The offshore transition to renewables

Plural offshore wind technology insights

April 2021

Agenda

Plural expertise

Offshore wind

- Summary
- Global capacity
- Supply chain
- North America case
- Upside scenarios and market risk

Appendix

We have extensive expertise across offshore technology applications

Our focus – offshore:

Mechanical and digitally-enabled technologies, and value-added services

Wind

- Development and installation
- Production facilities
- Subsea / transmission
- O&M

Oil and gas

- Exploration
- Production facilities
- Subsea
- O&M

Marine

- Oceanic shipping
- Offshore support vessels
- LNG
- Commercial brownwater
- Fishing

Agenda

Agenda

Wind is an increasingly attractive offshore segment for energy corporations, technology manufacturers and investors

Summary

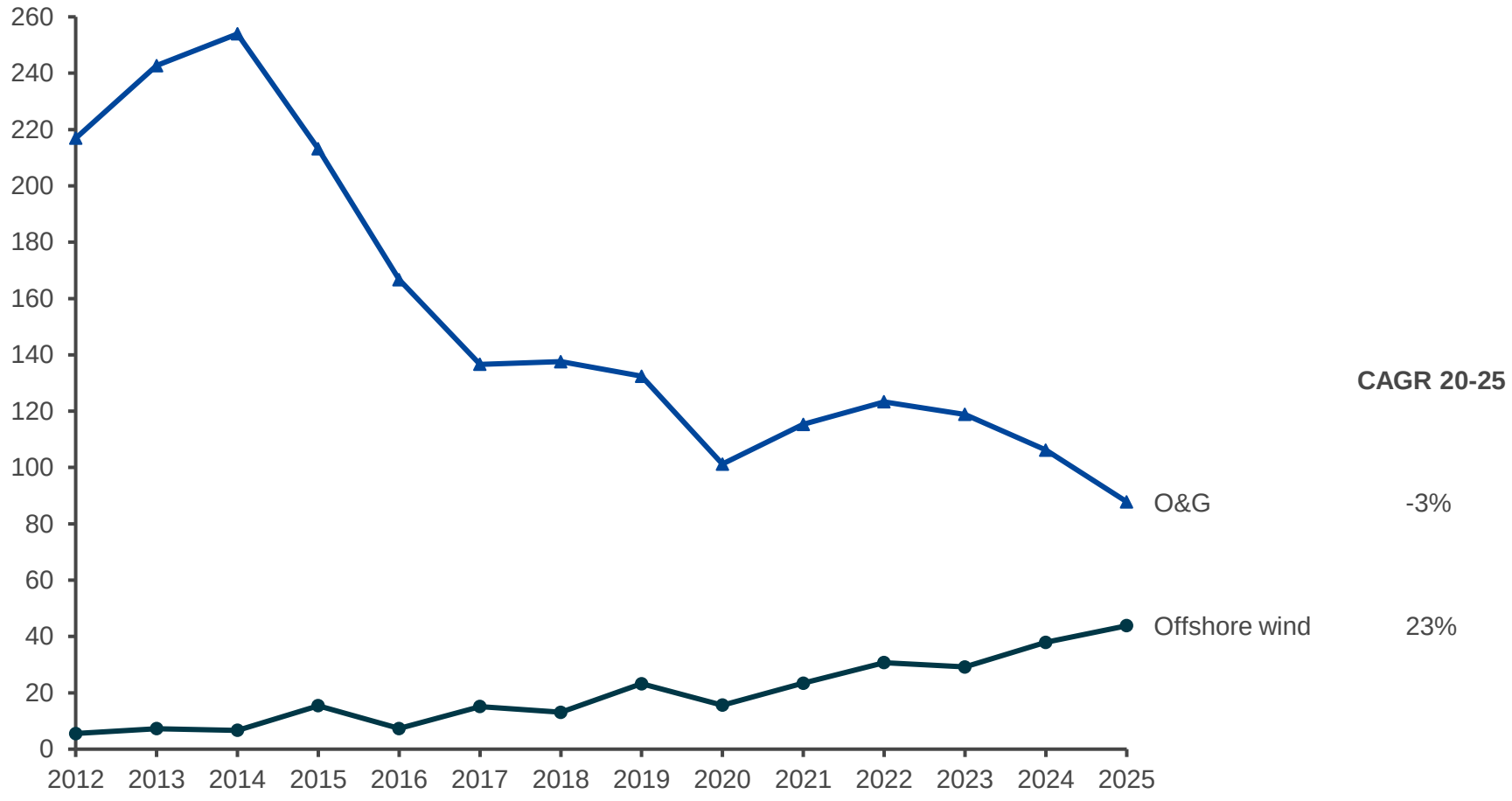
- Global capacity in offshore wind is increasing globally. This is being driven by:
  - Increasing cost competitiveness with other forms of clean power generation
  - Practical benefits of offshore wind (e.g. negligible land usage and constant power generation)
  - Energy companies' desire to diversify

- The offshore wind sector is fundamentally changing, moving further from the shore and into deeper waters. This will have implications for supply chain spending:
  - Foundations will become bigger and more expensive
  - There will be increased amounts of larger transmission equipment installed
  - Digital technology uptake will be accelerated

Source: Plural analysis

Globally, offshore O&G CAPEX has declined sharply; offshore wind is in early stage growth with a strong outlook

Upstream O&G and offshore wind, CAPEX $bn



Source: Wood Mackenzie [March 2020], Plural analysis

Offshore wind has numerous technology synergies with other industries, offering a strategic transition from a challenged O&G sector

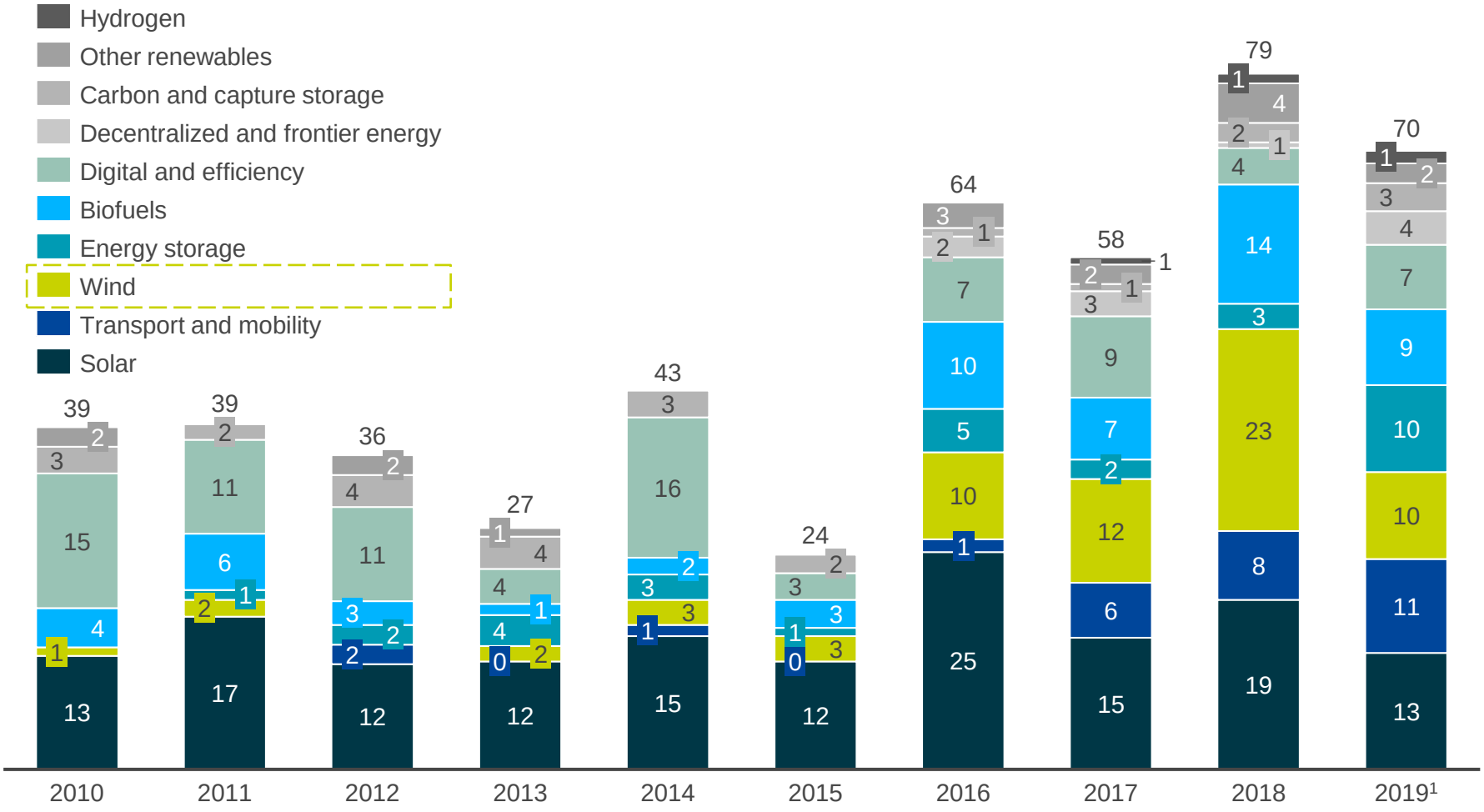
Offshore wind cross-sector technology transfer opportunities

	Oil & Gas	Aerospace	Conventional power gen
Materials	✓	✓	✓
Manufacturing	✓	✓	✓
Robotics	✓		✓
Health and Safety	✓	✓	✓
Asset management		✓	
Harsh environments	✓		✓
Vessels	✓		

Source: Plural analysis

Oil companies have been diversifying into renewables since the 2014 oil crash. The price crash of April 2020 will accelerate this change

Diversified investments of major oil companies, $bn

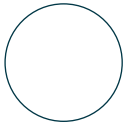


1. As of September 2019
Source: Bloomberg NEF

Agenda

Offshore wind has a number of practical benefits compared to other low carbon power sources

Practical benefits of low carbon power generation

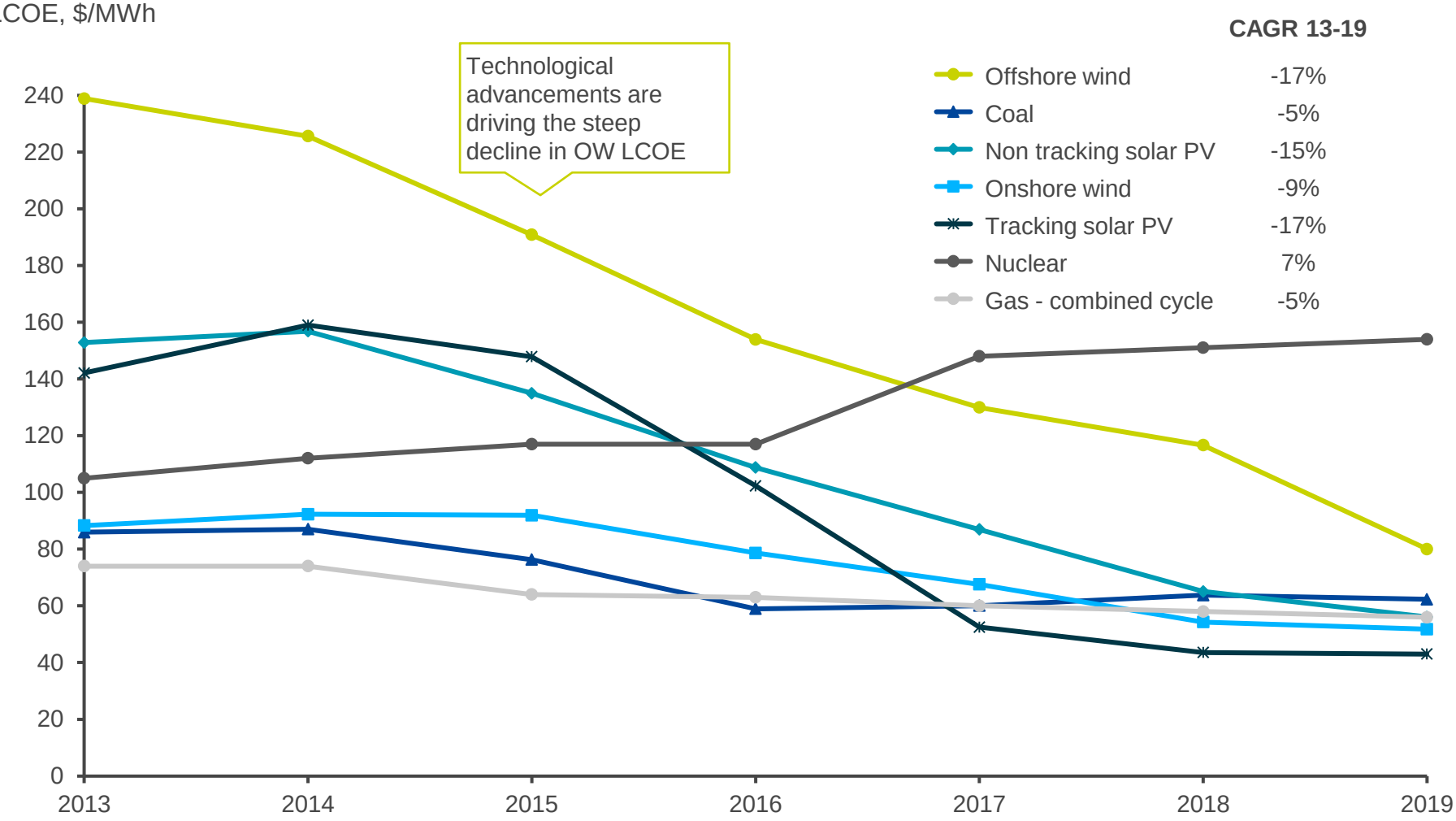
	Capacity factor[1]	Ability to meet peak demand	Planning restrictions[2]	Public perception
Offshore wind				
Onshore wind				
Solar PV				
Nuclear				

1. % of the time the infrastructure is producing power
2. Inverse

Source: Plural analysis

Offshore wind is fast becoming cost competitive with other renewables and carbon emitting power generation

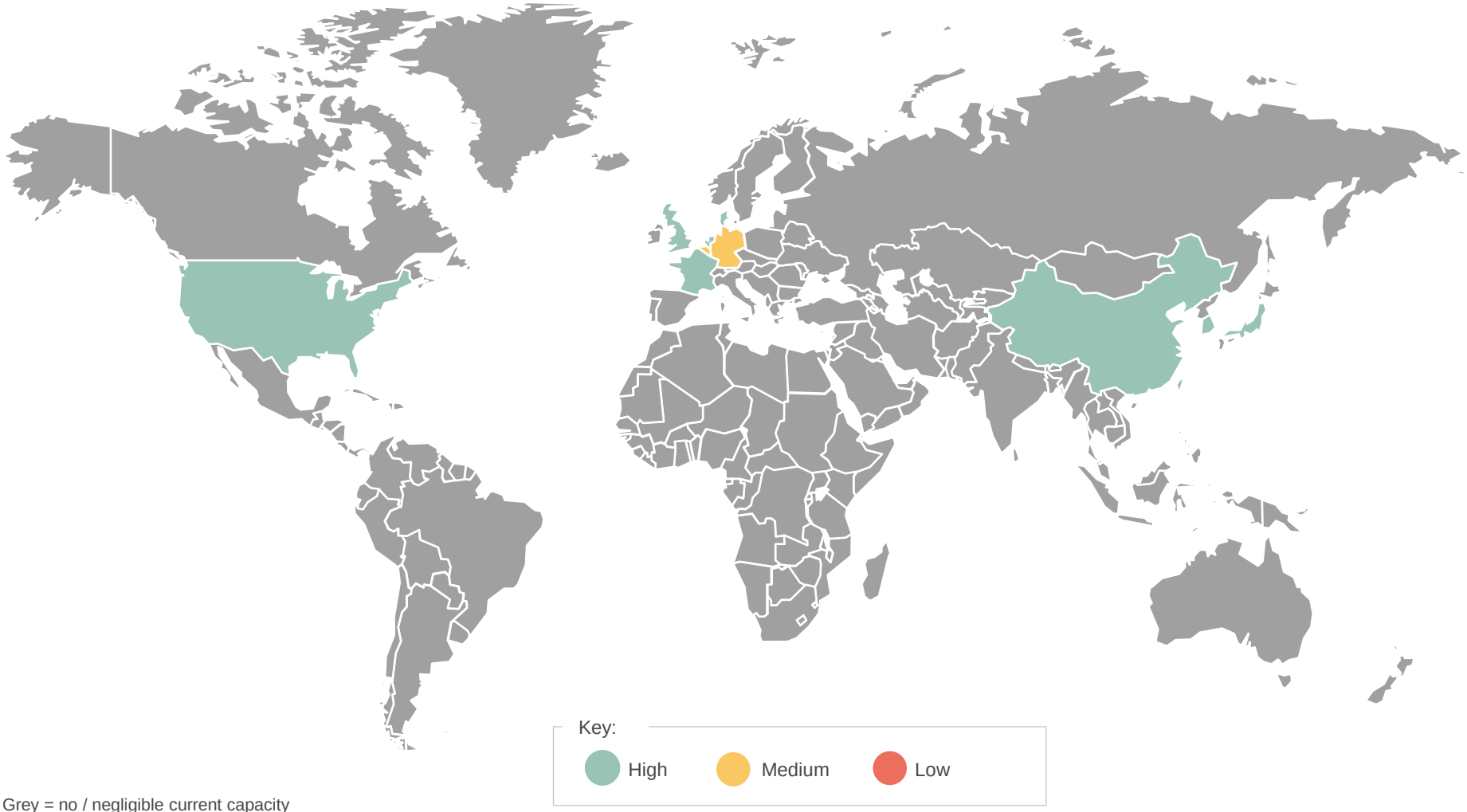
LCOE, $/MWh



Source: Bloomberg NEF, Lazard, Plural analysis

The majority of countries that currently have offshore wind infrastructure will experience high growth in capacity

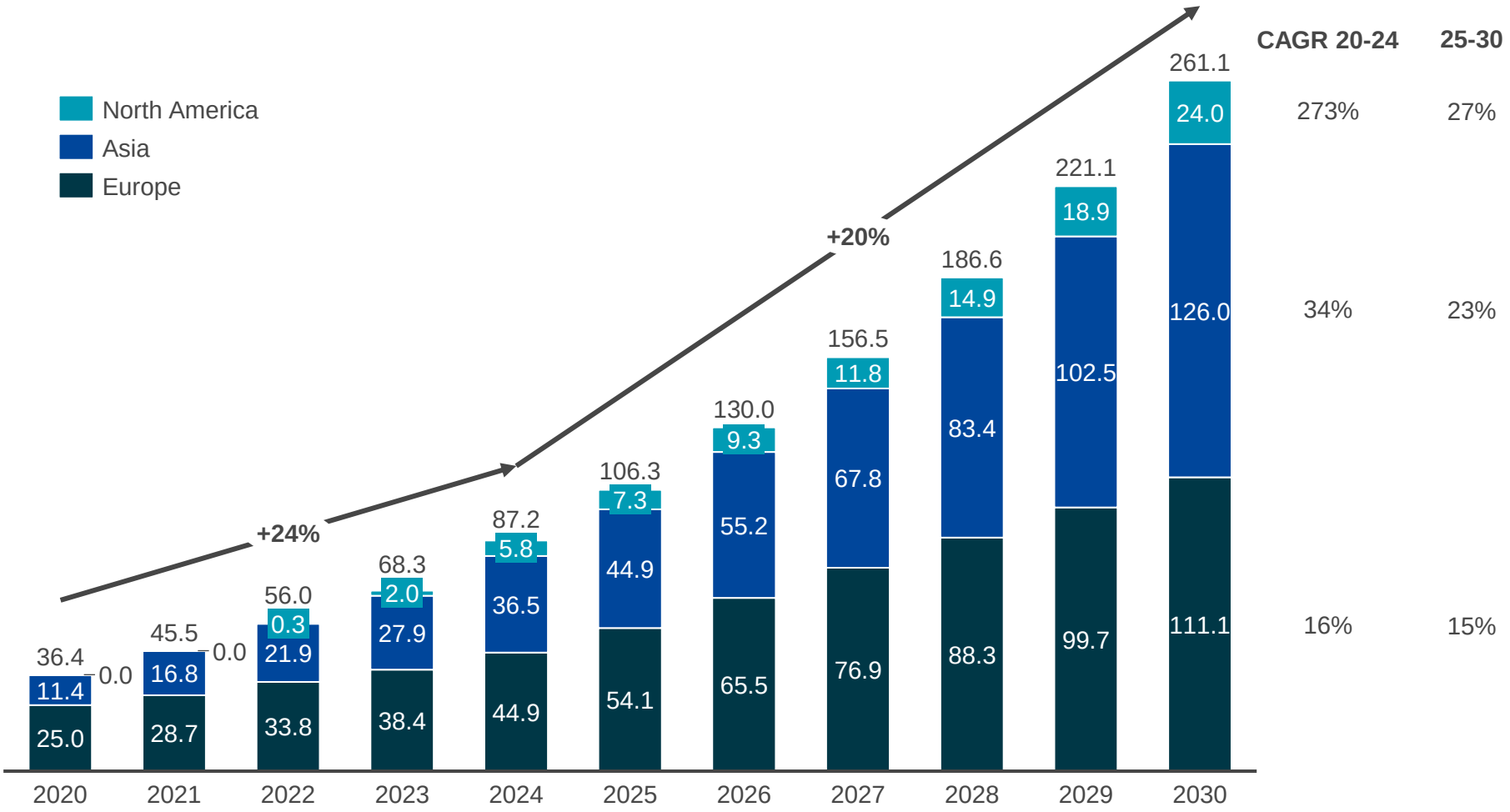
Offshore wind capacity growth by country, 2020-25



Grey = no / negligible current capacity
Source: Plural analysis

Global offshore wind capacity is forecast to grow at 24% CAGR to 2024. Most of the growth is likely to come from Asia.

Capacity by region, GW



Source: BVG Associates, GWEC, Wind Europe, IRENA, Plural Strategy analysis

Agenda

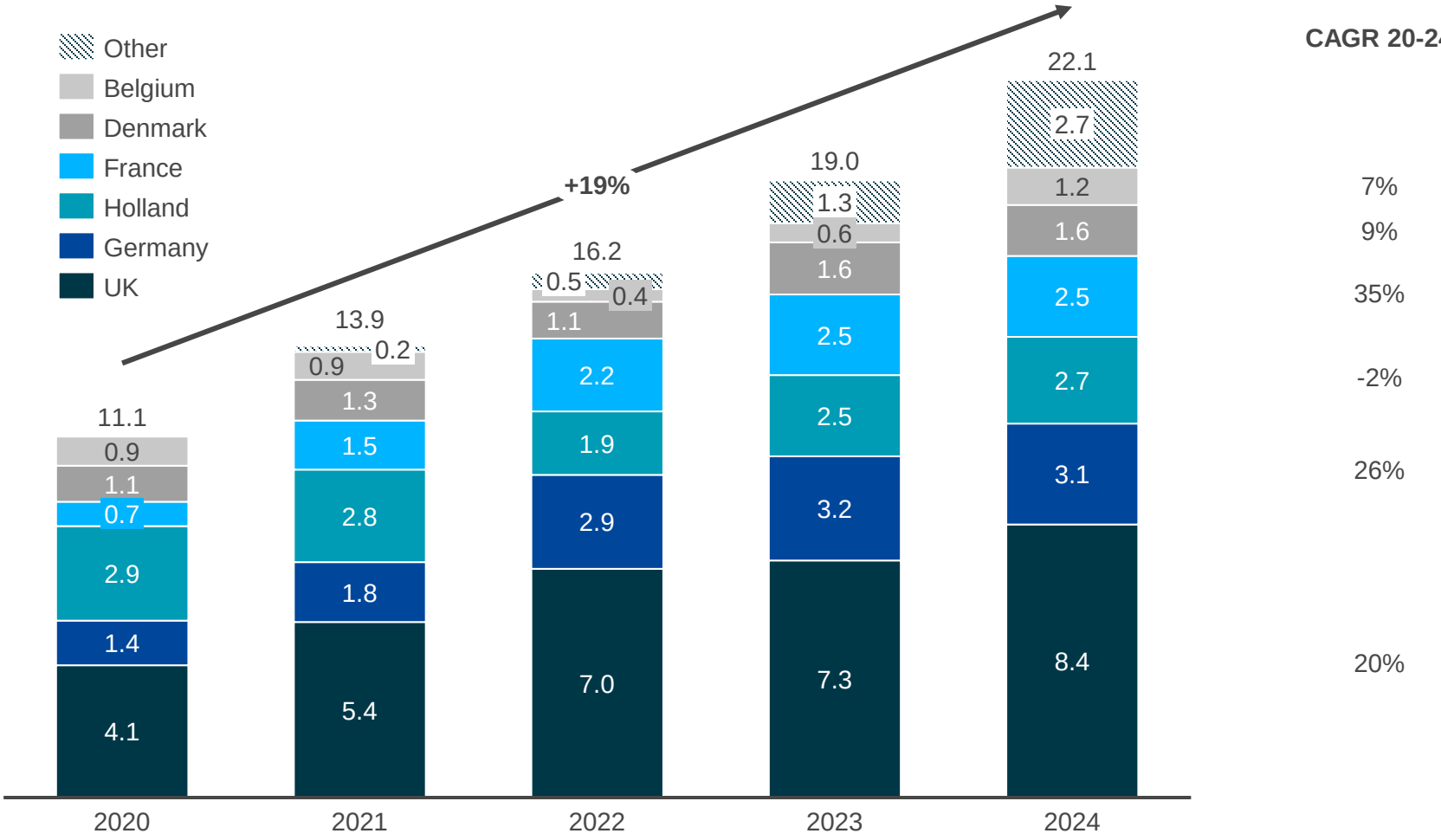
The supply chain can be split out into 5 main segments

Supply chain map

Development	Turbine supply	Balance of plant	Installation	OPEX
• Environmental surveys	• Turbine manufacture	• Foundations	• Turbine and foundation installation / vessels	• Maintenance and inspection services
• Consenting & development services	• Rotor supply	• Array cables	• Offshore substation installation / vessels	• Maintenance, inspection and monitoring technology
• Engineering studies, consulting & project management	• Tower supply	• Export cables	• Offshore cable installation / vessels	• Vessels & equipment
	• Drive train supply	• Offshore substation	• Installation ports and logistics	• Decommissioning
	• Power conversion	• Onshore substation	• Installation equipment	
	• Large fabrications	• Electrical systems		
		• Secondary steel work		

European supply chain spending is set to almost double by 2024; driven by the UK, German and French markets

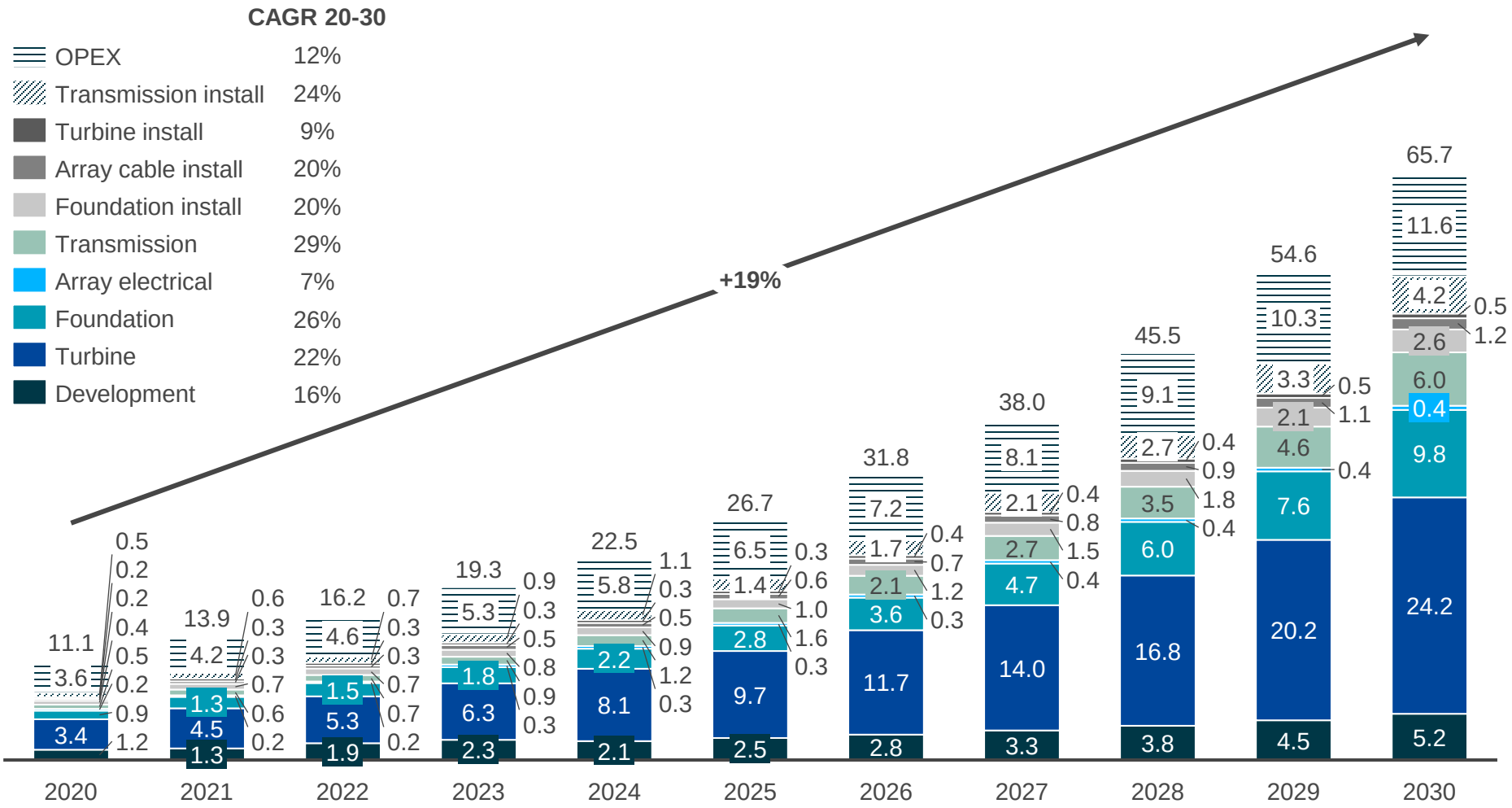
European expenditure across all offshore wind supply chain activities, Euro bn



Source: BVG Associates

The most promising technology segments are transmission, transmission installation and foundations driven by a shift towards deeper water farms

European expenditure across all offshore wind supply chain activities, Euro bn



Source: BVG Associates, Plural analysis

Emerging digitally-enabled tech segments are being driven by wind farms moving further from the shore and into deeper waters

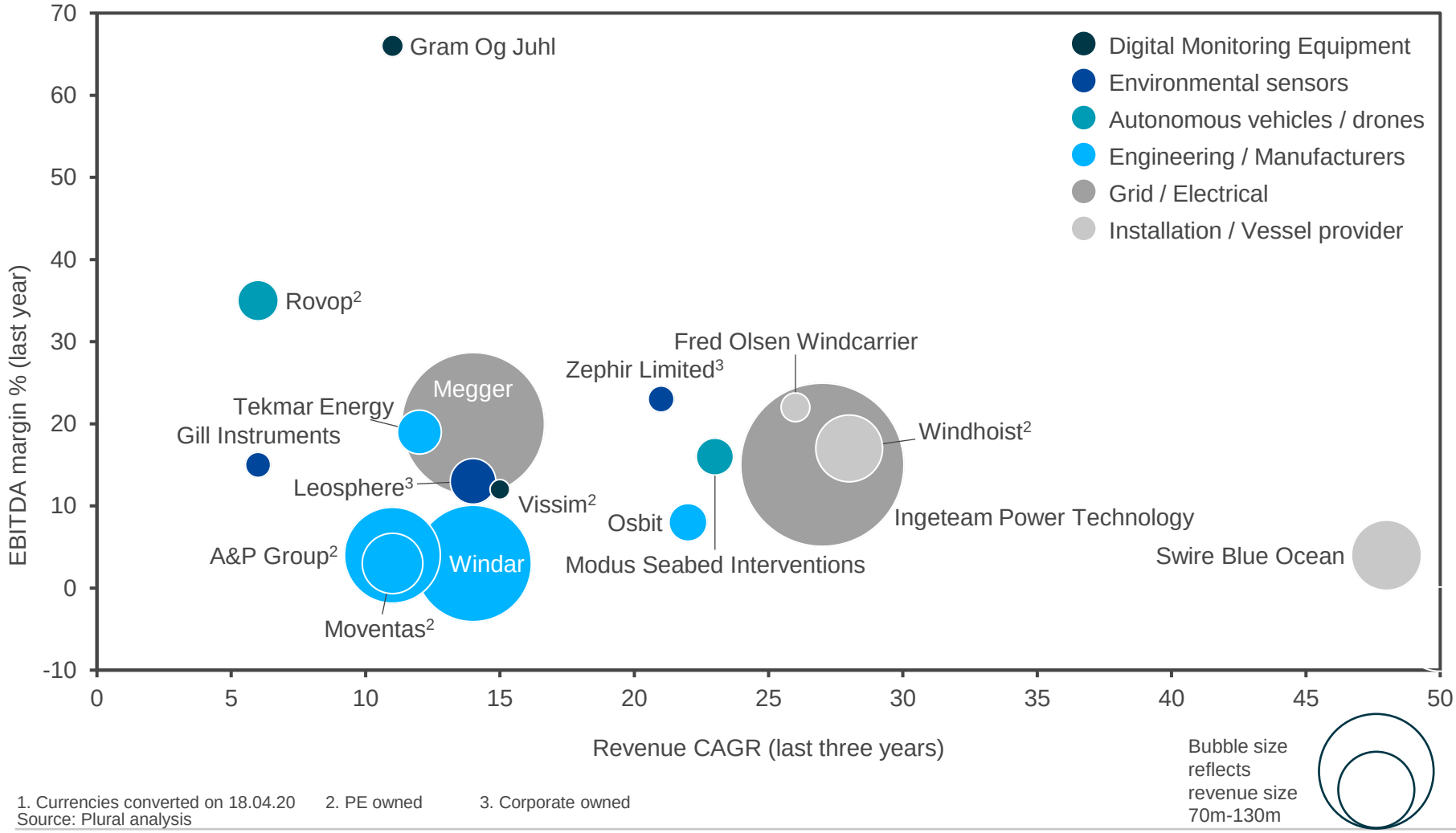
Key technology trends in offshore wind

Technology	Expected outlook 2020-30	Comment
Digital monitoring equipment		• With the shift to windfarms being further out to sea and sitting in deeper waters, it is becoming more cost efficient to monitor wind farms using digital technology, rather than paying for expensive surveys to be carried out • The development of floating wind farms and the subsequent accelerated shift of wind farms to be further away from the shore will help to drive uptake in these technologies
Autonomous vehicles / Drones		• This shift is also increasing the uptake of autonomous vehicles and drones • Instead of using divers in deeper water, an autonomous vehicle can carry out the inspection more safely and efficiently • Drones can be quickly deployed to inspect turbines that may have suffered damage
Predictive analytics		• Using increasing levels of data from sensors and other monitoring equipment, O&M costs can be driven down by using predictive analytics for fault prediction • This reduces downtime of the turbine and need for costly inspections • Services are provided by start ups or the big turbine suppliers

Source: Plural analysis

A number of installation / vessel providers and digital connectivity / monitoring players look attractive

Selected potential targets in the European offshore wind supply chain, Euro[1]

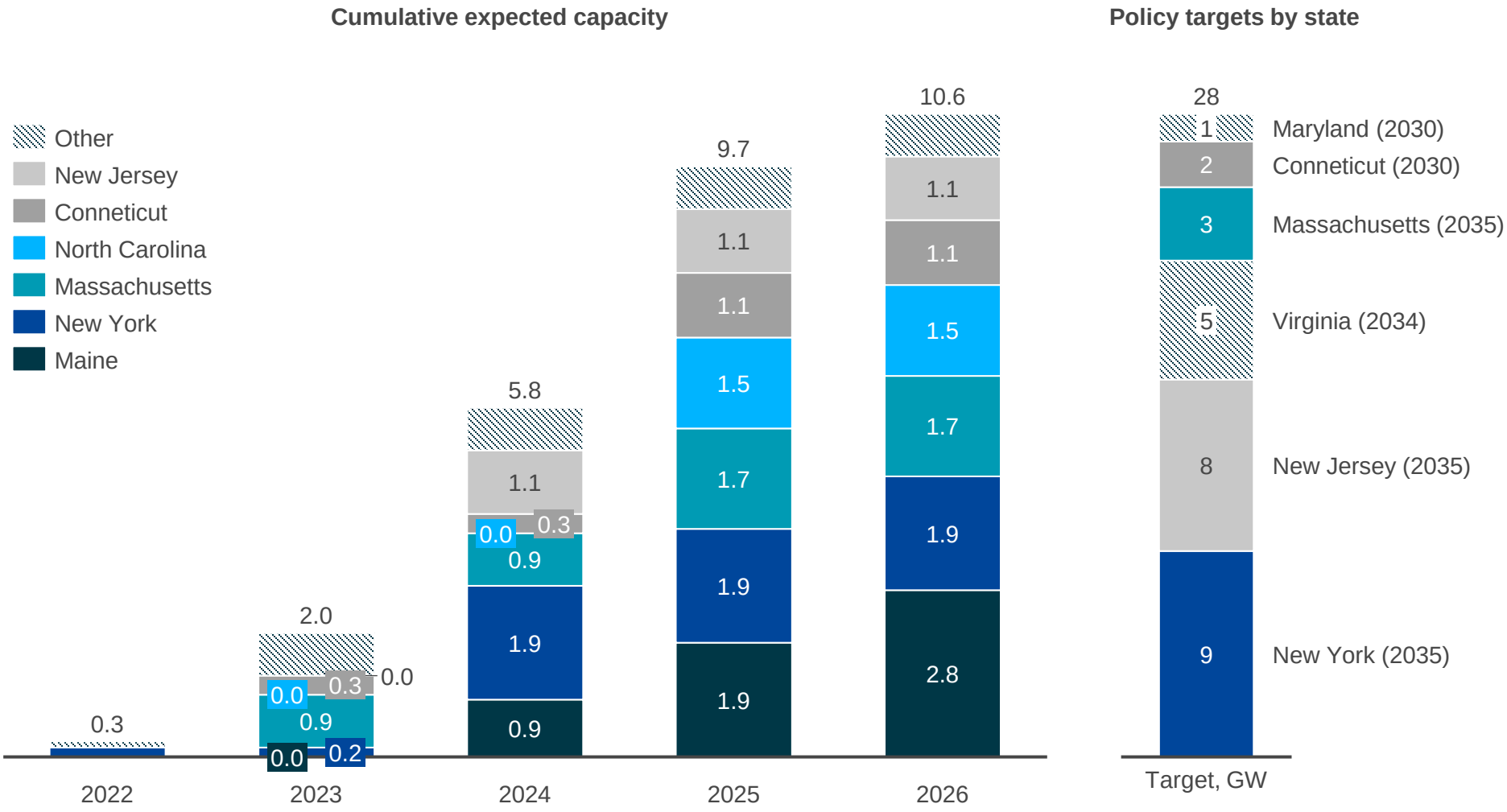


1. Currencies converted on 18.04.20 2. PE owned 3. Corporate owned
Source: Plural analysis

Agenda

North American capacity is likely to sharply increase from 2023 and concentrate in the North East

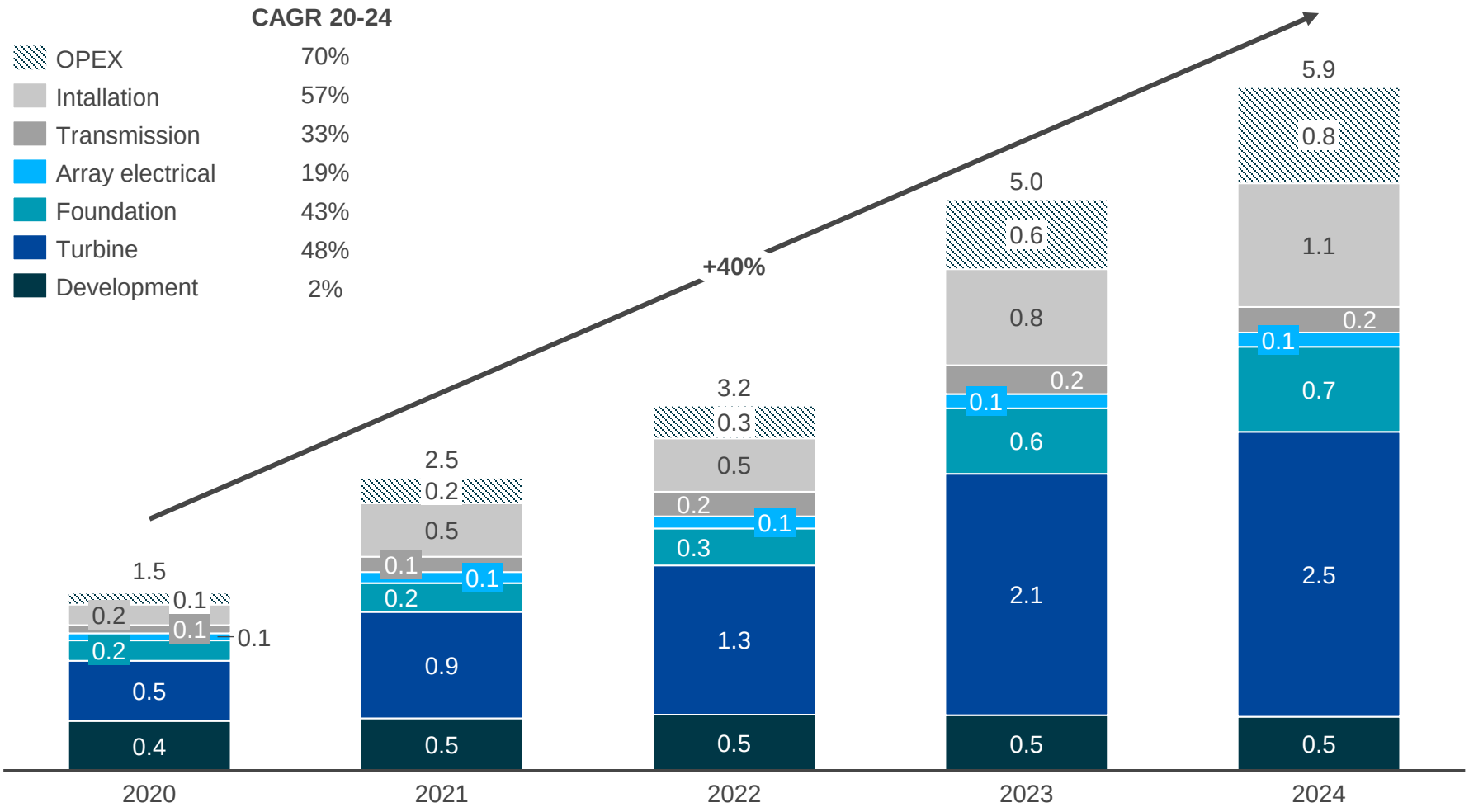
Capacity by state, GW



Other = Delaware, Maryland, Rhode Island
Source: GWEC

North American supply chain CAPEX spending is likely to rapidly grow, with an OPEX market establishing from 2023

North American expenditure across all offshore wind supply chain activities, Euro bn



Source: BVG Associates, Plural analysis

Agenda

Both upside scenarios and market risks in offshore wind are driven by a potential change in government interventions and Covid-19 impact

Upside scenarios and market risk

Upside

- Governments looking to add stimulus into their economies can use clean energy infrastructure projects as a way to boost demand & jobs in their Covid-19 hit economies
    - The UK Government has highlighted Offshore Wind as a sector that can help to drive a post Covid-19 recovery and has committed to 40GW of cumulated capacity by 2030
- A Democratic led government in the United States is likely to increase funding for and change legislation in favour of decarbonisation

Risks

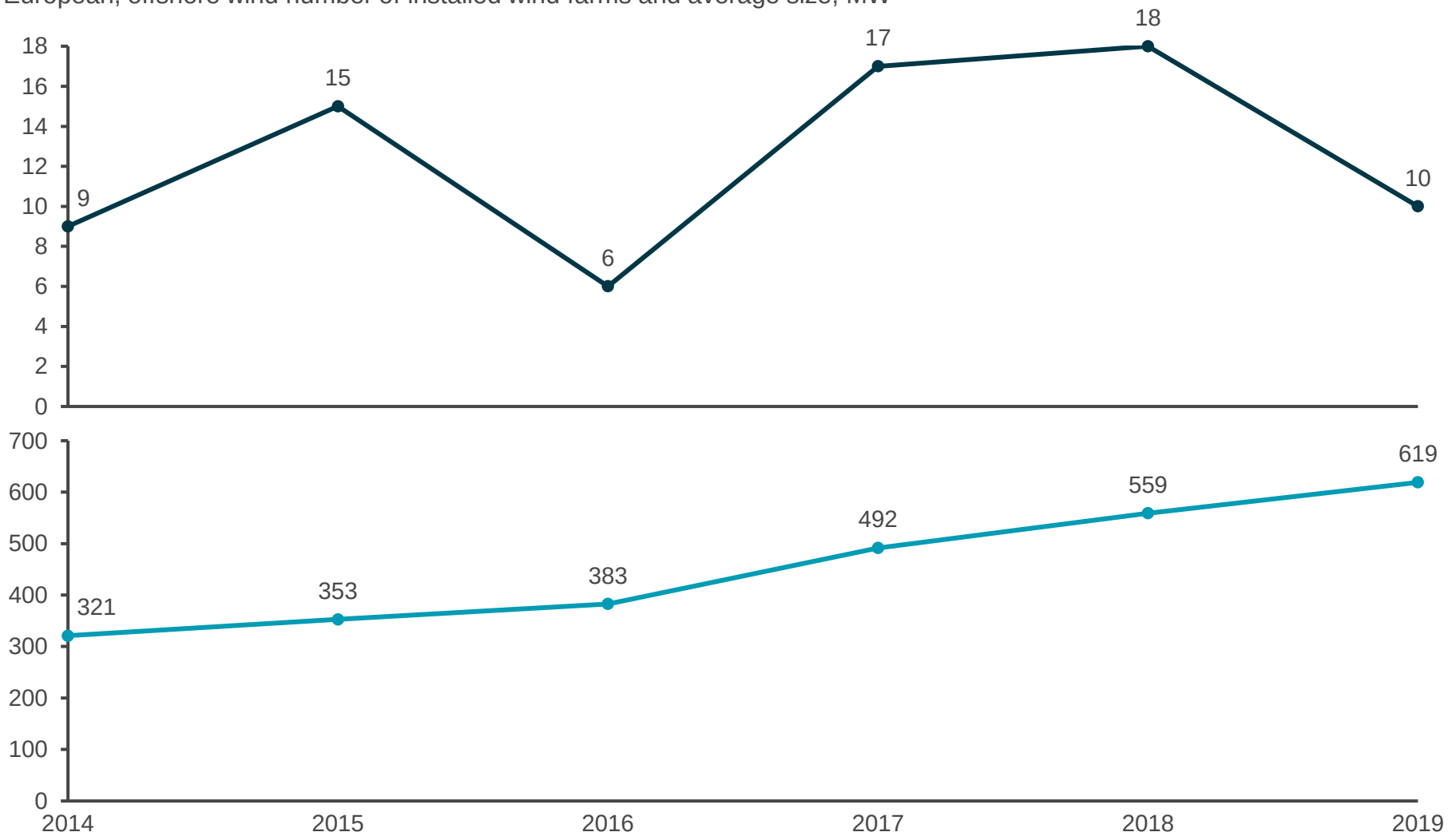
- Increasing fiscal deficits due to Covid-19 could make governments less willing to subsidise offshore wind projects
- The decrease in oil and LNG price as a result of Covid-19 may make offshore wind less financially attractive compared to these non-renewable alternatives
    - This is less applicable for European countries that are highly committed to decarbonisation
- Increasing farm sizes means that # offshore wind projects in Europe is staying flat
    - Infrastructure suppliers' revenues will still be exposed to relatively high variance

Source: Financial Times, Plural analysis

Agenda

Wind farm sizes are increasing, but number of new wind farm projects remains low; some sectors are project driven which can lead to high variance in revenue

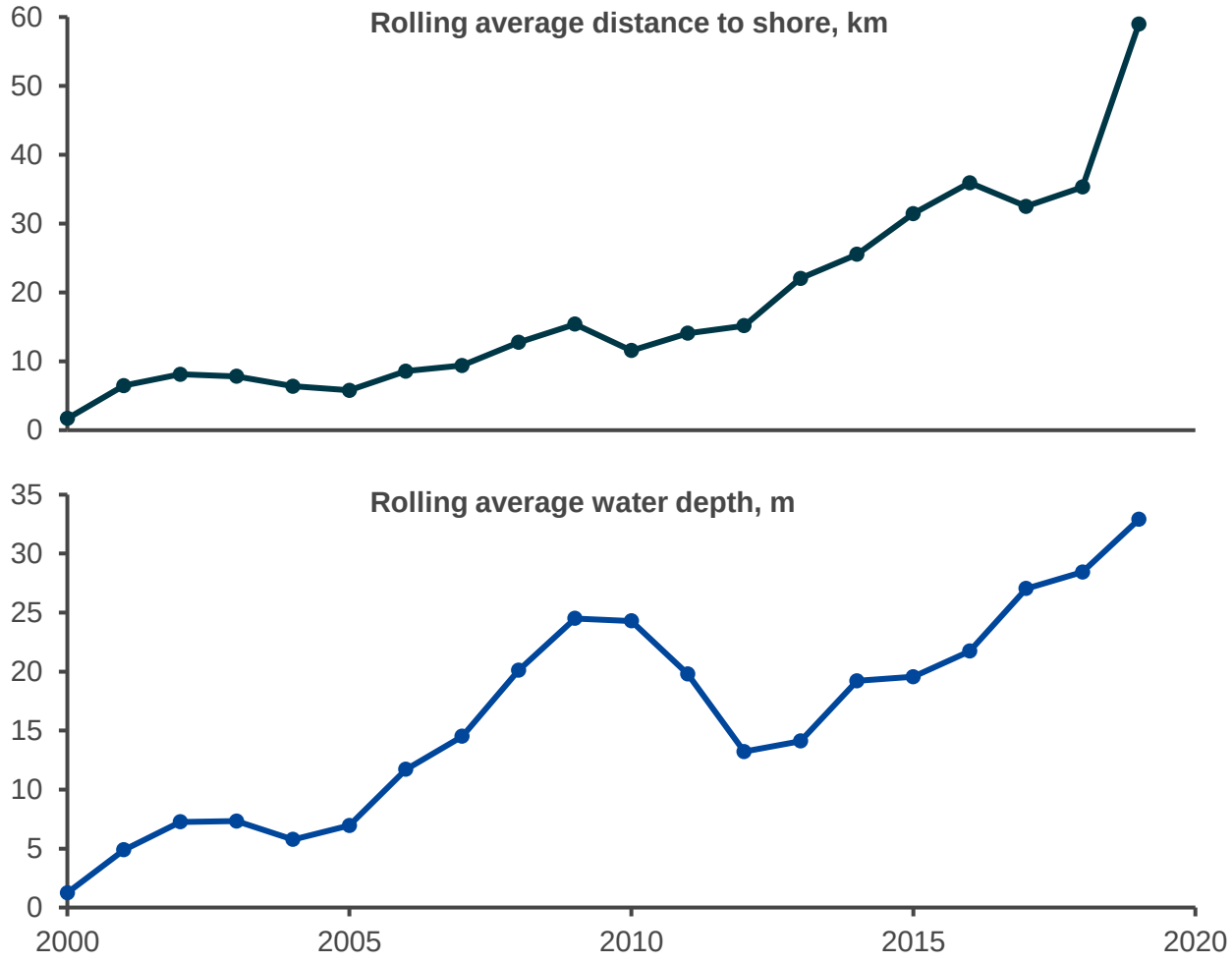
European, offshore wind number of installed wind farms and average size, MW



Source; WindEurope

European wind farms are moving further away from the shore and into deeper waters, creating new supply chain opportunities

European offshore wind farms, rolling average water depth and distance to shore



Commentary

- This shift enables wind developers to target more productive areas of water with a higher consistency of wind speed
- The development of floating wind turbines could accelerate this change
- Transmission infrastructure, particularly export cables, will increase in proportion of spend because of the increasing distance from the shore
- Digital monitoring equipment will become more necessary, as will the need for vessels that can withstand higher wind speeds and carry larger foundations
- Foundations will become more expensive with the transition to deeper water. Jackets are expected to be used more frequently since monopiles are currently unsuitable for use in deeper waters

Source: Wind Europe

In Europe, the turbine supply sector is dominated by a handful of large players

European offshore wind supply chain map, development and turbine

Segment	Sub-segment	Example suppliers
Development	Environmental surveys	• Niras, IMARES, Fugro EMU, MMT, Gardlne, Hi Def
	Consenting and development services	• *Typically specialised firms in country where the wind farm is installed*
	Engineering studies, consulting and project management	• DNV-GL, Ode, RES
Turbine supply	Turbine manufacture	• GE, MHI Vestas, Senvion, Siemens
	Rotor	• GE, MHI Vestas, Senvion, Siemens-Gamesa, LM Wind Power
	Towers	• Ambau, CS Wind, Titan Wind Energy, Valmont SM, Windar
	Drive train	• Bearings: SKF, Timken, Rothe, Erde, Schaeffler • Gearbox: ZF, Winergy, Moventas, GE
	Power conversion	• ABB, The Switch, Siemens and GE
	Large fabrications	• Grup Euskal, Liebherr, Sakana, Siempelkamp

Source: BVG Associates

There are numerous SME providers of installation services and vessels

European offshore wind supply chain map, balance of plant and installation

Segment	Sub-segment	Example suppliers
Balance of plant	Turbine foundations	• Bladt, BiFab, Navantia, Sif Group, Smulders Projects
	Subsea cables (array and export)	• JDR Cables, Nexans, NKT Cables, NSW, Prysmian, Trelleborg Offshore
	Electrical systems	• ABB, CG Power, GE Grid Sol., Siemens
	Substation structures (offshore and onshore)	• Babcock, Bladt, Fabricom, Hollandia, Navantia
	Secondary steel work	• Hutchinson Engineering, MTL, Wilton Engineering
Installation	Turbine and foundation installation / vessels	• Windhoist, Fred Olsen Windcarrier, Eide Marine Services (See wind Europe)
	Offshore substation installation / vessels	• Seaway Heavy Lifting, Heerema, Scaldis
	Offshore cable installation / vessels	• DeepOcean, Jan De Nul, Siem Offshore Contractors, Tideway, Van Oord, VBMS
	Installation ports and logistics	• Ostend, Hull, Ebsjerg, Eemshaven, Vlissingen
	Installation equipment	• IHC, Mench, Oceanteam, Sepro Technology

Source: BVG Associates

Operations and maintenance technology is playing an increasingly important role down the LCOE of the industry

European offshore wind supply chain map, operations and maintenance

Sector	Sub-segment	Example suppliers
OPEX	Maintenance and inspection services	• Global Wind Service, Ziton, 3Sun Group, Briggs Marine, CWind
	Maintenance, inspection and monitoring technology	• Argus remote systems, Wirescan, Gram Og Juhl, ABB, UPTIME Engineering, 4 Subsea, Anemo Analytics, ONYX InSight, Ingeteam
	Vessels & equipment	• SOVs: Havyard, Rolls Royce, Ulstein • CTVs: Bibby Offshore, Cwind, Dalby Offshore • Equipment: Cranemaster, ACE Winches

Source: BVG Associates

Case study: In September 2020, BP announced a strategic review, forecasting increased exposure to renewables and decreased spend in upstream O&G

BP strategic review, 2020

	Current output levels	10 year investment horizon	2030 position
Upstream O&G	• ~2.5m barrels a day	• Capital intensity decreasing • Continued efficiency focus to help drive ROACE growth • No exploration in countries BP does not currently operate within upstream O&G	• ~1.5 million barrels per day (40% decrease) • Carbon produced from upstream O&G operations to be reduced by 30-35%
Renewables	• 2.5 GW of capacity • 0 GW in offshore wind	• Investments of $5bn by 2030 (a 10 fold increase) • In September 2020, BP committed $1.1bn in its first offshore wind investment (4 assets in the NE of the US)	• 50 GW of renewable energy capacity • Early position built out in CCUS, hydrogen and US offshore wind

Source: BP

Matthew Vellacott
Partner
matthew.vellacott@pluralstrategy.com

Matthew Buffoni
Analyst
matthew.buffoni@pluralstrategy.com

Plural Strategy Group Ltd

915 Broadway, Suite 904
New York, NY 10010, USA
E info@pluralstrategy.com
T +1 917 472 1461

pluralstrategy.com

Plural Strategy Group Ltd

25 Bedford Street
London WC2E 9ES, UK
E info@pluralstrategy.com
T +44 203 958 7350

pluralstrategy.com