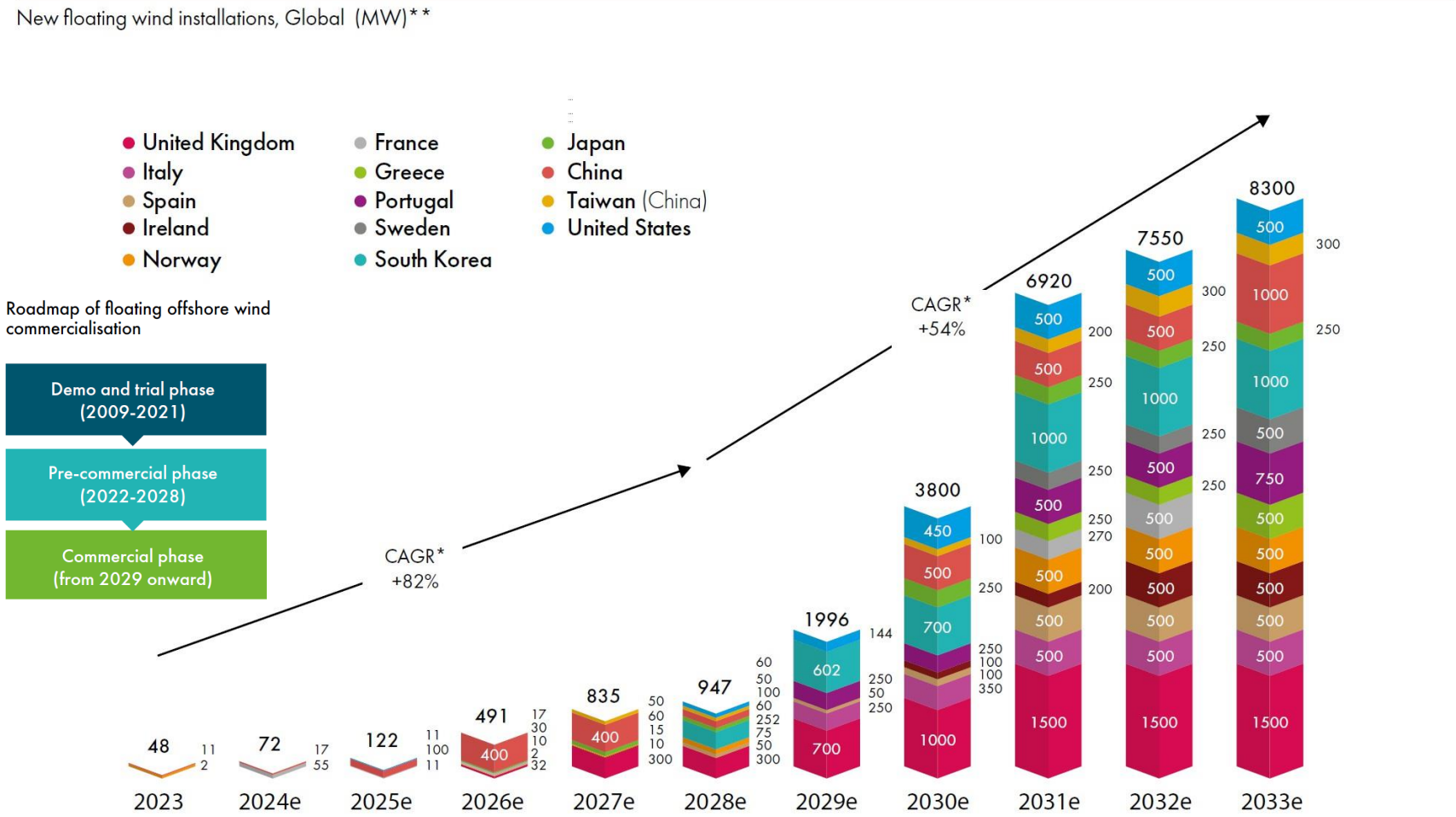
GWEC Market Intelligence predicts floating wind to become fully commercialised towards the end of this decade

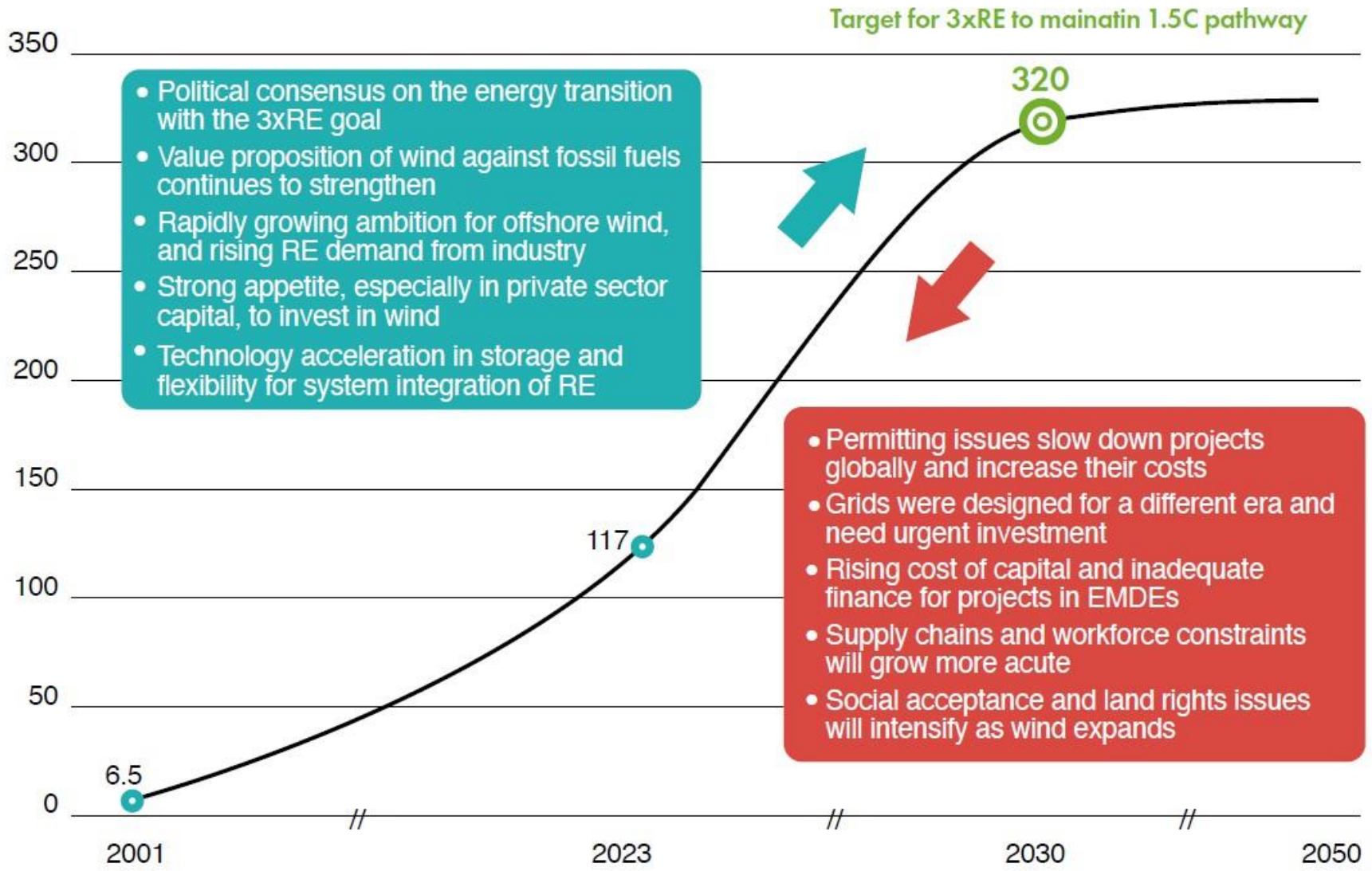


*Compound Annual Growth Rate., **Note: this floating wind outlook is already included in GWEC's global offshore wind forecast.
Source: GWEC Market Intelligence, June 2024

- As the end of 2023, a total of **236 MW** net floating wind was installed globally, of which **88%** is in **Europe** and the rest in Asia.
- GWEC Market Intelligence has **downgraded its global floating wind forecast** and predicts 8.5 GW to be built globally by 2030, 22% lower than the previous year's projection.
- There is a **lack of port infrastructure** that can accommodate foundation manufacturing and assembly.
- **Bottlenecks** in the implementation of floating foundation projects **is likely to occur** if restrictive trade policies and local content requirements come to play.

Global Supply Chain Challenges

Wind energy installations need to triple by 2030, but face competing pressures on growth in this crucial period



Source: GWEC Market Intelligence.

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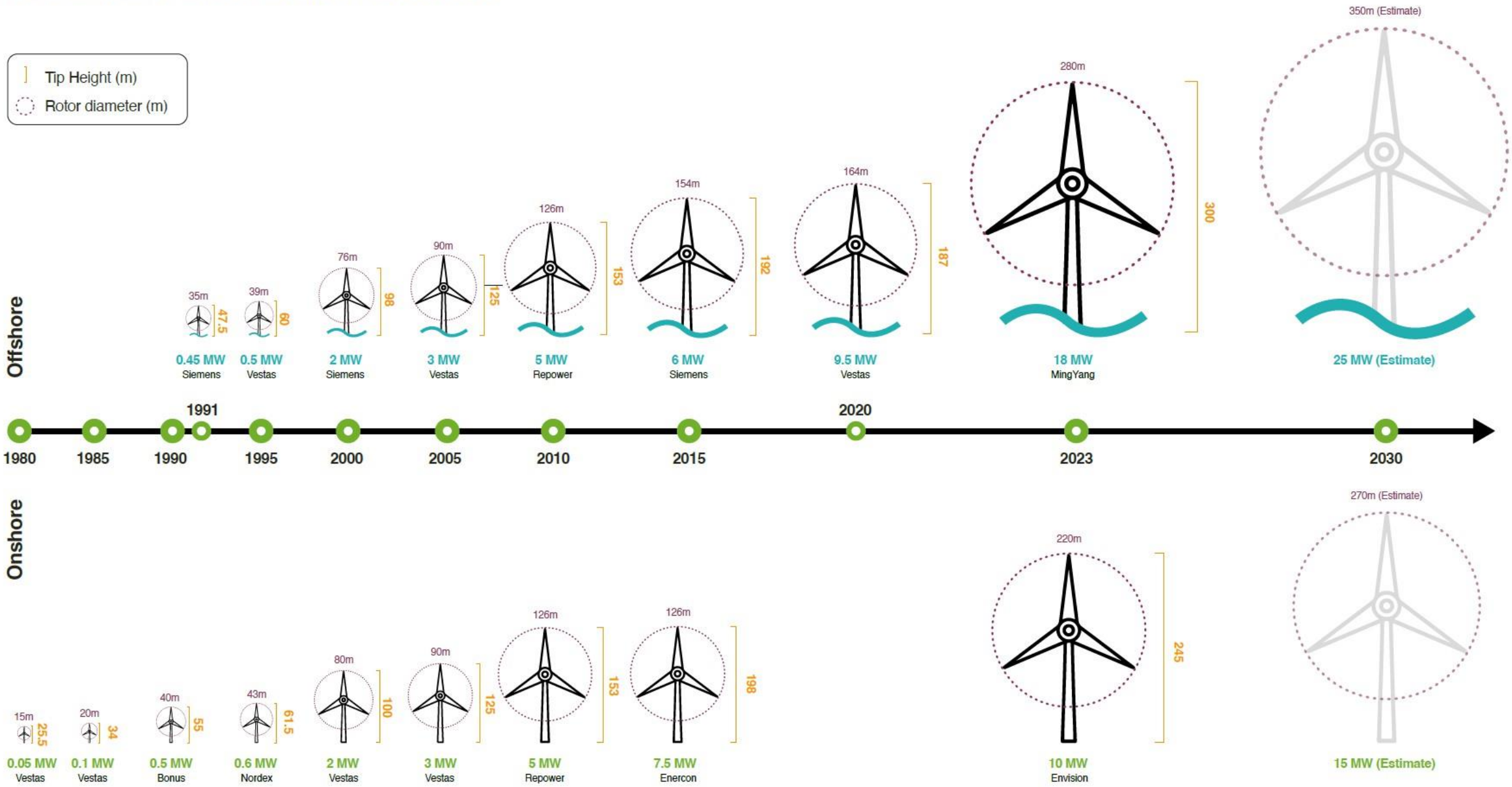
Trend of onshore and offshore turbine size 1980-2030



Building scale and RoI for supply chain investments

2013 - 6MW started. iPhone 5S (8MP – 165m)

2016 - 9.5MW started. iPhone 7SE (12MP - 160m)

2022 - 15MW started. iPhone 13 (12MP – 40m+)

100 units 2.3MW = 230MW
100 units 6MW = 600MW
100 units 9.5MW = 950MW
100 units 15MW = 1.5GW

China volume was mainly serviced by Chinese manufacturers. Vestas, GE, Siemens Gamesa need at least a total of 4.5GW year on year to keep factories fully utilized. Europe installed 3.3GW last year.

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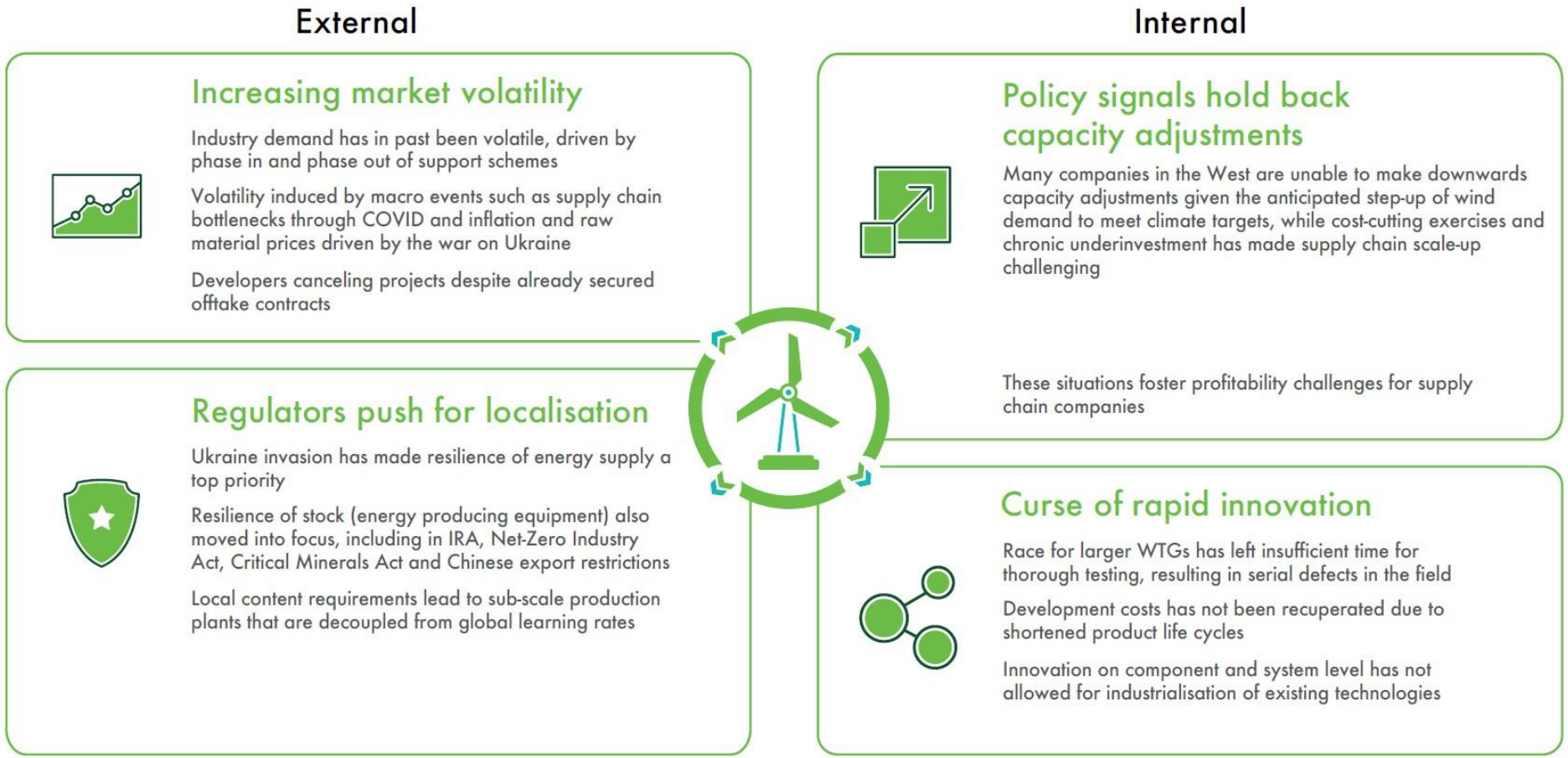
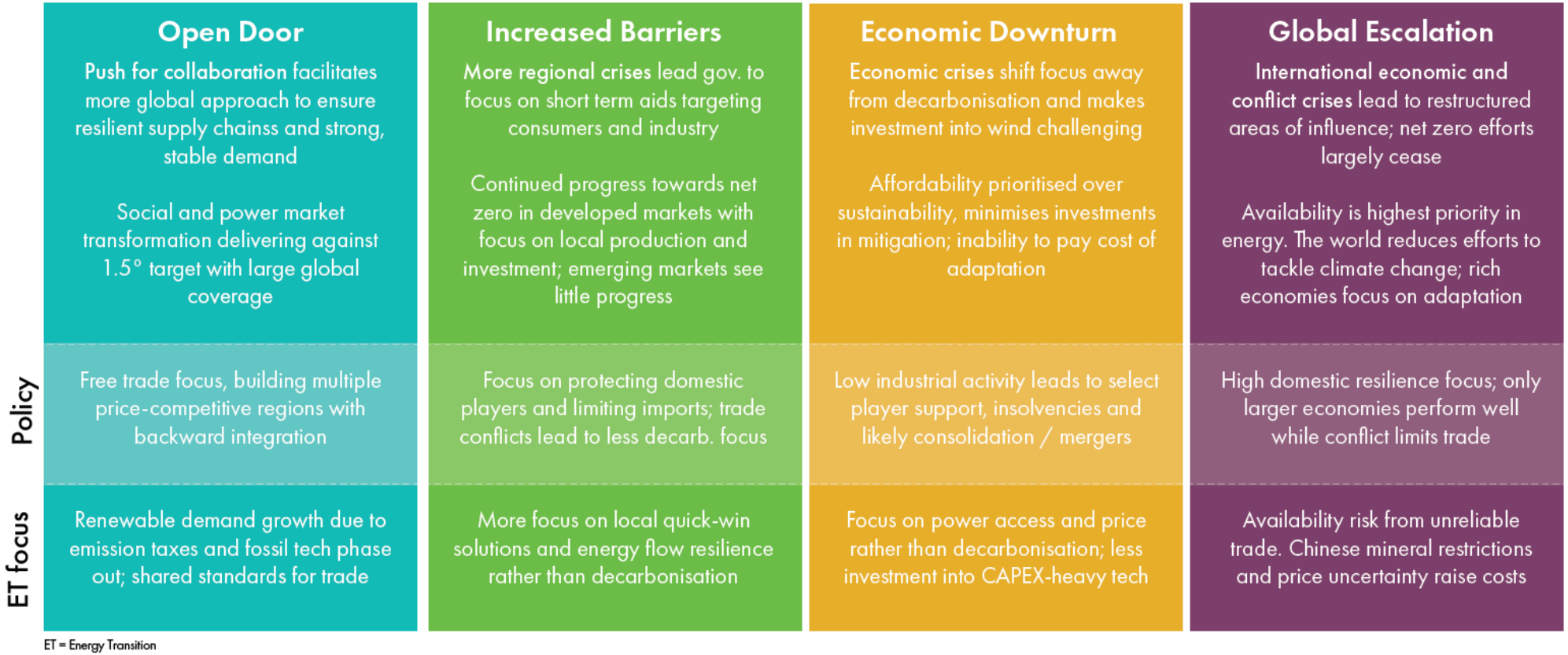
Numerous challenges are impacting the global wind energy supply chain today and leading to underinvestment



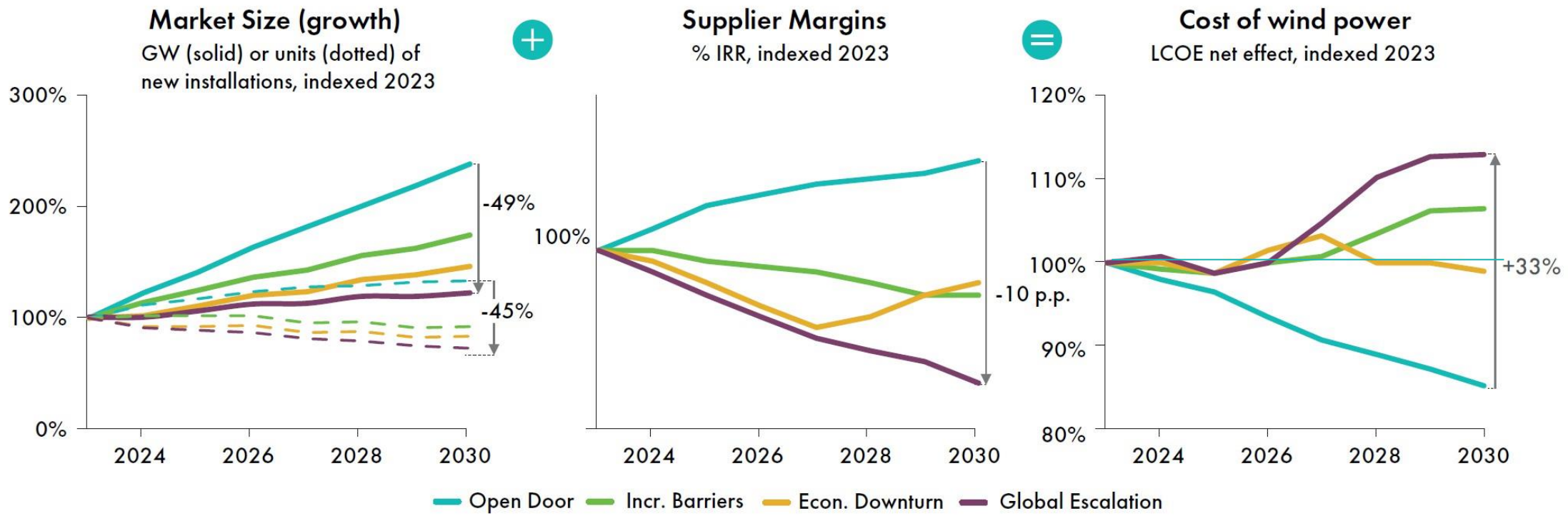
The world is heading towards four plausible futures, each with major wind industry impact



ET = Energy Transition

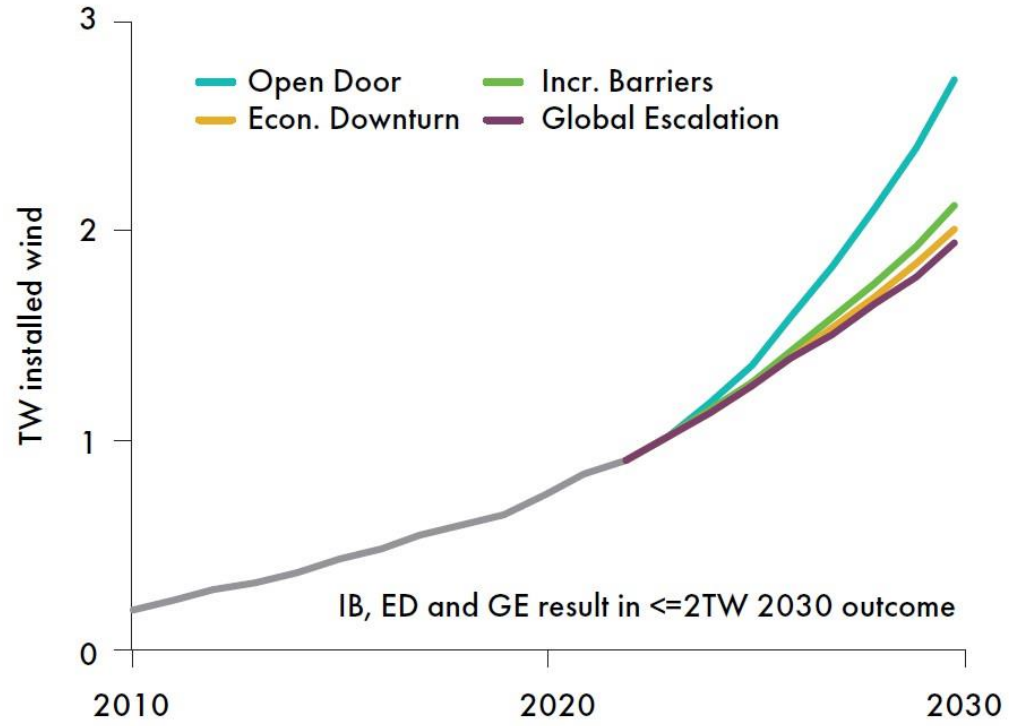
Which future we reach by 2030 has a major impact on wind industry growth, margins and cost

Global developments will impact wind market size, sustainable returns and cost curves



The wind growth outlook towards 2030 is falling short of net zero – supply chains must scale up

Only the Open Door scenario is sufficient for net zero; the Increased Barriers scenario is most likely to materialise and falls 650 GW short



Note: Interpolated 2024-2030 forecasts, assuming higher demand can have impact on installations from 2025 onwards.
Source: GWEC, IEA Net Zero scenario (released September 2023), BCG analysis

- Global wind capacity must scale from current 1 TW to at least 2.75 TW by 2030 to put us on 1.5°C pathway
- An **Open Door** Scenario offers stronger margins, lower LCOE and is the only way to feasibly meet a net zero pathway
- An **Increased Barriers** scenario is most likely to materialise, with a greater focus on domestic industrial resilience and localisation, falling 650 GW of net zero

APAC Offshore Wind Supply Chain

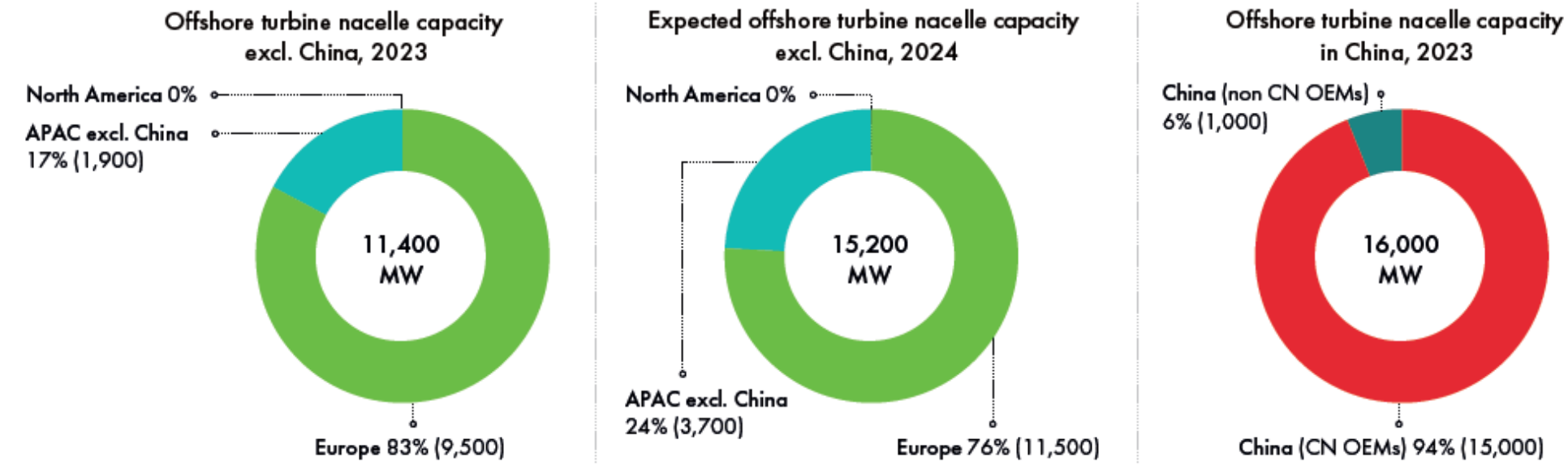
. Offshore wind nacelle

. Offshore wind installation vessels

. Offshore wind ports

Will there be enough offshore wind nacelle production capacity to feed the predicted growth?

Offshore wind demand and supply benchmark, 2023–2030 (MW)



	Demand vs supply analysis 2023-2030 (MW)							
	2023e	2024e	2025e	2026e	2027e	2028e	2029e	2030e
Europe	5148	2916	6527	9598	10808	16225	20465	26400
China	8000	12000	14000	15000	15000	15000	15000	15000
APAC excl. China	1769	1559	2894	2695	3256	5030	5535	6995
North America	533	955	2335	3535	4500	4500	4500	4500
LATAM	0	0	0	0	0	0	0	1350
Global	15450	17430	25746	30828	33564	40755	45500	54245

Source: GWEC Market Intelligence, September 2023

● Sufficient ● Potential bottleneck

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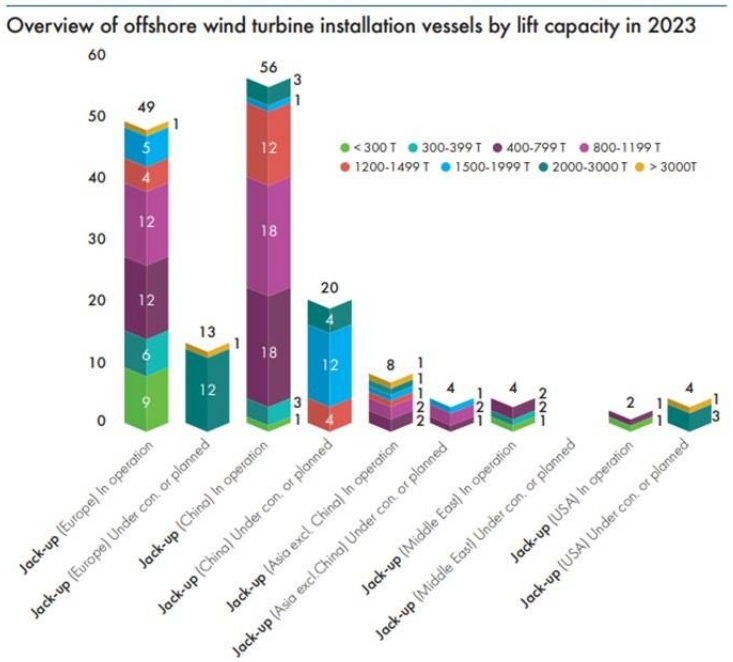
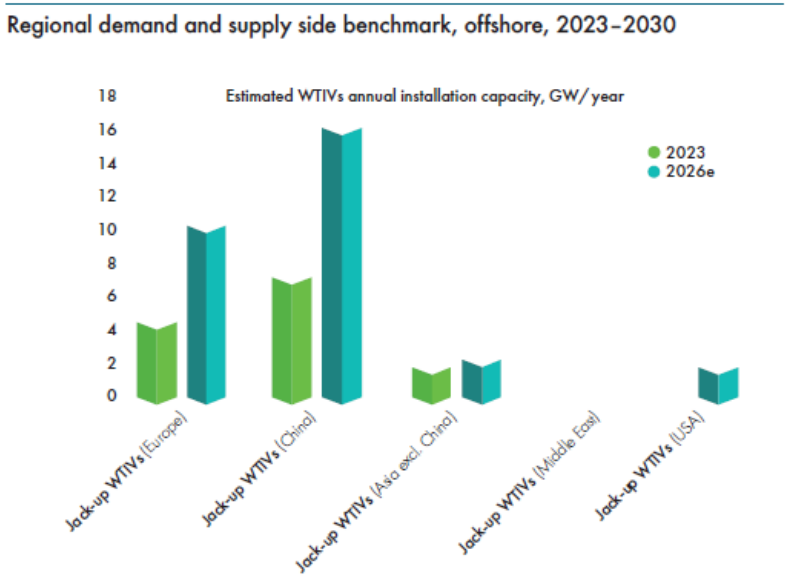
A likely shortage of vessels in all regions excluding China





	Offshore units (floating)								
	2022	2023e	2024e	2025e	2026e	2027e	2028e	2029e	2030e
North America	0	533	955	2335	3535	4500	4500	4500	4500
Latin America	0	0	0	0	0	0	0	0	1350
Europe	2460	5148	2916	6527	9598	10808	16225	20465	26400
Africa & ME	0	0	0	0	0	0	0	0	0
India	0	0	0	0	20	0	500	500	1000
China	5052	8000	12000	14000	15000	15000	15000	15000	15000
Other APAC	1259	1769	1559	2884	2675	3256	4530	5035	5995
Total	8771	15450	17430	26746	30828	33564	40755	45500	54245

Source: GWEC Market Intelligence Global Offshore Wind Turbine Installation Vessel Database, September 2023

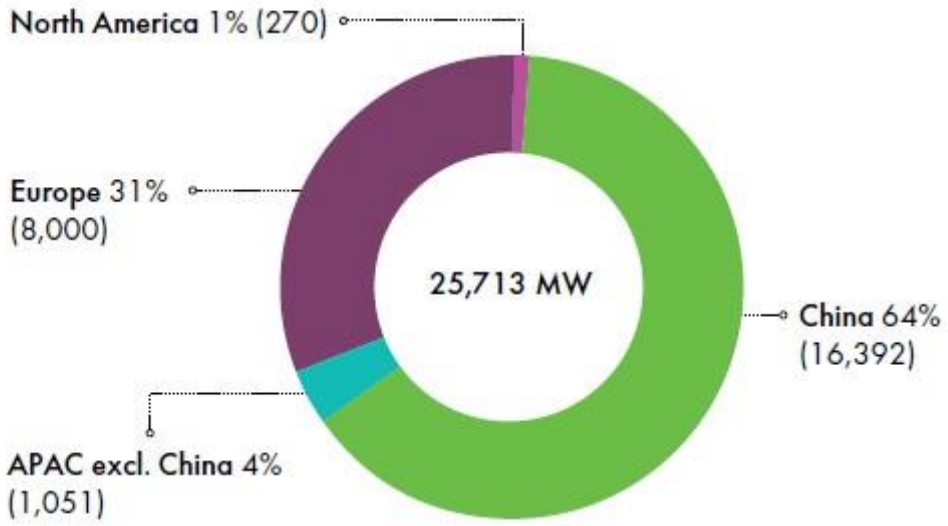
● Sufficient ● Potential bottleneck

- Globally, no shortage of WTIVs is expected up until 2026.
- A likely shortage in **Europe** towards the end of this decade means offshore wind markets in **APAC** that are heavily relying on European vessels will need to seek regional cooperation to ensure their offshore wind deployment won't get delayed.
- In **the US**, where only one tailor-made Jones Act compliant WTIV is currently under construction (with one year delay expected), plans for new WTIVs will have to be immediately executed to avoid bottlenecks.

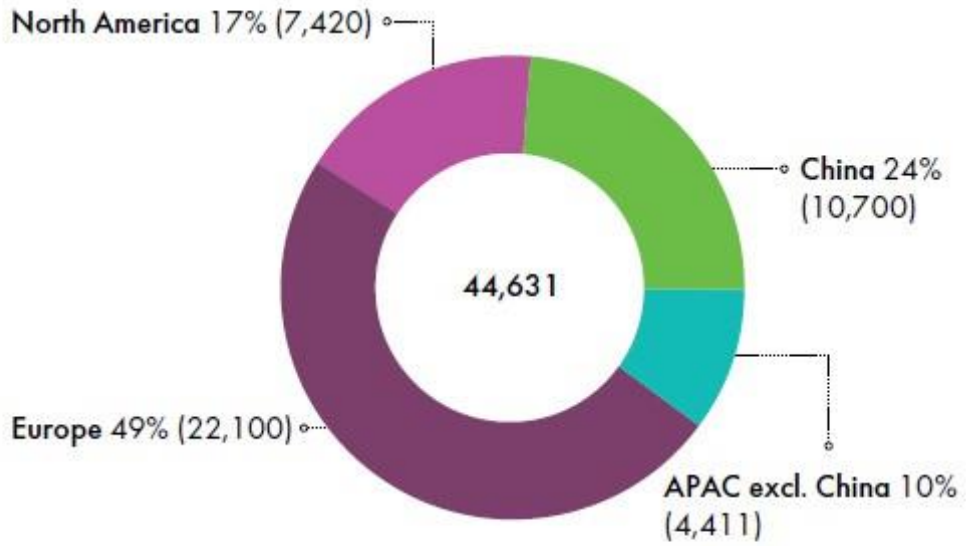
Offshore ports are currently under investment to accommodate the growth

Demand and supply side benchmark for ports, 2023–2030

Estimated operational port capacity available in 2023 (MW/year)



Planned port capacity to support offshore wind (MW/year)



	2022	2023e	2024e	2025e	2026e	2027e	2028e	2029e	2030e
North America	0	533	955	2335	3535	4500	4500	4500	4500
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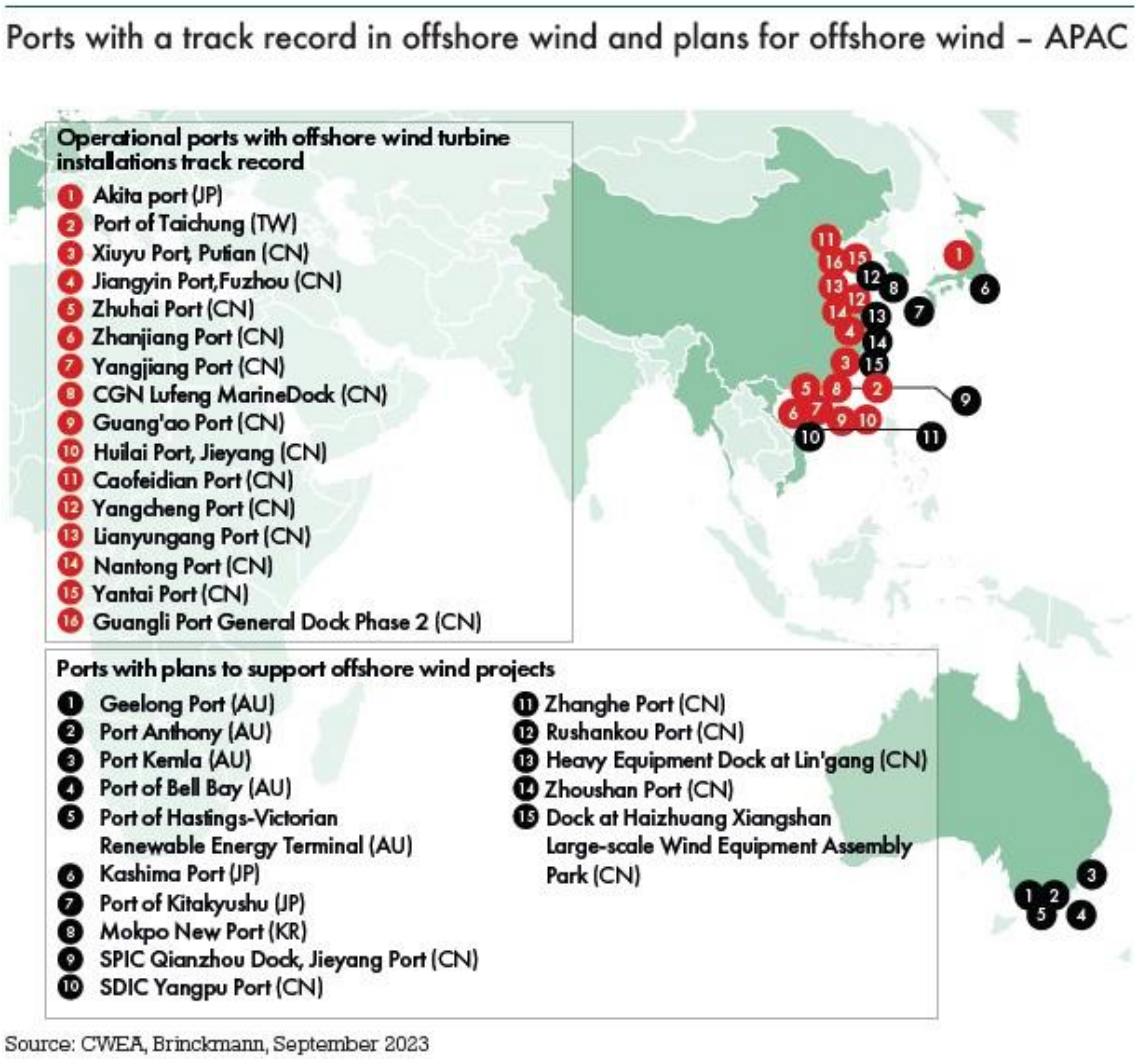
Total	8771	15450	17430	25746	30828	33564	40755	45500	54245

Source: GWEC Market Intelligence, CWEA, Brinckmann, September 2023

● Sufficient ● Potential bottleneck

Offshore ports are currently under investment in APAC



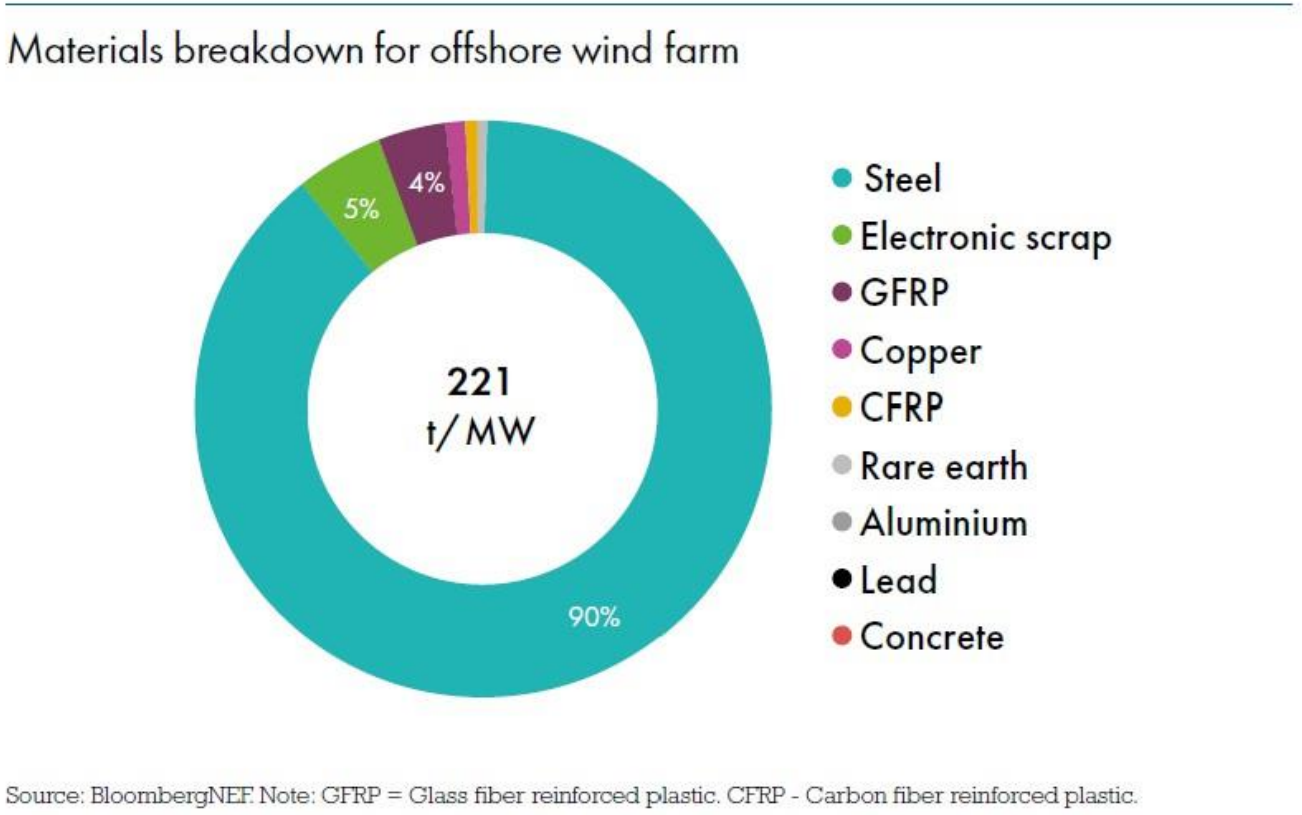
Source: CWEA, Brinckmann, September 2023

- In **Europe**, while the current operational port capacity is well-positioned to cover demand in the near term (2023–2025), more port capacity will be needed from 2026 to avoid bottlenecks.
- In the **APAC region** excluding China, simultaneous construction of utility-scale offshore wind projects is expected for the first time in 2023 in Japan, South Korea and Chinese Taiwan. This is likely to stretch the existing port facilities beyond their ability to cover demand during the forecast period, unless new port capacity is built and released to support the offshore wind growth.
- Only one purpose-built offshore wind port is available in **the US** at present, located on the east coast. It is imperative to bring new port capacity online to fill the gap.

Other offshore specific challenges

Increase in material costs

- 90% of offshore wind turbine is steel. Last two years, steel prices have increased by 50% from the start of 2020 to the end of 2021, and are being further impacted because of the invasion of Ukraine.
- The offshore wind industry also depends on copper for cabling and electrics, yet is having to manage price increases of 60%.
- Prices for neodymium and dysprosium, the two key rare earth elements (REEs) for direct drive and hybrid drive wind turbines, have tripled in price over the same period.



Source: BloombergNEF. Note: GFRP = Glass fiber reinforced plastic. CFRP - Carbon fiber reinforced plastic.

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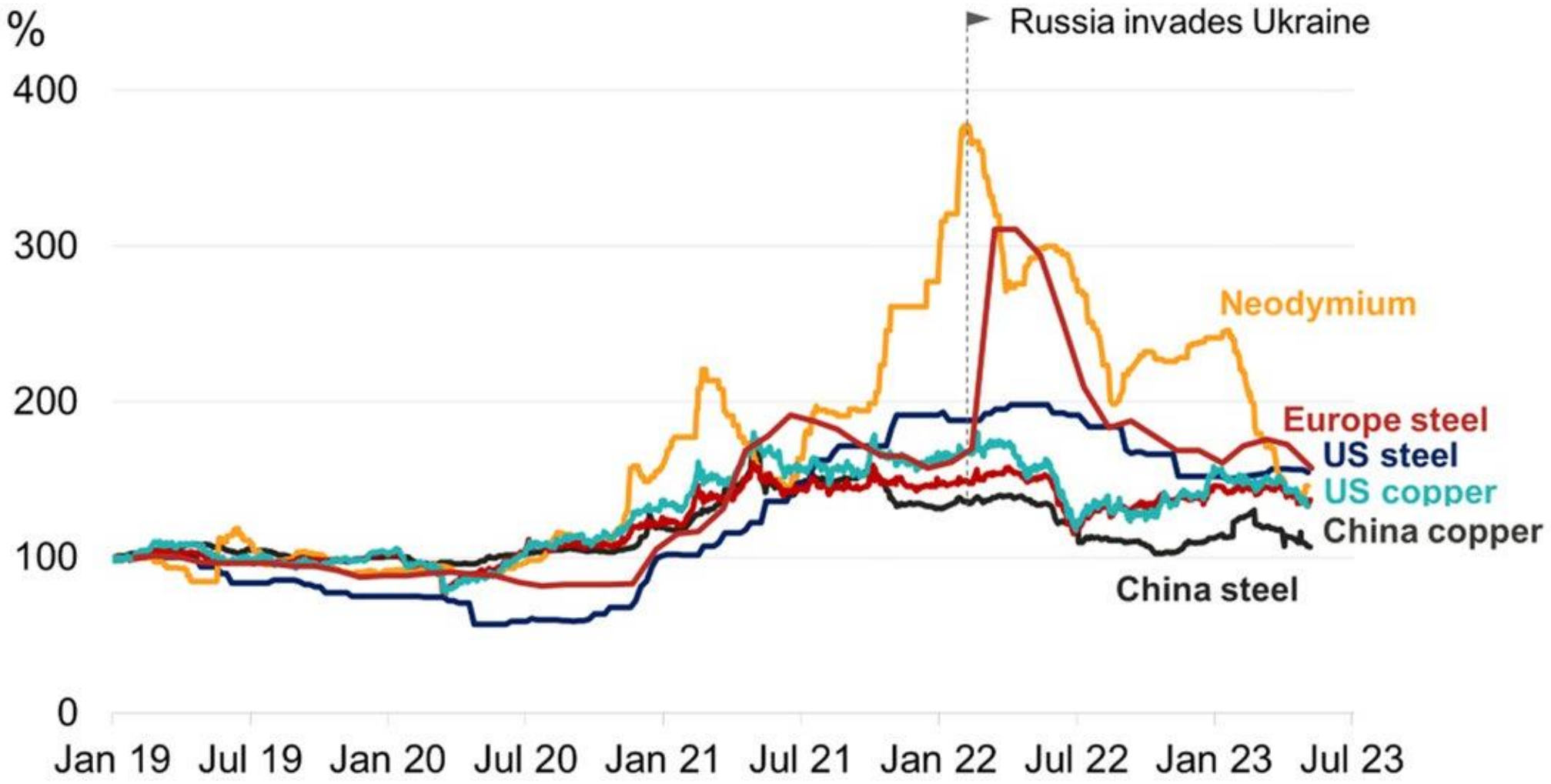
Materials prices remain elevated vs pre pandemic but have come down from their peak



Source: Bloomberg, 2023

Increase in logistical costs

- Delivery timescales of some key components to increase from five weeks to 50 weeks
- Freight costs have also risen: Spot rates for a 40-foot ocean freight container from Asia to the US reached a record-high – 10 times higher than rates just a few years ago.
- Turbine prices for future projects are forecast to rise by 9% in the second half of 2021.
- Very challenging for wind energy to continue to compete for razor-thin margins in tenders and procurement schemes
- Impacting the industry's ability to invest in supply chain growth and innovation.

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Local content, Ports and Vessels

- In many markets, increased scale has led to increase demands on inbound investment.
- In growing markets like South Korea, Japan, Taiwan and Vietnam there are differing expectations on local content.
- Offshore Wind requires very specific port infrastructure and investment is needed now
- Installers also need to invest in new vessels and equipment to successfully install larger turbines. Vessel capacity could be a potential barrier in the future.

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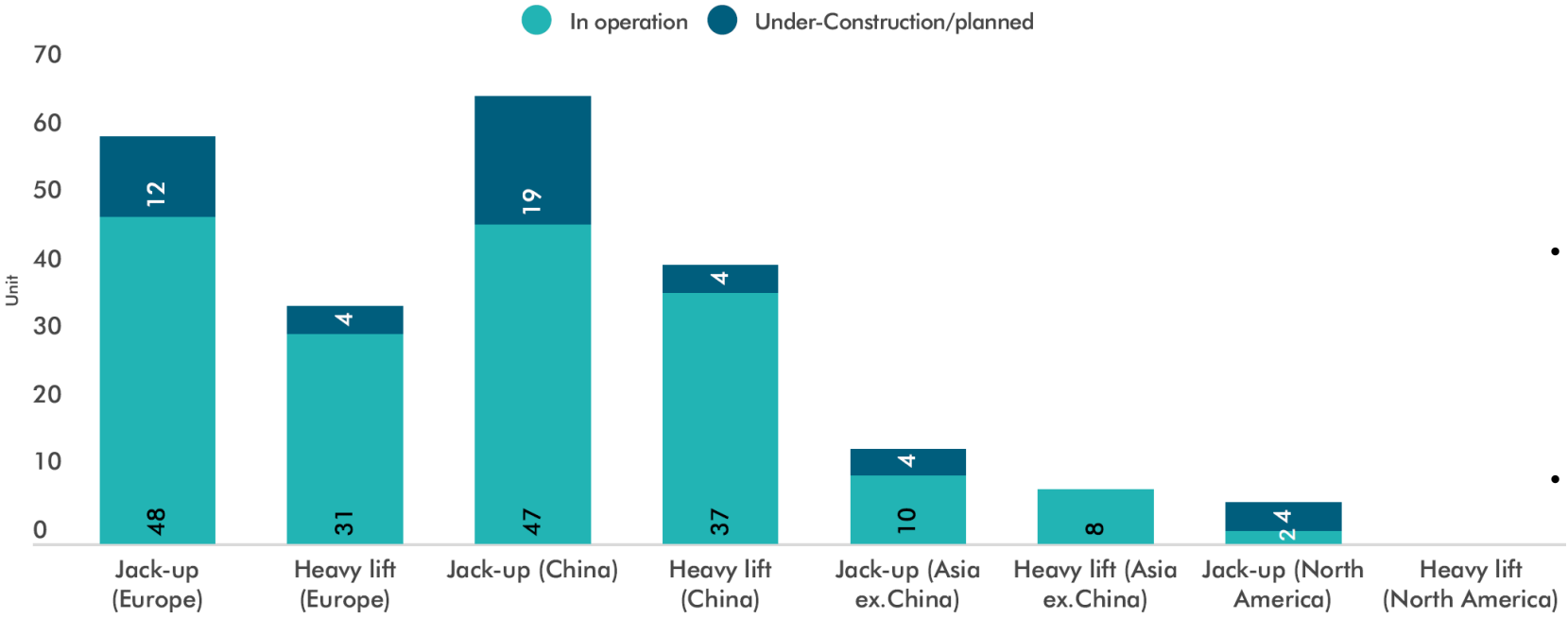
New investment in WTIVs is much Needed to Ensure Delivery



Source: GWEC Market Intelligence, October 2022

- Globally speaking, **no bottleneck is expected for WTIV vessels in the next five years** (2022-2026).
- In Europe, the current WTIV supply chain can copy the demand as the annual offshore wind installations is relatively flat and unlikely to reaching 10 GW milestone until 2026, which explains why European operators can release their jack-up and heavy lift vessels in the next two years to support the demand from emerging markets in Asia, mainly Taiwan and Japan, and USA.
- Looking at the supply chain situation in the period of 2027-2031, however, **a bottleneck is likely to occur from the end of this decade in Europe** unless investment in new WTIVs will be made before 2027 (assuming 3 years lead time).
- In **United States**, currently only two tailor-made WTIVs are under construction, to avoid bottlenecks, WTIVs currently under the planning stage has to be executed in the next 2-3 years in order to copy Biden Administration's 30 GW offshore wind by 2030 target. To reach the target, 4-5 WTIVs and 4-5 Heavy Lift vessels will be required according latest NREL study.

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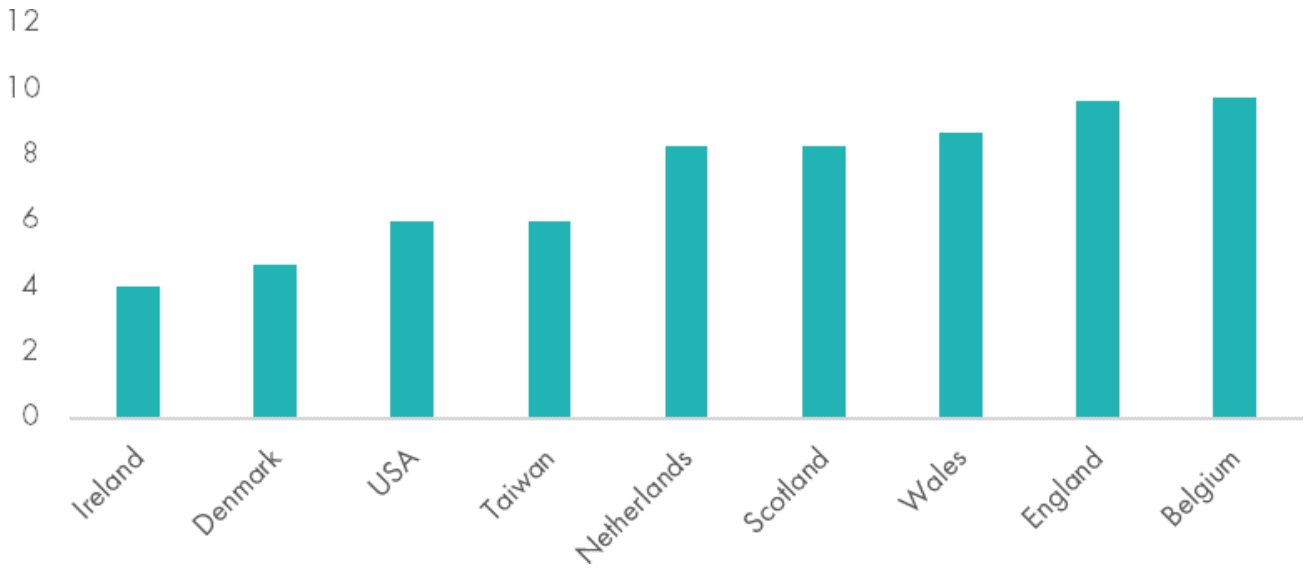
Streamlining permitting is a necessity

Average years of offshore wind lease award to full commissioning



Source: RenewableUK; GWEC Market Intelligence

- **Average of 9 years** from award of offshore wind lease to full commissioning (ranges from 4-15 years across markets)
- There is a global need to create more efficient and streamlined processes – the main bottleneck to growth is time
- Simplifying permitting can enable greater **investor certainty** and larger market volumes, which in turn supports **healthier competition in auctions** and more **sustainable development of supply chains**

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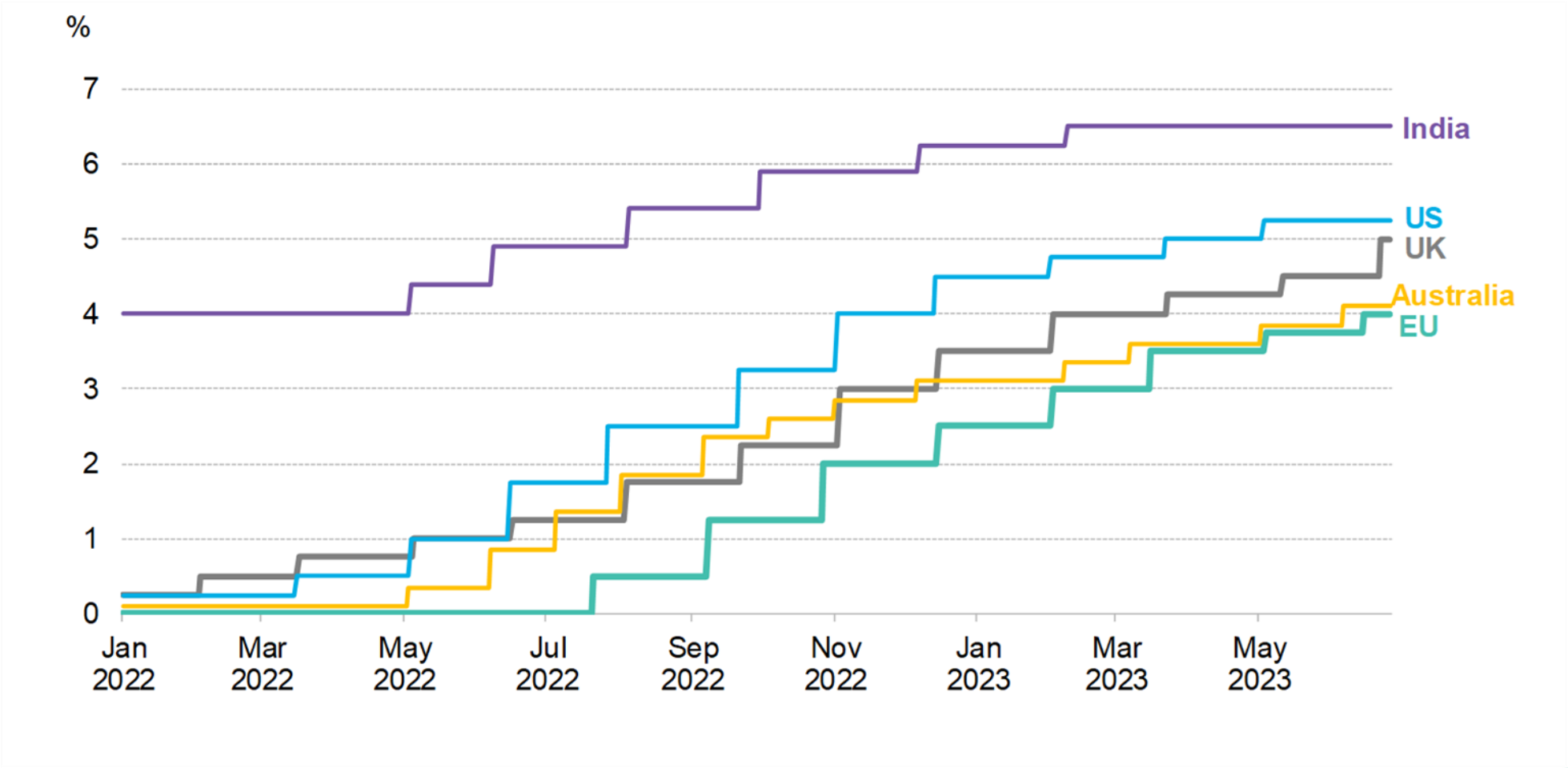
Rising interest rates are also raising costs across the value chain

Central bank interest rates



Source: Bloomberg, 2023

A turning point for offshore wind

- **Policymakers are forging ahead with new legislation, regulation, investment strategies, and international alliances (like GOWA)** to spur renewables
- **New initiatives like Ocean Energy Pathway (OEP)** are being created to accelerate offshore wind globally
- In this competitive environment, markets need **attractive policies to attract investment**
- To secure next stage of global growth, industry **needs ambitious + stable policy couple** coupled with **adequate market pricing**
- **Restrictive trade and investment policies may increase cost** and may risk delaying the global energy transition

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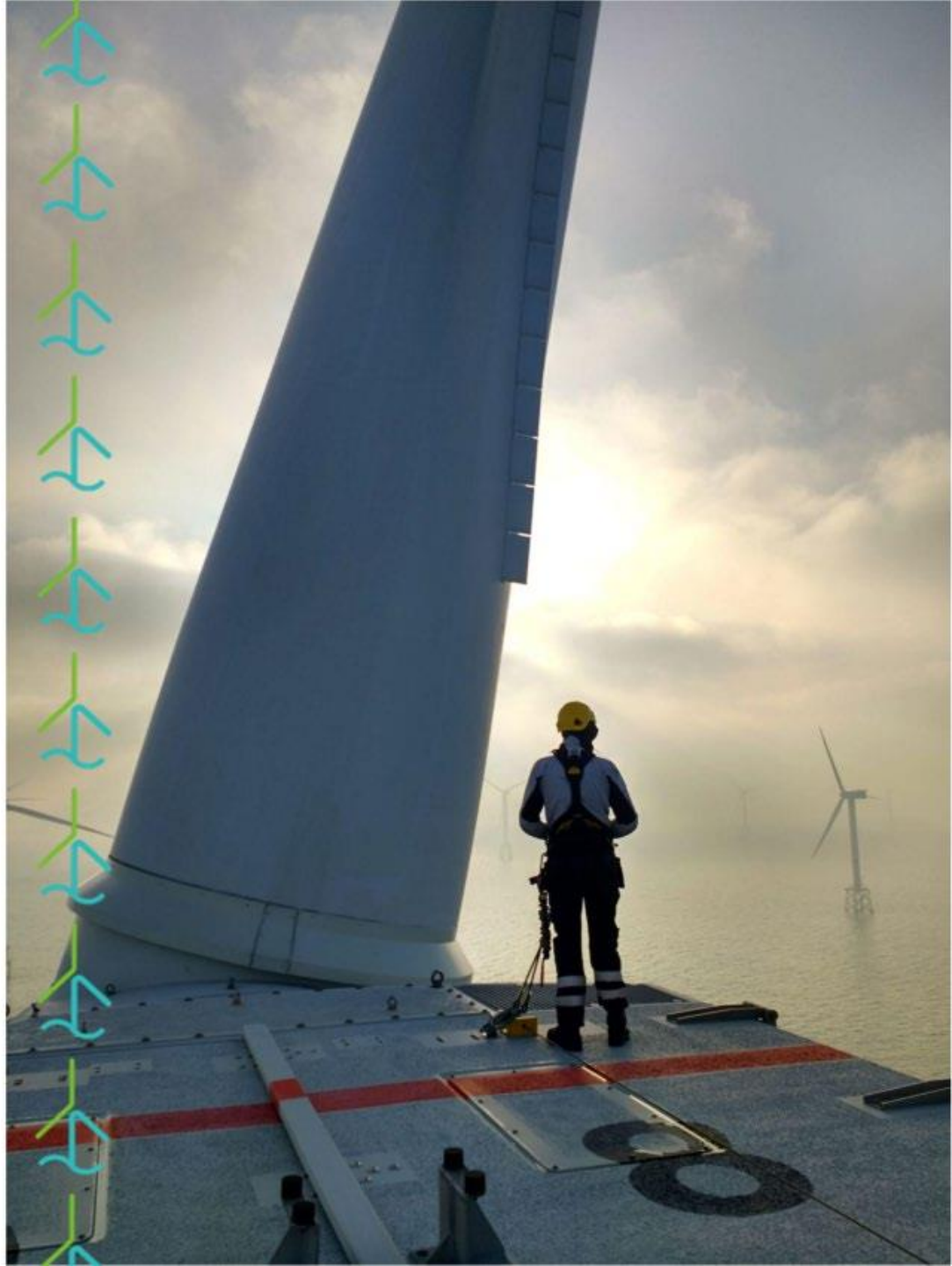

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Successful development in emerging markets

Strategy

What makes for a successful offshore wind strategy?

Clear role for offshore wind in country's energy mix

Clear role in economic development plans

Focus on reduced risk to attract foreign investment

Policy

What policies are needed to make this strategy a reality?

Long term, stable targets

Strong supply chain development plans

Policies to ensure meaningful stakeholder engagement

Policies to drive competition and reduce costs

Frameworks

What frameworks are needed to enact policies?

Marine Spatial Planning

Clear leasing process

Clear permitting process

Bankable offtake agreements

Grid integration planning

Strong H&S framework

Delivery

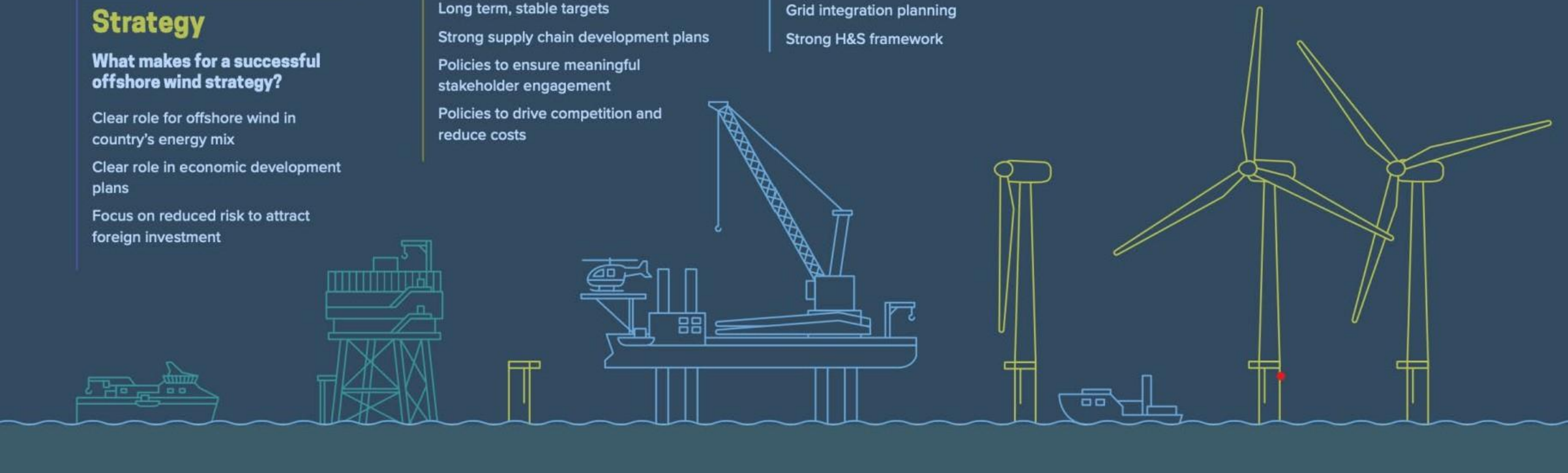
What enabling elements are needed to deliver?

Sector partnership with industry

Skills development programs

Proactive development of ports, grids and logistics

Continual focus on lowering risk and attracting low cost finance



The role of seabed leasing for offshore wind

- In offshore wind, the conversation must also extend to leasing processes. At present we do not see volumes of seabed release aligning with offshore wind targets.

- This is creating artificial constraints in the market, raising costs, which ultimately will be borne by consumers.

Examples of rental fees (not including other fees) for offshore wind leases

Country	Public agency	Project phase/element	Rental	Units
England and Wales	The Crown Estate	Operation	2%	Of gross revenue[41]
Netherlands	The Central Government Real Estate Agency	Operation	€0.98 (US$1.15)	Per MWh[42]
		Construction	€650 (US$763)	Per MW per year
		Array cables	€3.29 (US$3.86)	Per m^2 (single, one-off payment)
Scotland	Crown Estate Scotland	Operation	£1.07 (US$1.48)	Per MWh[43]
United States	Bureau of Ocean Energy Management	Construction	US$3.00	Per acre per year
		Operation	2%	Of gross revenue
		Export cable	US$70.00	Per mile

Some best practices in leasing

Leasing should cover both **Territorial Waters** and **Exclusive Economic Zone** to maximise opportunities in each country.

Marine spatial planning (MSP) should be used to identify large sea areas. A pragmatic and proportional approach can be utilised.

Leasing processes should be robust and transparent, to reduce the possibilities of legal challenges.

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Tendering should commence with a **prequalification questionnaire (PQQ)** stage to ensure tenderers have the capability to deliver on projects.,

Leasing should be **kept simple** and **encourage the pace of** development while maintaining flexibility in the light of unforeseen obstacles**.**

Sharing of **survey data into the public domain,** which allows other sea users to become informed. completed.

Depositing health and safety (H&S) data into an **industry accepted system** allows improved H&S management for the good of all.

Regular release of seabed, for example every 2-4 years, to give a steady flow of projects.

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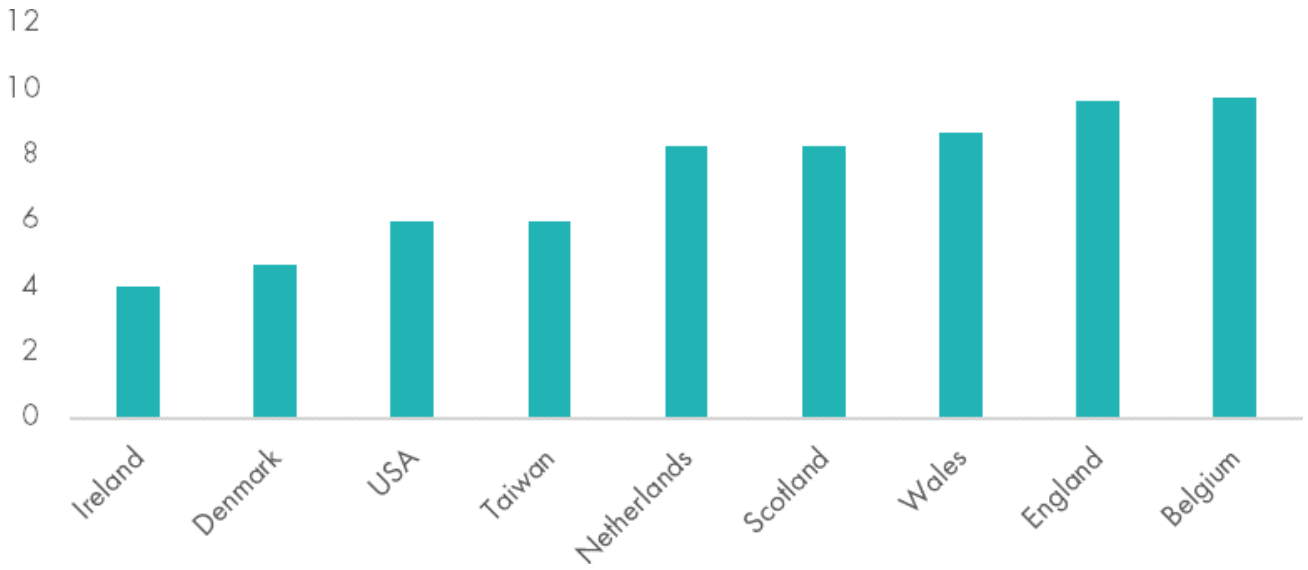
Streamlining permitting is a necessity

Average years of offshore wind lease award to full commissioning



Source: RenewableUK; GWEC Market Intelligence

- **Average of 9 years** from award of offshore wind lease to full commissioning (ranges from 4-15 years across markets)
- There is a global need to create more efficient and streamlined processes – the main bottleneck to growth is time
- Simplifying permitting can enable greater **investor certainty** and larger market volumes, which in turn supports **healthier competition in auctions** and more **sustainable development of supply chains**

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Actions to streamline permitting

maximum lead times to permit wind plants. From three to 1.5 years

Dedicate **centralised authorities and single focal points** to work with renewable developers

Invest in more staff and digital resources for the various authorities.

Build **digitised, searchable and up-to-date databases** for land registrations and siting of renewable energy projects,

Align land and ocean use guidance at national and sub-national level, include designation of **promotional "go-to" zones.**

Promote **active dialogues between local authorities, communities and industry** for shared understanding of priorities.

Implement an **emergency clearing house mechanism** for legal disputes to prevent extended delays to critical infrastructure projects,.

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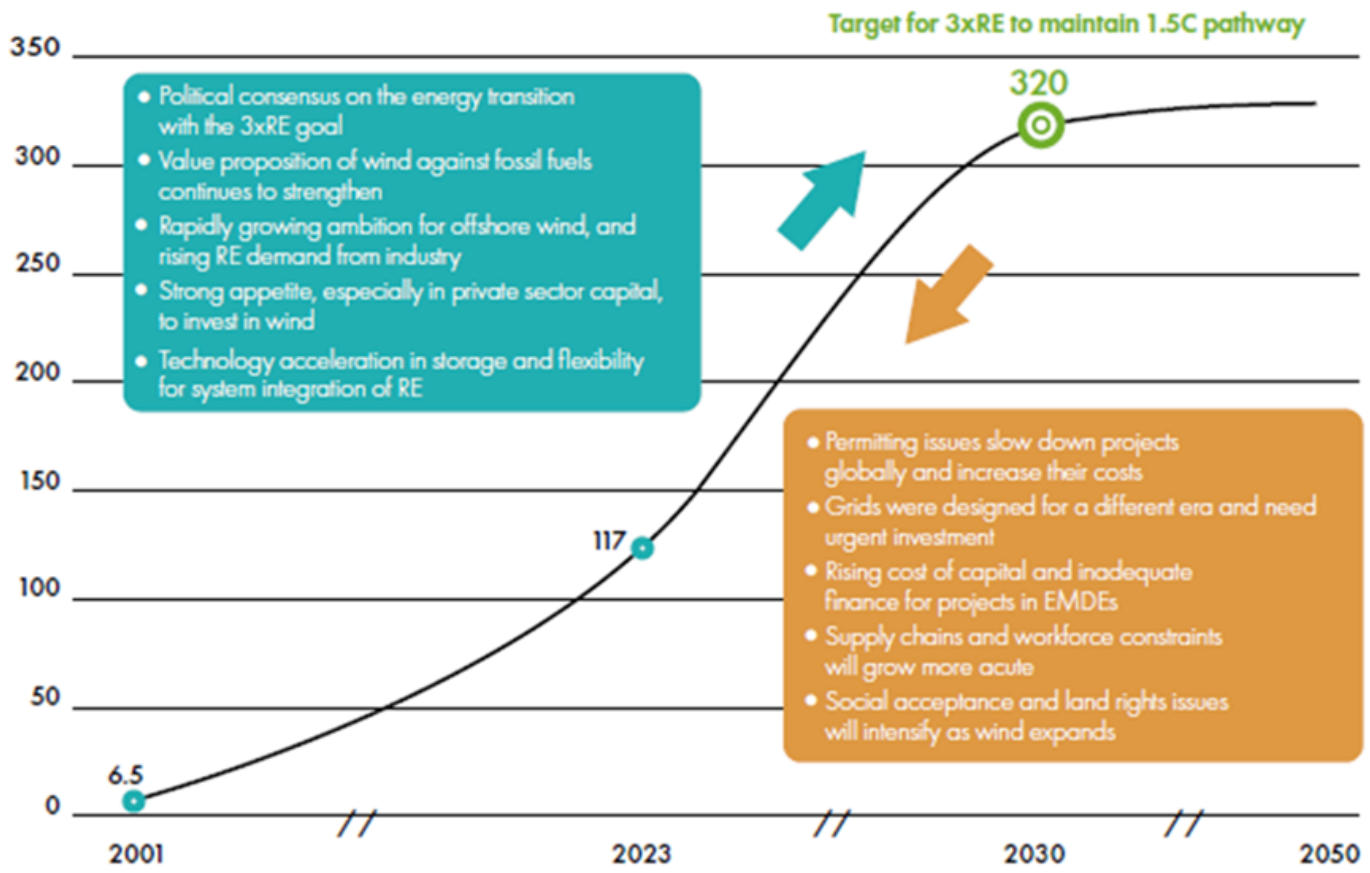
Competing pressures on wind growth to meet 3xRE

Wind energy installations need to triple by 2030, but face competing pressures on growth in this crucial period



Source: GWEC Market Intelligence.

- The road to reaching 11,000 GW of installed renewable energy capacity by 2030 is steep and lined with challenges.
- Global wind growth needs to rapidly accelerate, with **annual wind installations roughly tripling to at least 320 GW** over the course of the decade to get on-track for a 1.5C pathway.
- Wind has achieved steady growth over the last two decades, and record growth in 2023. But the industry faces competing pressures to ascend the growth curve in this decade required for 3xRE.

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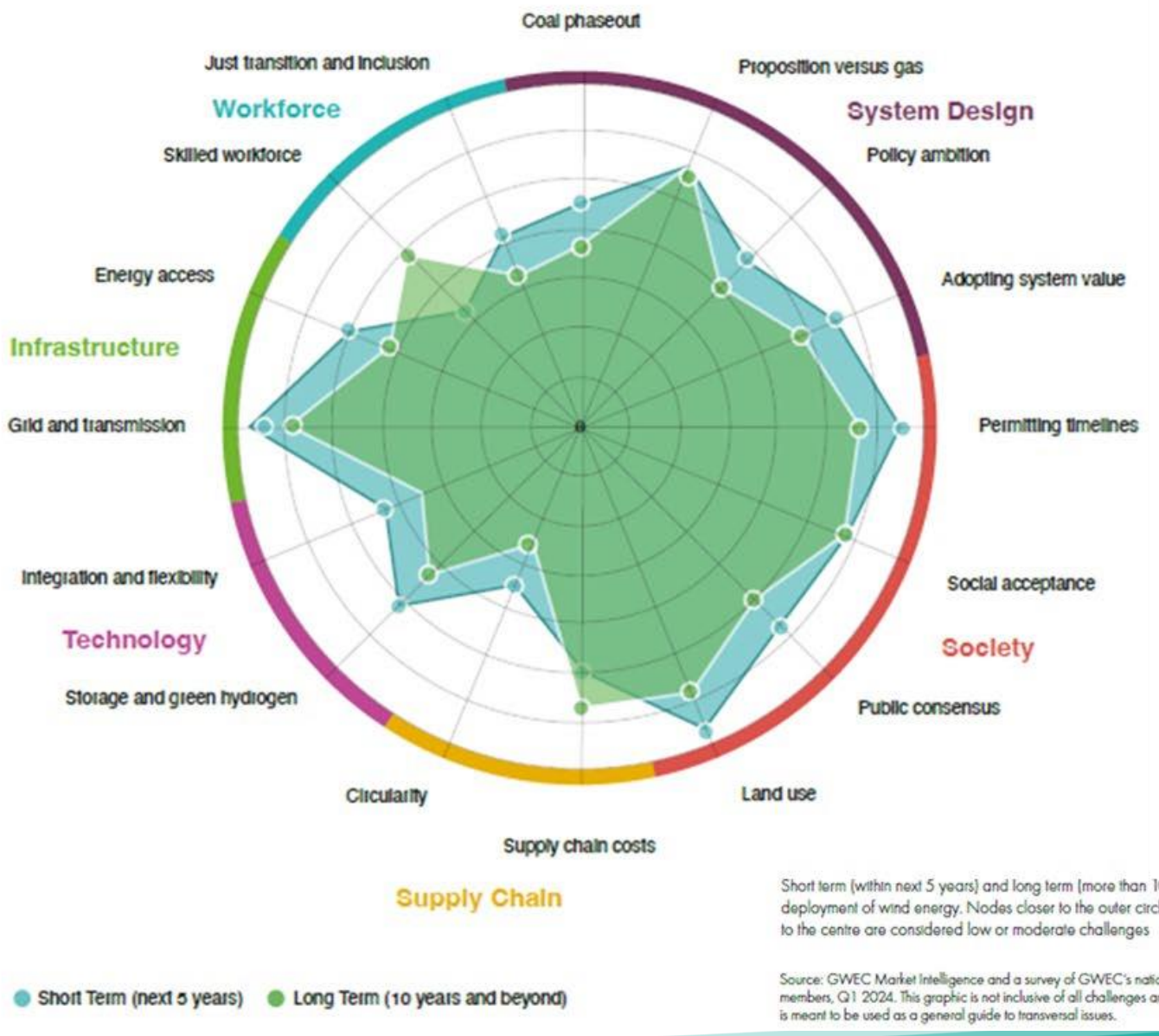
Overview

- GWR 2024 examines four areas – investment, supply chains, system infrastructure and public consensus – critical for setting the conditions for wind growth and for meaningful engagement to mitigate the risks of an unstable and disorderly transition.
- Addresses issues of the current technological era, including the rapid innovation cycle of the supply chain, disinformation, automation and AI , and a digitalisation gap between Global North and South.
- Each section includes a list of recommendations on improving the conditions for wind growth. Common thread is more robust collaboration needed between industry, policymakers, investors and communities.
- Markets to Watch has expanded to include: Australia, Azerbaijan, Brazil, China, Egypt, India, Japan, Kenya, Korea, The Philippines, Saudi Arabia, the US, Vietnam.
- Peer reviewed by colleagues at IRENA, SSE, Vestas, Electricity Sector Association of Kenya.

THEME: What is wind energy's role in meeting the global goal to triple renewable energy capacity by 2030?

Long term challenges easing, short term challenges more acute



Short term (within next 5 years) and long term (more than 10 years ahead) challenges which could slow down deployment of wind energy. Nodes closer to the outer circle are considered more severe challenges, while nodes closer to the centre are considered low or moderate challenges

Source: GWEC Market Intelligence and a survey of GWEC's national and regional wind and renewable energy industry association members, Q1 2024. This graphic is not inclusive of all challenges and factors impacting the growth of wind energy in different markets, and is meant to be used as a general guide to transversal issues.

- A 2024 survey of GWEC's wind and renewable industry associations found more optimism on the long-term opportunities for wind energy growth, but short-term challenges.
- The exception is in supply chain and workforce bottlenecks, which are perceived to grow as a challenge over time.
- Challenges in the next 5 years are concentrated on grid and transmission, permitting timelines and land rights issues.

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Key takeaways from the report

Investing in wind energy for 3xRE	• Meaningful action is needed to **mobilise larger volumes of investment** into wind energy, including enhancing public-private partnerships for investment in EMDEs • Growth at scale comes with stable and ambitious policy environments that offer **reasonable returns on investment**
Building the supply chain for 3xRE	• **Collaborate** to build a secure global supply chain with healthy, managed competition • Trade policy should foster **competitive industries**, not push higher costs onto end-users • **New production models** are needed to industrialise and decelerate the turbine platform race on size • Ensure the advantages of **AI and machine learning** outweigh the drawbacks
Generating the grid and system infrastructure for 3xRE	• **Close the gap on grids** by making grids a national cross-cutting policy priority, requiring clear targets for grid investment and system flexibility, anticipatory funding, and public support for grid expansion • **Scale modern and flexible power systems** with storage, demand-side response and other flexibility solutions
Fostering public support in wind energy for 3xRE	• **Action to accelerate permitting of wind projects,** including greater cooperation among policymakers, industry and communities • **Community engagement** is more critical than ever • **Guard against misinformation and disinformation** that sow doubt in wind and renewable energy • The global wind industry must fulfil its role in **delivering a just and equitable transition,** which requires socioeconomic cohesion around the transition agenda

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Bottlenecks are set to emerge across the global wind value chain

Theme	Critical materials					Key components								Assembly		Offshore wind enablers		
Subject	Rare Earths*	Steel Plate*	Copper	Concrete	Carbon Fiber*	Gearboxes*	Generators*	Blades*	Power Converters*	Castings*	Towers*	Foundations*	Cables*	Onshore nacelles*	Offshore nacelles*	Installation vessels*	Ports*	Workforce
Global level criticality	●	◔	◔	○	◑	◕	◑	◑	◔	◕	◑	◑	◔	◔	◑	◑	◑	◕
Time to action ** – Europe	2023	-	-	-	2025	2024	2024	2024	2024	2023	2025	2025	2025	2024	2024	2025	2023	2023***
Time to action ** – North America	2023	-	-	-	2025	2023	2023	2023	2023	2023	2023	2023	2023	2024	2023	2023	2023	2023***
Time to action ** – China	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***
Key findings	• General availability of needed materials at the global level, with copper mining/refining and concrete production available for all major regions					• Risk of manufacturing bottlenecks before 2030 for multiple components at regional level, in particular gearboxes, generators, blades as well as offshore wind size compatible metal castings, towers and foundations • Strong centralisation for some key components, especially gearboxes and castings. North America is generally fully dependent on imported components and is already today experiencing undersupply of especially components for offshore wind including offshore towers, foundations and subsea cables • Supply chains will generally benefit from building out regional manufacturing hubs to ensure more resilient access to needed components while ensuring continued trade and global interlinkages to enable flexibility and address demand volatility							• Offshore assembly risks undersupply as uncertain industry outlook may lead to plant cancellations		• Offshore wind needs to scale both port capacity and wind turbine installation vessels with sufficiently large crane capacity • US critically lacks vessels and ports while announced expansion plans and orders in other markets can address need to 2030; any cancellations will pose risks		

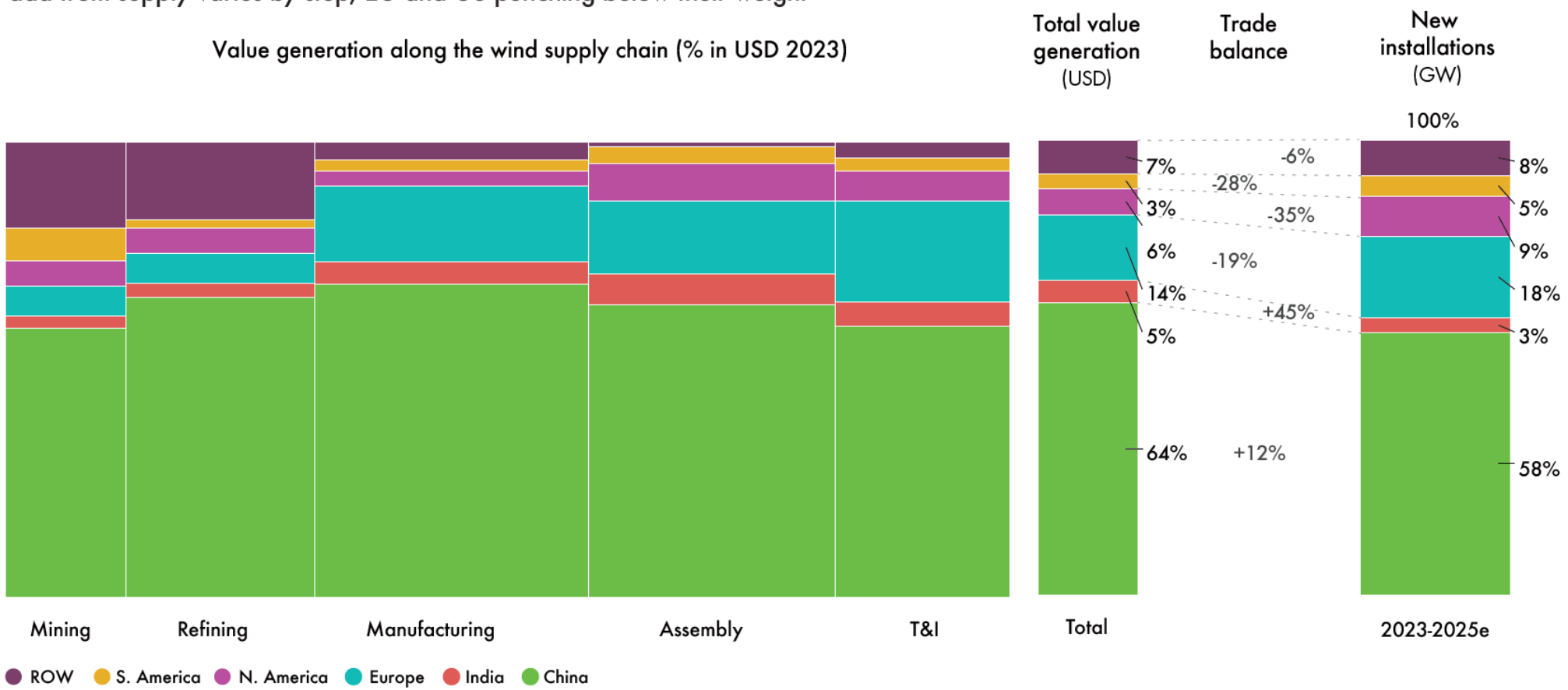
○ No global bottleneck risk ● Immediate global bottleneck

* Deep dive analysis provided ** Time to action denotes time when new capacity construction must be started to avoid bottlenecks in each region without trade

*** Workforce with major challenges, addressed in GWEC & GWO: *Global Wind Workforce Outlook 2023-2027*

China dominates the global supply chain – but also global installations

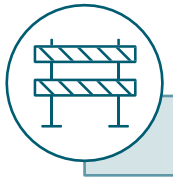
Value add from supply varies by step; EU and US punching below their weight



Note: Analysis on location of value-add, not nationality of producer. Mining, refining and production split for wind use estimated based on national capacity, sourcing policy and trade patterns, and do not include major Chinese ownership in major mining markets such as Indonesia and Chile. Manufacturing includes sub-suppliers for towers and blades. Assembly includes OEM R&D.

Source: GWEC, IEA, BCG analysis.

Six recommendations to secure the supply chain for 1.5C



1: Address basic barriers to wind industry growth in land, grids and permitting to increase volume and predictability

2: The wind industry must standardise and industrialise

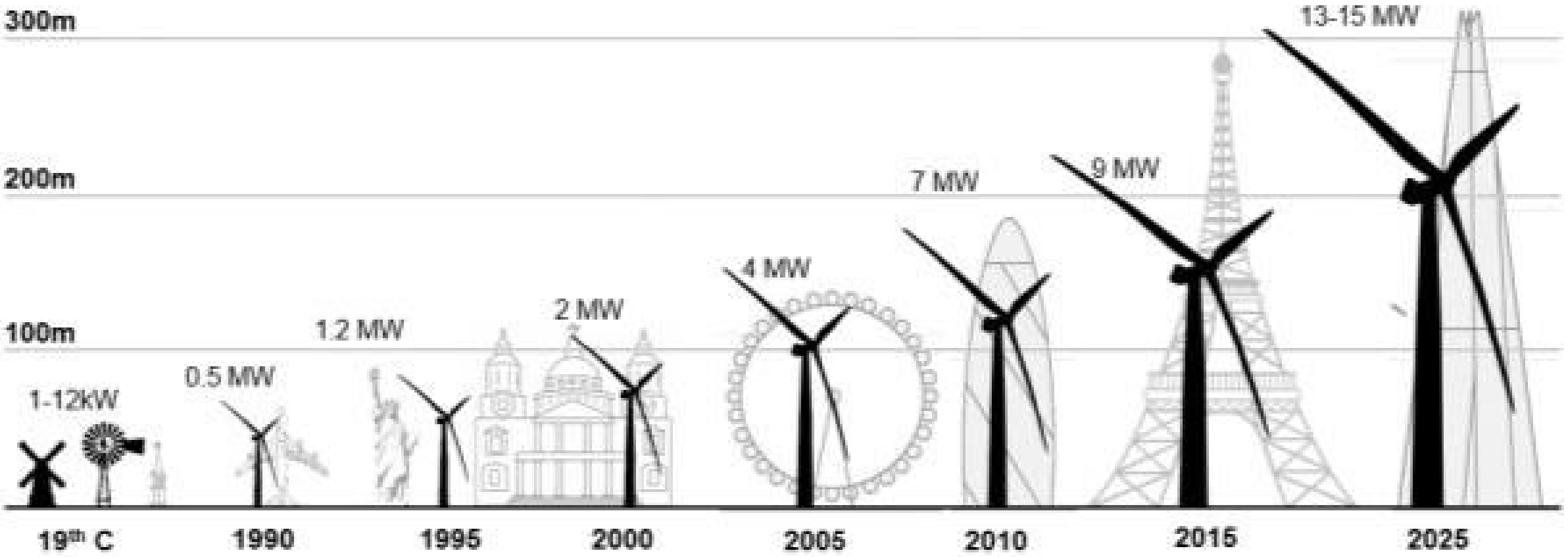
3: Regionalisation will be needed to support growth and resilience, while maintaining a globalised supply chain

4: The market must provide clear and bankable demand signals to reach net zero

5: Trade policy should aim to build competitive industries, not push higher costs onto end-users

6: Fundamental reform of the power market underpins further wind growth

Evolution of wind turbines



Source: Orsted

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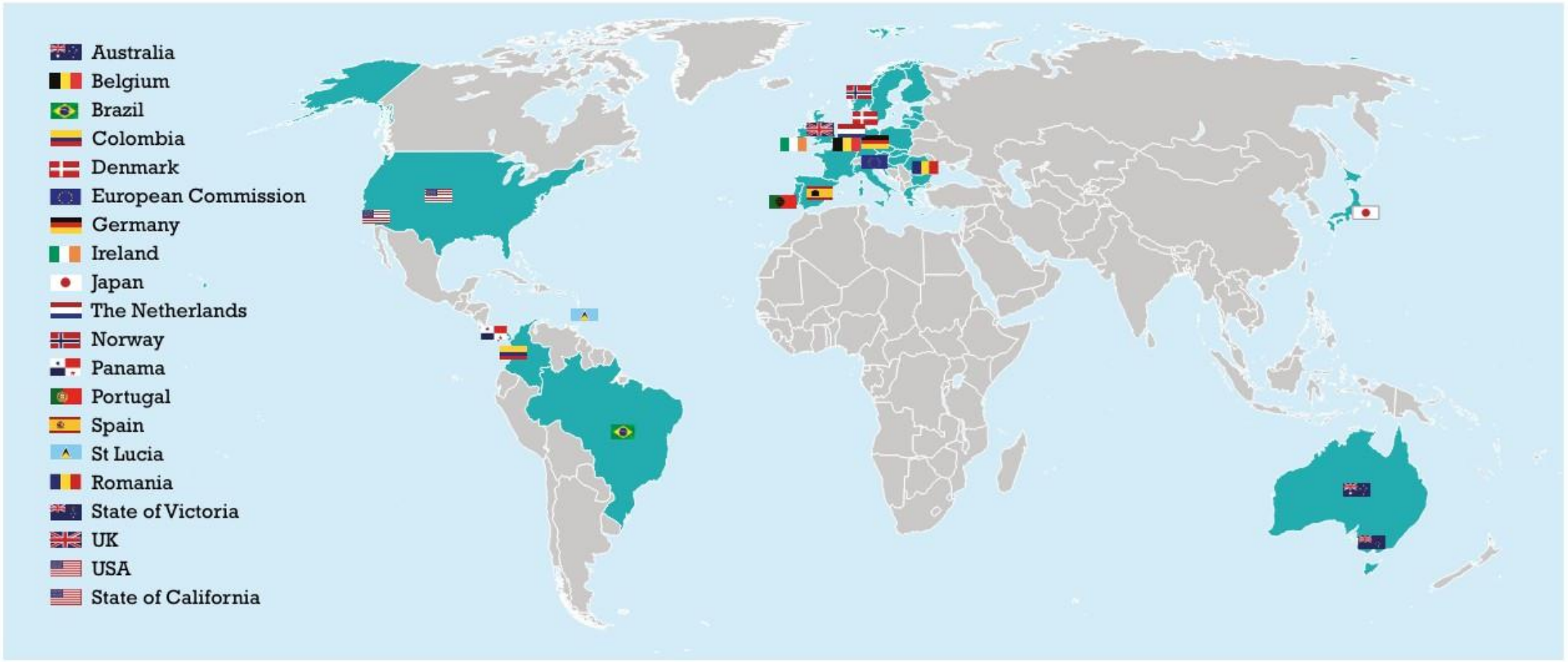
Offshore wind has proven itself as a maturing, competitive and diverse industry

Membership of the Global Offshore Wind Alliance has swelled to **over 20 governments from APAC, LATAM, Europe**, who have all pledged to collaborate towards 380 GW of offshore wind by 2030 and 2000 GW by 2050 – in line with the COP28 3x pledge

GOWA Government members (as of January 2024)



OEP's Approach: Technical Assistance

Ocean Energy Pathway makes enabling, strategic investments in emerging offshore wind markets, bringing key players together with independent experts to help create a thriving sector.

Our programmes can involve:

- **Policy advice:** guidance on policy frameworks, regulations, and strategies.
- **Capacity-building:** offering training workshops and supporting expert delegations to strengthen knowledge.
- **Technical analysis:** conducting technical and in-depth economic studies and assessments, to help facilitate decision-making.
- **Implementation support:** project management and monitoring to assist practical application of policies.
- **Knowledge-sharing and best practices:** facilitating dialogue and cooperation between governments, industry, and civil society.