EIC INSIGHT REPORT

GLOBAL OFFSHORE WIND

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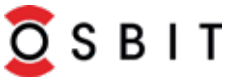

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INTRODUCTION

Operational offshore wind capacity surpassed 30GW in 2020, with over 5GW added throughout the year in what represents yet another industry record. While the UK continues to retain its status as global leader in offshore wind, China is closing the gap, having surpassed the 7GW mark for operational capacity in 2020. The Chinese project pipeline of over 56GW currently being tracked in the EICDataStream project database can almost be described as a league of its own and is expected to provide the country with a leadership position in the first half of this decade.

Offshore wind's potential does not, however, stem from the significant growth in one market, but the fact that it is now represented on almost every continent. Striking within the just under 404GW of capacity additions by 2035 that the EIC is tracking, is the significant role played by emerging markets and the leading industry players pushing them onto the offshore wind scene. Examples include Brazil with over 47GW in the pipeline, Ireland with just under 23GW and Poland with roughly 9GW of project activity. In the first two examples, this pipeline has emerged while developers and supply chain companies continue to wait for offshore wind development and legislation frameworks to be finalised.

The global offshore wind sector has also not been held back by the global Covid-19 pandemic. While it is important to remember that the past year has had devastating impacts on certain industries, communities, and countries – and continues to do so – the offshore wind market has largely been able to move forward. Initial delays and disruptions to fabrication and component delivery, to name just two examples, were reported alongside final investment decisions (FIDs) being reached on several projects in 2020. These include the 2.4GW Dogger Bank A&B offshore wind farms in the UK, the 342MW Kaskasi project in Germany, and the 496MW Saint Brieuc project in France. Although administrative and consenting processes had to be adjusted in many countries, tender and auction rounds were launched or progressed: the Hollandse Kust Noord tender in the Netherlands that was awarded to the CrossWind joint venture (Shell-Eneco), the UK's seabed leasing rounds under Crown Estate England & Wales as well as Crown Estate Scotland, and the offshore wind solicitations in New York (2.5GW), New Jersey (2.4GW) and Massachusetts (1.6GW).

The offshore wind market has featured prominently in many countries' post-Covid recovery plans and in proposed roadmaps to net-zero carbon emissions by 2050. The coupling of renewable energy in general, and offshore wind in particular, with the production of green hydrogen is gaining in significance. The EIC is currently tracking 59 projects in Europe alone that reference the link between onshore and offshore wind to green hydrogen production using electrolysis. The combination provides a pathway for industrial and downstream market players to decarbonise their feedstock and operations in the long-term, while offering an additional source of revenue and electricity offtake for offshore wind generators. The offtake aspect is especially important considering the ongoing challenges and uncertainties in some mature and emerging markets in curtailment of renewable energy and lack of onshore transmission infrastructure.

To realise the upcoming offshore wind pipeline available, governments and industry will need to address ongoing issues in the consenting and financing of developments. For more mature markets such as the UK or Denmark that may mean updating legislative frameworks to incorporate cumulative impacts from offshore wind farms or streamlining planning in reaction to a growing number of applications. For emerging ones this could include identifying the right level of subsidy to promote growth and local investments. In the context of progressing decarbonisation efforts, it will be particularly important to promote development frameworks that address the integration of various technologies – such as electrolysers and offshore wind – rather than support a single sector.

Abbreviations

BOEM – The Bureau of Ocean Energy Management
BSH - Federal Maritime and Hydrographic Agency
CES – Crown Estate Scotland
CfD – Contracts for Difference
DEA – Danish Energy Agency
EA – Environmental Assessment
EIA – Environmental Impact Assessment
EIS – Environmental Impact Statement
FID – Final Investment Decision
FiT – Feed-in-Tariff
GoM – Gulf of Mexico
HRA - Habitats Regulations Assessment
LoI – Letter of Intent
MoU – Memorandum of Understanding
NOI – Notice of Intent
O&M – Operations and Maintenance
PPA – Power Purchase Agreement
TSO – Transmission System Operator

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The UK offshore wind market held on to its leadership position and surpassed the 10GW operational capacity mark in 2020 with the full commissioning of the 714MW East Anglia 1 project. Despite the local and global ramifications of the Covid-19 crisis, the UK market generally progressed throughout 2020 and 2021. Construction activities were launched or progressed at the 1,386MW Hornsea Project 2, at the 860MW Triton Knoll project, and the 950MW Moray East development. While the 450MW Neart na Gaoithe project has seen offshore construction delayed into 2021, part of this has been attributed to a greater than expected difficulty in seabed conditions.

The Contracts for Difference (CfD) Round 3 winners that secured a subsidy in 2019 have been able to move forward throughout 2020/21 despite the greater uncertainty brought upon by Covid-19. The 2.4GW Dogger Bank A&B developments reached FID in November 2020 under SSE Renewables and Equinor,with Eni now holding a 20% stake in the developments. Eni also acquired a 20% stake in Dogger Bank C in November 2021, which will come into effect following financial close by the end of 2021. The first two phases will benefit not just from a 15-year CfD contract, but also from power purchase agreements (PPAs) with Danske Commodities, Shell Energy Europe, Ørsted, and SSE Energy Supply. Financing of the £6bn CAPEX investment required for the A&B phases was achieved through senior debt facilities across the two phases of £4.8bn, with ancillary facilities of around £700m. The offshore transmission infrastructure is valued at £830m per phase. Debt was provided by a group of 29 banks and three export credit agencies.

The last of the Dogger Bank developments, RWE Renewables' 1.2GW Sofia offshore wind farm, reached financial close in March 2021. CAPEX for the project stands at approximately £3bn. Preferred supplier agreements for the main work packages

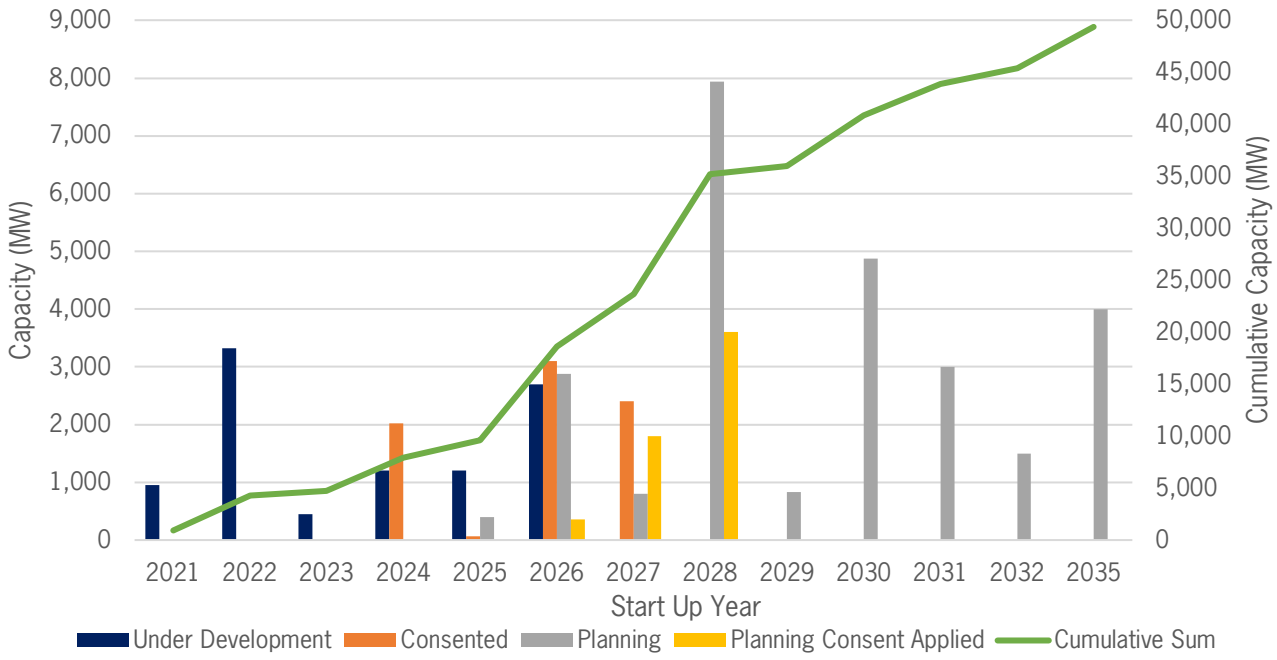

Figure 1

Overview of UK project status and cumulative capacity installations by start-up year. NB: Start-up year refers to the year of first power achieved and not overall commissioning.
Source: EICDataStream.

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were announced in late 2020 and official construction works commenced in June 2021. Key contract awards include GE Grid Solutions for the 17,000-tonne HVDC offshore substation and jacket foundation, Prysmian for the project's 440km, 320KV subsea power export cable and Van Oord as the main EPCI contractor for monopile foundations and inter-array cables. EEW Group has been selected by Van Oord to provide the 1,200-1,500-tonne XL monopiles, which will be fabricated at the contractor's Rostock facility in Germany. Sembcorp Marine has awarded a contract to Heerema Marine Contractors to transport and install the HVDC offshore converter platform, and has signed a deal with Iv-Offshore & Energy b.v. to supply engineering and procurement services for the same platform. RWE is also planning to create an operations hub for offshore wind farms at Grimsby's Royal Dock, which is where the Sofia project will locate its O&M activities in the future. Offshore construction activities are scheduled to commence in 2023, for a 2026 commissioning.

SSE Renewables' 1,075MW Seagreen project reached financial close in June 2020 with the 51% ownership acquisition from TotalEnergies. CAPEX for the development was estimated at £3bn, including £500m for the offshore transmission infrastructure. The owners will also benefit from a long-term PPA with Statkraft for 50% of the wind farm's output. Turbine supplier Vestas is making its mark on the project, having announced plans to manufacture 99 out of the 114

THE UK'S LONG-TERM PROJECT PIPELINE WAS STRENGTHENED IN 2020 WITH THE LONG-AWAITED PUBLICATION OF THE GOVERNMENT'S ENERGY WHITE PAPER

V164 wind turbine blade sets in the UK, ensuring compliance to its local supply chain criteria. Offshore construction activities have commenced – the first wind turbine jacket foundation was installed in October 2021 and the offshore substation's jacket foundation and accompanying pin piles are enroute from UAE (as of October 2021). First power is anticipated for 2022 and overall commissioning in 2023. The wind farm is also offering shorter 5-year corporate PPAs, for which tenders will be released towards the end of 2021. In addition, SSE and TotalEnergies have also applied with Marine Scotland and East Lothian Council for the export cable connection for a 360MW extension to the Seagreen project, designated as Seagreen 1a. The application has been recommended for approval, with a decision to be made by the end of 2021. Planning consent is in place for the extension's 36 10MW turbines, however the developers are looking to increase its power capacity for the next CfD auction. Following discussions with National Grid, a new grid connection of 500MW has been granted, allowing for more powerful turbines to be considered. The turbines will connect to landfall at Cockenzie via a 108km-cable corridor, followed by an underground cable to a new onshore substation.

The UK's long-term project pipeline was strengthened in 2020 with the long-awaited publication of the government's Energy White Paper, institutionalising the 40GW operational capacity by 2030 target. Steps to reach that target as well as prepare for the post-2030 buildout were taken in 2020 and early 2021 with the launch of the Crown Estate England & Wales and the Crown Estate Scotland's ScotWind seabed leasing rounds. This year will also see the launch of the fourth CfD allocation round in December 2021, with results expected in early 2022.

Looking first at the CfD auction, in which up to 11GW of offshore wind capacity could participate. Planning consent has been secured for approx. 6GW worth of projects. An additional 5GW could reach consent in the months leading up to the subsidy round, including ScottishPower Renewables' 800MW East Anglia 1 North and 900MW East Anglia 2 projects, which are due consents in January 2022. A decision on Vattenfall's 1.8GW Norfolk Boreas development has been pushed back to 10 December, with the project needing final consents secured to compete for support. Consent for the 1.8GW sister project Norfolk Vanguard was

Bidding Area	Location	Developer	Proposed capacity (MW)	Option fee deposit paid (exc. VAT)
Dogger Bank A & B	Off the Yorkshire Coast, North East of Scarborough	RWE Renewables	1500 & 1500	£114,304,500 & £133,350,000
Humber Estuary	Off the Lincolnshire Coast, East of the Humber Estuary	Green Investment Group – TotalEnergies consortium	1500	£124,573,500
Mona	Off the Northern Welsh Coast, North East of Anglesey			
	EnBW-BP consortium	1500	£231,000,000	
Morgan	Off the coast of Barrow-In-Furness, West of Morecambe Bay	EnBW-BP consortium	1500	£231,000,000
Morecambe Bay (Flotation)	Off the Lancashire Coast, West of Blackpool and South West of Morecambe Bay	Offshore Wind Limited (Cobra Instalaciones y Servicios, S.A. and Flotation Energy plc Joint Venture)	480	£44,751,840

Table 1

List of projects and successful bidders that are to progress to the next stage of the Round 4 seabed leasing process. ***Source: The Crown Estate.***

rescinded in early 2021, after a judicial challenge was launched by a local resident focusing on the potential cumulative impacts of the projects' onshore transmission infrastructure. At the time of writing, the Department for Business, Energy and Industrial Strategy (BEIS) was understood to be forgoing an appeal of the decision, opting instead to re-determine consent on the project. A timeline and process for this was not disclosed. However, the Government has recently extended the CfD round's application window from January to July 2022, which is expected to give these yet-to-be consented projects, a better chance of taking part.

While offshore wind has seen an uptick in the demand for and occurrence of PPAs and wholesale trading as alternative financing mechanisms to subsidies, the uncertainty caused by the Covid-19 pandemic in power demand and thus prices, has put subsidy auction rounds firmly back on everyone's agenda. The UK has allocated an additional £265m to support the upcoming CfD auction, with £224m of this budget going towards fixed-bottom offshore wind. Floating offshore projects are also taking part for the first time in the second pot for less established technologies. Of the £55m available for this pot, £24m has been ringfenced for floating turbines. Both fixed and floating projects also do not have any capacity caps in place and final levels of support and capacity may increase ahead of the auction's opening in December.

Increased scrutiny on commitments made by developers in terms of local contracting and investment is expected for the next CfD round, with the UK government running two consultations in late 2020 and early 2021 on proposed changes to the Supply Chain Plans (SCPs) that are submitted with CfD bids. Proposals cover a compliance and monitoring process for the commitments made in SCPs as well as a more detailed supply chain questionnaire aligned with the UK's Industrial Strategy for developers to complete as part of the application process. In a consultation in July 2021, BEIS issued the 21 questions that will form the SCP questionnaire. The questionnaire is divided into four sections: green growth, skills, infrastructure and innovation; with most importance given to the estimated local content percentage across the project's life cycle.

A string of UK supply chain investment announcements have been made in the past year, including plans by the UK's Offshore Wind Growth Partnership (OWGP) to launch a funding call of £4.2m for UK supply chain companies - its largest funding investment to date. Following this, OWGP launched a £3m funding

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programme for UK companies focussing on the consenting and development process to help accelerate the planning stage of offshore wind farms. In the UK's Autumn Budget 2021 £380m was administered to offshore wind, and £160m was confirmed for upgrading port infrastructure and manufacturing.

The Government is also investing £95m for the development of two offshore wind port hubs on Humber and Teesside. Able Marine Energy Park (AMEP) and Teesworks Offshore Manufacturing Centres are due to receive up to £75m and £20m respectively, with construction activities to begin later in 2021. Both ports have been designated as freeports under a new initiative announced by the UK's Chancellor in early March 2021. AMEP also holds an exclusive Memorandum of Understanding (MoU) with SeAH for the establishment of a monopile foundation fabrication facility, which would represent the country's first such site.

Following this announcement, in July 2021 foundation manufacturers SeaH Wind and Smulders announced plans to invest more than £180m from private investment, on top of grant funding from the Government's Offshore Wind Manufacturing Investment Support scheme, into its production facilities. SeAH Wind will secure £117m for its monopile foundation factory at the AMEP and Smulders Projects UK, receiving £70m for its existing site in Wallsend, Newcastle, for transition pieces. GRI Renewable Industries has also announced plans to

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construct a turbine tower factory at AMEP. It will initially supply 100 towers a year and is expected to become the most relevant and biggest marshalling port for offshore wind in the UK. At the Port of Leith, Forth Ports plans to invest £40m to create Scotland's offshore wind hub for installation vessels. The site will accommodate a heavy lift capability of 100 tonnes per square metre, logistics and marshalling, and lay down, assembly, supply chain, and manufacturing activities.

The Teesside area meanwhile has been selected by GE Renewable Energy for the manufacture of 107-metre Haliade-X turbine blades. The manufacturer secured planning approval for the factory in September 2021. Construction started a month later and production is due to begin in 2023. The turbine supplier is also looking at a potential tower fabrication site at the Port of Nigg in partnership with Global Energy. An £18.9m investment to expand capabilities at the port could be made, which would also see the fabrication of offshore substation components in collaboration with Rosetti Marino. Siemens Gamesa is enhancing its turbine manufacturing capabilities in the region too, with construction underway to double the size of its blade manufacturing plant in Hull by 2023. Another Scottish supply chain player that has seen significant change is Burntisland Fabrications (BiFab), whose Methil and Arnish facilities have been acquired by Harland & Wolff owner Infrastrata. The company holds a non-exclusive partnership with Navantia and Windar for the fabrication of offshore wind foundations. In April 2021, Saipem signed the Neart na Gaoithe contract for the supply of eight jacket foundations with Harland & Wolff, which became void in 2020 when BiFab went into administration. Meanwhile, Germany's EEW Special Pipe Constructions (SPC) sold its Teeside EEW Offshore Structures Britain (OSB) site in July 2021 to Wilton Engineering.

JDR Cable Systems recently revealed its plans to build the £130m Cambois subsea cable manufacturing facility near Blyth, Northumberland, by 2024. XLCC has also signed an option agreement with Peel Ports Clydeport for the construction of two HVDC subsea cables in Ayreshire, Scotland. A planning application will be submitted in February 2021 and production will focus on cables for interconnections and export cables. In addition, major developers have recently shown their interest in strengthening their presence in the UK market.

TotalEnergies has opened its UK Offshore Wind Hub in Aberdeen, which will help the move of its existing oil and gas presence in the area to offshore wind. The opening is likely to help drive its interest in floating wind and the latest ScotWind leasing round (discussed later). Research into advancing the UK's potential port capabilities also continues, with a recent independent Port Enhancement Study highlighting Cromarty Firth as a strong location for a marshalling and assembly hub for the sector in the near future.

The Crown Estate England & Wales Round 4 seabed leasing process was first launched in late 2019, an overview of which can be found in Figure 2. The round's timeline was adjusted in October 2020 owing to impacts from the Covid-19 pandemic, with completion of the lease awards now expected in spring 2022 instead of 2021. The multi-cycling bidding process was delayed to early 2021 and preferred bidders were eventually announced in February. The stage featured an auction process for the sites based on competitive annual option fees to be paid. The current successful bidders of the seabed leasing round progressing to the next stage can be found in Table 1. Successful sites and their developers will now undergo a nine- to twelve-month Plan-Level Habitats Regulations Assessment (HRA) before a Wind Farm Agreement of Lease is awarded in spring 2022. The lease award remains subject to the outcome of the HRA, as evident in the rejection of a lease agreement for Ørsted's Race Bank extension project in 2019 after the HRA was conducted.

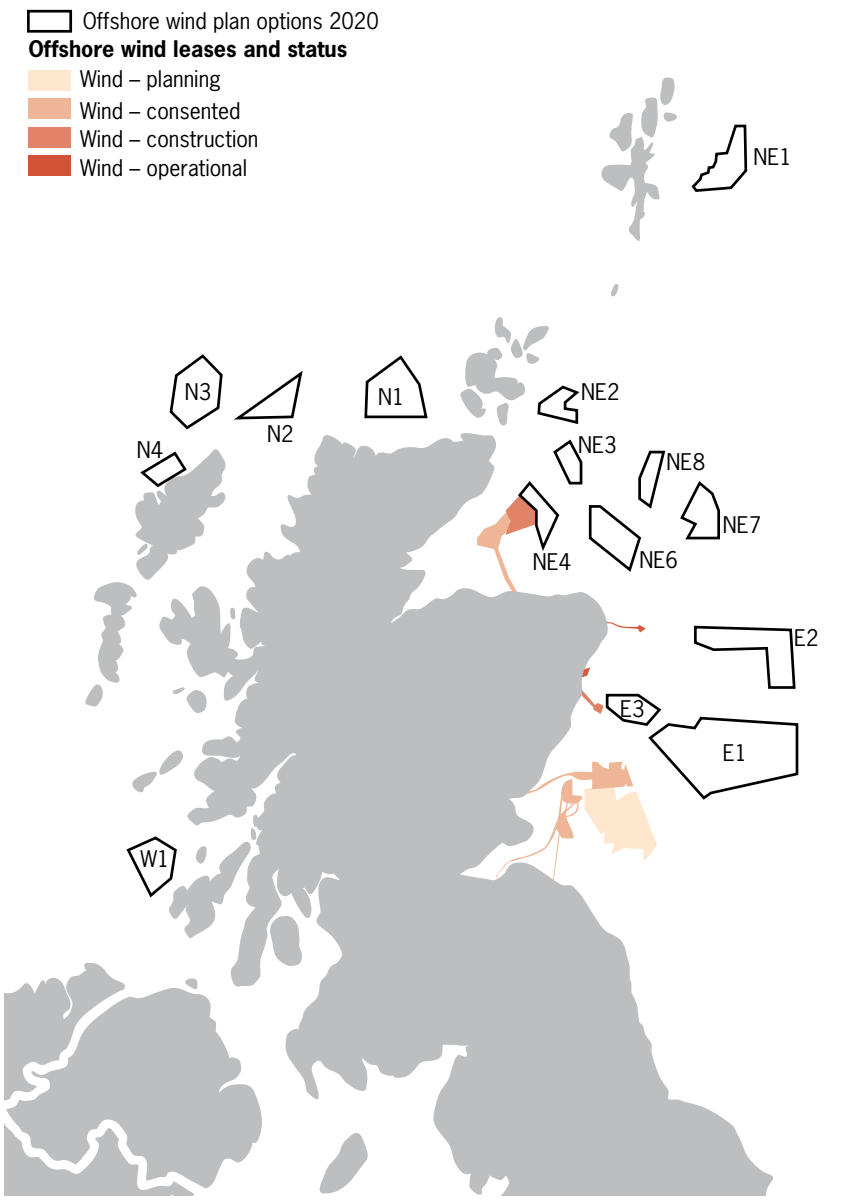

Figure 2

Overview of offshore wind plan options and current developments as outlined in the Sectoral Marine Plan for Offshore Wind Energy.
Source: Scottish Government.

Results have added another potential 8GW of offshore wind capacity to the UK's project pipeline and has seen the entry of new offshore wind developers to the market, including BP and TotalEnergies. The bidding process has been criticised by industry stakeholders for potentially driving up the long-term costs of offshore wind with the annual option fee arrangement that will see selected developers pay a total of £879m (approx. US$1.2bn) until project

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consents have been secured. The outcome has led to fears that future rounds will continue to benefit companies with significant balance sheets, at the expense of smaller industry players or criteria based on technical ability and offshore wind expertise. The high option fees could also lead to repercussions for consumer prices as well as for results achieved in the next CfD auction round. It has, however, been a clear signal for the market demand for UK offshore wind sites.

A new floating wind seabed leasing round was also drafted in November 2021 by the Crown Estate, for the development of up to 4GW of capacity in England and Wales. The process could see rights awarded as early as the end of 2023, with delivery of the selected projects anticipated for 2030 onwards. Engagement with stakeholders on the process will now take place in two phases over the winter of 2021/22, with phase one covering spatial design and locations, and the second focussing on the tender design, supply chain, community benefits, ports and grids and other wider considerations.

In late March 2021, the Crown Estate Scotland (CES) published updated designs for the ongoing ScotWind seabed leasing round, after the Crown Estate England & Wales results prompted a review of the process. However, a change to the same competitive bidding process was rejected by CES, who opted instead for an increase in the maximum one-off option fees to £100,000 per square kilometre, from an initial £10,000.

Formally Confirmed Bidders	Additional Information
Shell and Scottish Power Renewables (Iberdrola)	Multiple proposals submitted for large-scale floating offshore wind farms. (Previously was considering three sites for two 2GW connection due in 2028 and 2033 as well as a 1GW project to be connected by 2031).
NextGen (Parkwind, Quaybridge Scotland, and Maple Power)	Project proposed in 2018, with early development work/ surveys completed. Backed by several strategic partners, including BlackRock's latest Global Renewable Power Strategy and Sumitomo Corporation. Ripple joined consortium to help bring community ownership for applications. Partrac completed a campaign of meteorological and oceanographic measurements for the site.
Equinor	Bid for a floating wind development.
RWE	Specific technology undisclosed, but likely to be floating wind based on its worldwide activity.
Magnora and TechnipFMC	Two applications submitted for floating offshore wind farms (under JV Magnora Offshore Wind).
BP and EnBW	£10m investment to build 2.9GW of offshore wind development, to power Scottish households, a green H2 production plant and EV charging network. – investment covers supporting infrastructure, including ports, harbours and shipyards Bespoke supply chain portal previously launched for the Scottish engineering and supply sector. Heads of Terms agreement previously signed with Forth Ports for planned Renewables Hub at the Port of Leith.
Mainstream Renewable Power and Siemens Financial Services (SFS)	Siemens Gamesa Renewable Energy and Siemens Energy to work as Tier One suppliers if the bid is successful. (Previously MRP planned to pursue the 2GW Belzona project for a 2028 start-up date on the western coast).
ESB	Applications for two floating wind farms with a capacity of up to 1GW each.
Invenergy & BW Offshore	JV formed to develop up to 5.4GW as part of leasing round (fixed and floating)
BayWa, Elicio and BW Ideol	The partnership (named the Floating Energy Allyance) has already signed an MoU with the Port of Cromarty Firth for a serial production facility for floating foundations. Exploring two floating wind sites – 1.2GW (Buchan 1) and 932MW (Buchan 2). Committed to manufacture 100% of floating concrete foundations at a port location in Scotland.
DEME Concessions, Qair Marine, and Aspiravi International	Consortium called Thistle Wind Partners (TWP). Early development works done at Scotwind sites
Aker Offshore Wind and Ocean Winds	Joint bid to develop up to 6GW of FOW in several sites in the Outer Moray Firth. Aker plans to use underwater substations as part of bid.

Formally Confirmed Bidders	Additional Information
Ørsted, Falck Renewables, and BlueFloat Energy	Two floating bids submitted. Partnered with Energy4All to execute community ownership scheme to share the financial benefits. Falck Renewables and BlueFloat Energy previously signed a letter of interest with Peterhead Port Authority to study construction and maintenance options for proposed floating projects. As part of its 5 bids (>8.5GW), Ørsted intends to invest up to £12bn with Scottish companies to build offshore wind over the next decades.
Ørsted	Three bids – mix of fixed and floating. Previously secured a 1.8GW grid connection on the eastern coast for use, should it be successful for a 2033 connection. As part of its 5 bids (>8.5GW), Ørsted intends to invest up to £12bn with Scottish companies to build offshore wind over the next decades.
Cobra and Flotation Energy	Up to 7GW across several sites. Partnering with Wood and Royal Haskoning DHV.
TotalEnergies, Green Investment Group (GIG) and Renewable Infrastructure Development Group (RIDG)	2GW bid – West of Orkney Wind Farm (2029) – MoU with the European Marine Energy Centre on Orkney (technical innovation and environmental data collection) – site investigations done and grid connection finalised. Looking to use the electricity to produce green hydrogen industrial scale at Flotta Terminal (Repsol). Has a £140m initiative to develop Scottish SC & harbour infrastructure for this project.
Fred Olsen Renewables and Vattenfall	Signed 3 MoUs with two Orkney offshore service providers, Green Marine and Leask Marine, and Orkney Harbour Authority – to facilitate the development of local suppliers & opportunities in the area.

Other Major Bidders	Additional Information
Eni and Red Rock	Proposal supported by Transmission Investment, bringing extensive expertise in grid infrastructure.
SSE Renewables, Marubeni Corporation and Copenhagen Infrastructure Partners	Signed an MoU with the University of Highlands and Islands to collaborate on the delivery of targeted education, research and employability initiatives. SSE has Scottish grid connections secured for almost 2GW.
Macquarie Capital	Previously reported to be seeking connections for a 1.5GW project and a 750MW project through its Offshore Wind Power Ltd affiliation.

Tables 2 and 3

List of some of the major developers bidding in the ScotWind Leasing Round, with additional information regarding relevant consortium/development plans. Developers are tabulated based on confirmed bids after 16 July (Table 2) or announcements prior to the deadline (Table 3).
Sources: EICDataStream; OffshoreWindBiz.

The new designs now provide developers the option of valuing their bids at £2,000, £6,000 or £10,000 per km2 or in the new bands at £10,000 intervals up to the maximum of £100,000. The total option fee amount that can now be leveraged stands at £860m, as opposed to the initial £86m from 8,600km2 of seabed available. In addition, the threshold for commitments made as part of the Supply Chain Development Statement has been raised to 25% from an initial 10%, a change that reports have deemed should not be an issue, in terms of implementation for developers and their respective projects. The submission of a Supply Chain Development Statement is a requirement for all developers participating in the leasing round.

ScotWind covers 15 biddings areas, with the majority featuring water depths that would favour floating foundation technology. Only three areas hold depths of 60 metres and less. The presence of oil and gas platforms in the region offers the opportunity for additional cross-sector decarbonisation projects, particularly for smaller floating developments of up to 250MW in the zones E1, E2 and NE7. Interest and intention to participate has been voiced by a number of developers, of which many major players have formed various consortiums to jointly bid in the process.

The application window for bids officially closed on 16 July 2021. CES received 74 applications from developers looking to secure project rights in the 15 areas.

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Figure 3

Map of extension projects of existing offshore wind farms in the UK, currently in the planning stages.
Source: EICDataStream.

Many of the bidders are reportedly major developers proposing floating technology. However, it is important to note that this is only the very initial stage of the leasing process, with various hurdles still ahead, before a seabed lease is finally secured. Each application is currently being assessed one by one, and in January 2022 initial offers for the first option agreements to successful applicants will be made. Following this the agreements will be finalised, and developers will start progressing with their detailed plans to bring the wind farms forward in the planning process. Only when all the required consents have been secured, will CES grant full seabed leases. A list of some of the major developers that have reportedly placed bids in the auction can be found in Tables 2 and 3 (as of October 2021).

CES also plans to open another new leasing process in early 2022. The Scottish Government launched a consultation for a new Sectoral Marine Plan for Offshore Wind for Innovation and Targeted Oil and Gas Decarbonisation (INTOG) in August 2021. The tender will focus on offshore wind farms that will decarbonise the O&G sector and innovation projects with capacities less than 100MW.

Developers of Scottish offshore wind projects will face particular challenges, including the already noticeably greater complexity in seabed conditions that increases project costs. One example of this is the diverse physical characteristics of the surrounding waters having a mix of deeper and wider ranged water depths. Scottish offshore wind farms are yet to reach the scale of offshore wind complexes like Dogger Bank or the East Anglia Hub, meaning synergies and economies of scale cannot be exploited for greater cost reduction. Another significant issue that the industry demands to be addressed is the higher transmission charge for Scottish developments. The issue becomes especially pertinent with the increased competition in CfD rounds and the number of projects across the UK looking to

OFFSHORE GRID SYSTEM APPROACH – NO LONGER FIT FOR PURPOSE?

Reaching a 40GW by 2030 target will mean another 30GW of offshore wind energy connected to the UK grid throughout this decade. Under the current approach, responsibility for the construction and installation of offshore substations, export cables and the onshore connection lies with the developer. The infrastructure is then sold under the Office of Gas and Electricity Markets (Ofgem) competitive tender process for offshore transmission. The successful bidder becomes the Offshore Transmission Owner (OFTO).

With the increasing scale of projects and the sheer volume of capacity to be connected, concerns have been raised over the cumulative impacts, particularly concerning the onshore connection. The issue has been exemplified in the recent overturning of BEIS' planning consent of the Norfolk Vanguard by a UK High Court after local residents had filed a judicial challenge over the potential cumulative onshore impacts for the Norfolk Vanguard and Boreas connections. A shift to a centralised offshore grid system as currently practiced in Germany and the Netherlands could reduce the number of onshore connections required by bundling offshore grid connections for several offshore wind projects into one power export cable. National Grid estimates suggest that shifting to a centralised approach could save consumers £6bn by 2050, though this would pose a significant challenge and could endanger the 40GW target. Implementing an integrated offshore grid by 2030 would still save consumers £3bn.

To assess the future approach to offshore grid connections, BEIS and Ofgem have established four workstreams:

1) Early opportunities: assessing the opportunity for minor changes or flexibility in projects under advanced development, with a view to consulting on regulatory changes in 2021

2) Pathways to 2030: a focus on projects planned for start-up in the late 2020s or early 2030s, including projects developed out of the fourth Crown Estate and the ScotWind leasing rounds. Considerations will be made to ensure the offshore grid approach does not pose a barrier to the realisation of a 40GW by 2030 target. Interactions between the onshore and offshore sections of the transmission infrastructure will be considered.

3) Enduring regime: establishing a new policy framework for future and long-term offshore wind connections, expected to require changes to current regulations and industry codes.

4) Multi-purpose interconnectors (MPIs): ensuring that legislative changes are aligned with the realisation MPIs from 2027 onwards

Information on Ofgem's approach to offshore transmission as well as updates on the workstreams can be found at https://www.ofgem.gov.uk/electricity/transmission-networks/offshore-transmission and https://www.gov.uk/government/groups/offshore-transmission-network-review.

participate. It is understood that current Ofgem regulations can add up to £10/MWh to price tags. Grid charging costs could see the levelized energy cost increase by 6.8% for developments in the 2030s.

When looking further down the UK's project pipeline, the country will be seeing the addition of "extensions" to some of the existing offshore wind farms installed from earlier Crown Estate leasing rounds. Alongside the wind farm sites in the current seabed leasing round, these extension projects also will come into fruition towards the latter half of the decade and will be where procurement opportunities lie during this period. Figure 3 shows the six extension projects tracked on EICDataStream that are currently in the planning stages, with consent applications to begin from 2022 onwards.

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In November 2020, the European Union unveiled its offshore wind deployment target of 60GW by 2030 and 300GW by 2050, as part of the union's Offshore Renewable Energy Strategy. The target will support the union's long-term plan of carbon neutrality by 2050 under the European Green Deal, and comes alongside additional strategies for electrification, transport and the deployment of 40GW worth of electrolysers for the production of green hydrogen. Implementation of these targets will be supported by the promotion of clear legislative frameworks, strengthening of regional supply chains as well as the support for investments and raising of funds to finance an expansion in renewables. A framework will also be developed for future offshore grid system build-out as European countries continue to assess the potential for greater interconnectivity.

Following this in July 2021, the European Commission put forward its "Fit-for-55" package, which intends to reduce the EU's greenhouse gas emissions to 55% by 2030, to assist the course to net zero by 2050. As part of the package, alongside proposals on carbon pricing, corporate renewable PPAs, energy taxation, and electric vehicles, the EU's 2030 renewables target has increased from 32% to 40%. This rise is said to require 30GW of wind energy installations per year from now until 2030, increasing the current 179GW capacity by threefold to 452GW. However, at present only 15GW is being built annually, and has now put further pressure on the region to bolster its offshore wind sector. The new proposals have instigated discussions on the market's setbacks and the package will now be debated by National Governments and the European Parliament, to take the next steps in bringing it forward.

The region reached approximately 25GW of installed capacity by

Country	Projects	Volume (MW)	Date	Description
UK	Various – Seagreen 1a, East Anglia Hub, Moray West, Hornsea Project Three, Norfolk Boreas	5,000	December 2021	CfD Allocation Round 4 for 12GW across technologies, floating separate
Denmark	Thor; Hesselo	1,600-2,200	November 2021; 2022	Prequalification closed for Thor (800-1,000MW), prequalification for Hesselo to open in 2021
Norway	Utsira Nord; Sørlige Nordsjø II	4,500	January 2021	Applications opened in June 2020, with tender launch in January 2021; floating technology for Utsira Nord
Netherlands	Hollandse Kust West (Alpha + Beta)	1,400	Q3/Q4 2021	Centralised tender for pre-determined zones – process under review. Zero subsidy continues?
France	Normandy; Brittany	1,270	TBC	1,000MW fixed-bottom project for Normandy (additional 2GW to follow); April 2021: Up to 270MW floating for Brittany tender launched
Germany	N-3.7; N-3.8; O-1.3 (Baltic Sea)	950	September 2021	255MW, 433MW and 300MW respectively; new centralised tender model with pre-emption rights for certain developers.
Poland	Baltic Power, EW Baltica-2 & Baltica-3, FEW Baltic II, B-Wind & C-Wind Polska, Baltyk II & III	5,900	June 2021	CfD-style auction with price cap at PLN 319.6 (€67.93); Applications submitted.

Table 4

Planned European offshore wind auctions 2021-2022.
Source: Government sources, Platts Power in Europe, offshorewind.biz.

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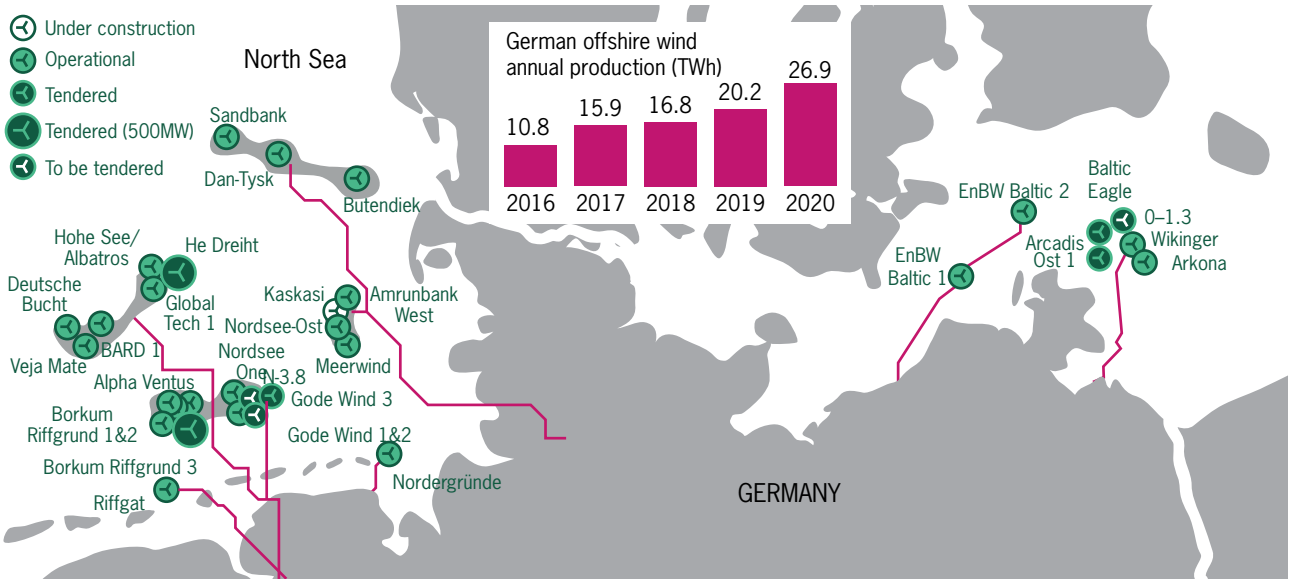

Figure 4

Overview of Germany's offshore wind portfolio.
Source: Platts Power in Europe, TenneT.

the end of 2020, with the UK making up just over 10GW. Current project pipelines tracked under EICDataStream amount to around 111GW by 2030 (excluding the UK), although current estimates of projects could delay certain start-up times into the early to mid-2030s. To maximise early planning and collaboration, offshore wind development will benefit from the publication of National Maritime Spatial Plans, for which the submission deadline for coastal states was 31 March 2021. However as of the end of April only six countries met this deadline, with 16 countries yet to submit their plans. The EU's project pipeline is further aided by continued tender and auction processes across several countries as can be seen in Table 4. Prominent in this list Poland, which is seeing its first CfD-style auction for 5.9GW of offshore wind capacity.

Germany

Germany's current installation rates have slowed down when compared to its previous years. In 2021, the country is set to installing zero offshore wind turbines, making it the first time the sector has not increased in capacity in over 10 years. There are a number of setbacks currently stalling its growth, including its slow and complex permitting process, lack of grid capacity and a lack of political action to bolster the market's expansion.

Germany's parliament approved the country's updated offshore wind law, the Windenergie-auf-See-Gesetz (WindSeeG) in late 2020, setting the 20GW by 2030 target in stone. Long-term ambitions will see 40GW of operational capacity by 2040, up from the current 7.1GW. With increasing movement and interest in the green hydrogen production market, the German government is furthermore considering plans for specific offshore wind tenders for the production of green hydrogen, in line with a potential electrolyser capacity target of 5GW by 2030. In October 2021 the Ordinance on Auctioning Sites for Alternative Energy Generation in the German Exclusive Economic Zone came into force, for the purpose of producing offshore green hydrogen. Germany's Federal Maritime and Hydrographic Agency (BSH) will be responsible for future technology-neutral auction sites, with auctions expected to start as early as 2022.

Notable projects in this regard include the AquaVentus project led by RWE Renewables, which is targeting up to 10GW of offshore wind capacity by 2035 for the

production of green hydrogen. A first phase will see deployment of a 14MW AquaPrimus hybrid turbine-electrolyser unit at the port of Mukran in 2023. By 2025, the next phase will see two further turbine hybrids installed, with green hydrogen produced to be transported to Heligoland for consumption. In May and June 2021, the project saw numerous well-known companies join the initiative, including the likes of Ørsted, Van Oord Offshore and McDermott. Creating a second demand and offtake market for offshore wind in Germany is particularly incentivised by ongoing onshore grid constraints that prohibit the power produced in the North to the country's southern demand centres.

Zone	Tender Year	Volume (MW)	Year of Commiss-ioning	Area (km2)	Planned grid connection
N-3.7	2021	255	2026	17	NOR-3-3
N-3.8	2021	433	2026	23	NOR-3-3
O-1.3	2021	300	2026	25	OST-1-4
N-7.2	2022	930	2027	58	NOR-7-2
N-3.5	2023	420	2028	29	NOR-3-2
N-3.6	2023	480	2028	33	NOR-3-2
N-6.6	2024	630	2029	16	NOR-6-3
N-6.7	2024	270	2029	45	NOR-6-3
N-9.1	2024	1,000	2029	100	NOR-9-1
N-9.2	2024	1,000	2029	104	NOR-9-1
N.10-1	2025	1,000	2030	95	NOR-10-1
N-10.2	2025	1,000	2030	93	NOR-10-1
N-9.3	2025	1,000	2030	105	NOR-9-2
N-9.4	2025	1,000	2030	99	NOR-9-2

Table 5

Overview of Germany's 2021-2025 offshore wind auction schedule. Zones are those listed in the 2020 Area Development Plan.
Source: Recharge; German Wind Energy Association.

Germany's third offshore wind tender round was launched on 26 February 2021, after an almost three-year hiatus that had left the local wind industry almost begging legislators to ramp up ambitions and targets. That process is now underway in a first step to reaching 20GW of installed capacity by 2030. The third auction round represents 958MW in capacity across three sites: N-3.7 and N-3.8 in the North Sea as well as O-1.3 in the Baltic Sea. Projects were awarded based on price, with the lowest bidder successful. However, the tender also included a right of entry option for developers holding offshore wind sites from the country's previous decentralised siting and tender model. Companies had the option of matching a winning bidder's proposal to secure the development rights for a zone. The tender will include an award of the grid connection agreement as well as completed maritime, soil, wind and oceanographic assessments that were carried out by BSH. The costs of these pre-assessments will be charged to the winning developer, with information to be used for the project's consent application.

Bids were invited for the tender until September 2021and were capped at €73/MWh, compared to the €120/MWh that was set for the 2017 auction. As of September 2021, RWE Renewables and EDF Renewables were selected as the winners of the 225MW N-3.7 and 433MW N-3.8 sites respectively. Due to no other step-in rights existing at N-3.7, it is certain that RWE Renewables will develop a project here. However, Northland Power and RWE Renewables exercised their existing step-in rights at N-3.8 in November, securing the lease instead to build its Nordsee Two project. It is noted that Northland Power and RWE Renewables are reportedly looking to co-develop a 1.3GW cluster, by targeting its step-in rights and entering the three upcoming auctions at N-3.8, and the 480MW N-3.6 and 420MW N-3.5 - the latter two would be put on the block in 2023. For the 300MW O-1.3 zone, RWE Renewables was chosen as the winner of the tender. Yet again in November Iberdrola exercised its step-in rights based on RWE's lowest bid, where the company will now develop its 300MW Windanker

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wind farm. Overall commissioning of the projects at the three zones are scheduled for 2026.

While initiating the new tender schedule and model was an important step towards Germany's goals, current capacity and thus project scales arguably leave much to be desired to revive a local supply chain that has been waiting for activities to continue. Increases in project scale to the 1GW range are currently planned for 2024, with 2GW zones to be tendered after 2025, for a post-2030 commissioning date according to draft plans identified in the 2020 Area Development Plan. Various site investigation activities are currently being carried out at the N-3, N-9, and N-10 zones in preparation for the tenders and their respective documentation, and assessments of the wind conditions at the N-6.6 and N-7.2 sites are underway by Offshore Wind Consultants (OWC).

Despite industry requests, no special tender to fill the gap in the offshore wind pipeline will be introduced by the government. The next round of installation campaigns to launch in the coming two to three years are now focused on Iberdrola's Baltic Eagle, Ørsted's Borkum Riffgrund 3 and Gode Wind 3, EnBW's 900MW He Dreiht as well as RWE Renewables' 342MW Kaskasi, which achieved FID in April 2020. Subsea 7-subsidiary Seaway 7 will lead as the main installation contractor for the offshore substation, 38 monopile foundations and 52km of 33kV inter-array cables. Offshore construction work is expected to commence in 2021, with start-up in 2022. Bladt Industries is fabricating the offshore substation with Semco Maritime handling the electrical installation aspect, while Twentsche Kabel Fabriek (TKF) is covering the array cable scope. Bladt is also responsible for monopile foundations, which will feature a trial of specialised collars at three units under an RWE patent. Turbines will be delivered by Siemens Gamesa in the SG 8.0-167 DD Flex model and will feature the world's first recyclable wind turbine for commercial offshore use.

The other developments listed above are currently finalising project designs, with procurement of the main packages underway. The He Dreiht project is currently tendering for various supply packages with awards expected to be made towards the end of 2021 and 2022. The project will feature 70 turbines – for which Vestas has been pre-selected to provide its V236-15.0 MW units - located 90km northwest of Borkum island. Once an unconditional offer is in place, installations will begin in Q2 2025 and will be the world's first deployment of its new 15MW turbine. At the time of writing, updated plans were yet to be filed to feature this bigger and latest hardware.

Iberdrola recently announced EEW as the monopile foundation supplier for its 476MW Baltic Eagle project located 28km north of Rügen. The project will feature 50 units of V174-9.5MW Vestas turbines, for which the Port of Roenne will be the installation port, and is due for commissioning in 2024/25. The 50 monopile foundations will be fabricated in its Rostock factory in January 2022 for load-out in April 2023. Windar will supply the accompanying transition pieces with main construction works taking place in its yard in Avilés, Spain. Van Oord has been chosen for the transport and installation of monopile foundations and for the supply and installation of inter-array cables, and Fred Olsen Windcarrier for the transportation and installation of Vestas' turbines, while Engie Fabricom-Iemants will fabricate the offshore substation and its jacket foundation. Van Oord has also awarded contracts to Tekmar Energy for cable protection systems and TKF for inter-array cables. An FID for the project is still pending.

Ørsted's Gode Wind 3 and Borkum Riffgrund 3 projects have secured planning approval in April and October 2021 respectively from BSH, now having all the required consents from authorities under its belt. For both developments Prysmian is responsible for the design, supply and testing of more than 150km of 66 kV XLPE–insulated inter-array submarine cable systems, Bladt Industries and Steelwind Nordenham will supply the 107 XXL monopiles, and Jan de Nul will transport and install the monopiles. Boskalis will also install the 106 inter-array cables. An FID is expected for both projects by the end of 2021. Subject to this FID, 50% of Ørsted's share in the project will be farmed down to Glennmount Partners. Ørsted and BASF have also signed a 25-year corporate PPA for 186MW of the Borkum Riffgrund site – the longest corporate PPA ever announced for an offshore wind development.

OFFSHORE GRID SYSTEM EXPANSION –CONNECTING THE FUTURE

Designing and constructing an effective offshore grid system is crucial in realising the current European offshore wind pipeline and thus meeting climate change and renewable energy targets. Germany and the Netherlands continue to take a centralised approach to this, with transmission system operators (TSOs) TenneT, Amprion and 50Hertz responsible for the development and installation of offshore platforms and power export cable system that connect offshore wind clusters to the main onshore grid.

In the Netherlands, TenneT is progressing with grid build-out in line with the country's offshore wind tender schedule. Key contractors were announced throughout 2020 for the next batch of projects, covering the Hollandse Kust Noord (HKN) and Hollandse Kust West (HKW) Alpha platforms, with options in place for the Hollandse Kust West Beta development. Platform designs feature TenneT's standardised 700MW concept, with HKN comprising a 45-metre high jacket foundation of 1,930 tonnes and pin piles of 870 tonnes. Engie Fabricom and Iemants (Smulders) secured the overall supply and installation scope for the HKN and HKW projects in 2020, with DEME Offshore responsible for transport and installation of the units. HVAC cable systems of 220kV will be supplied by LS Cable & System and installed by Jan De Nul. TenneT is also developing three 2GW, 525kV offshore platform concepts for the 6GW Ijmuiden Ver zone (Alpha, Beta & Gamma) due to be installed in the second half of the decade. A qualification system for the construction scope was launched in April 2021, and a tender for the first 2GW connection opened in October. . Consultation on the draft permit and draft spatial plan for the Beta and Alpha connections will start end of 2021 and at the beginning of 2022 respectively, with final permits in place by mid-2022. The Gamma connection was only recently proposed early this year, to utilise the synergistic benefits with the Beta offshore grid as much as possible. TenneT will build the two 2 GW offshore grid connections, with the first one planned for 2028. If consented, the Gamma project must be operational by 2030, at the latest. In Germany, wind industry associations voiced support in March 2021 for TSO plans that will see 10GW of new capacity connected between 2030 and 2035. The proposals fall under Scenario B of the regular area development plan updates put forward by German TSOs Amprion, 50Hertz, TenneT and TransnetBW. Featured are at least five 2GW North Sea offshore grid hubs until 2035, representing an investment of €35.5bn. It is understood that Amprion would lead on the delivery of the LanWin4, LanWin3 and LanWin1 hubs in 2031, 2033 and 2035 respectively, while TenneT focuses on construction the LanWin5 and LanWin2 hubs in 2033 and 2034. The systems would allow for both electrical connection as well as power-to-X solutions. Updated grid plans are expected in the coming months. Germany will be keen to exploit future green hydrogen production opportunities to take the pressure off onshore grid constraints that have so far hampered a full-scale offshore wind build-out. Construction and fabrication activities for the offshore systems currently focused on the DolWin5 and DolWin6 HVDC systems under TenneT that will start-up in 2023/24, both under construction.. Meanwhile Amprion is moving forward in the consenting process with the BorWin4 and DolWin4 developments – due towards the end of the decade. As in the Netherlands, platforms will be upgraded from 900MW capacity ranges to 2GW for future developments.

Netherlands

The commissioning of the 752MW Borssele I&II (Ørsted) and the 731MW Borssele III&IV (Blauwind) projects in late 2020 and early 2021 has brought the country's operational capacity to 2.5GW out of the currently targeted 11.5GW by 2030. Construction and installation activities in the next couple of years will now be focused on the realisation of the 1.5GW Hollandse Kust Zuid project under Vattenfall and BASF as well as the 759MW Hollandse Kust Noord project that was awarded to the Shell-Eneco joint venture CrossWind in 2020. Key suppliers for each development can be found in Table 6. Offshore construction activities for Hollandse Kust Zuid commenced in July 2021, with the transportation of the foundations for its installation, followed by inter-array cables and turbines. Monopile foundation installations at the site are underway, and DEME Offshore have completed installation of the export cable. Preparations are now underway for the next round in the country's tender timeline

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Project	Operator	Start-up Year	Capacity (MW)	Key Suppliers
Hollandse Kust Zuid	Vattenfall	2023	1,500	Installation monopile foundations & inter-array cables: Subsea 7 S.A. EPC monopile foundations: Sif Group Turbines: Siemens Gamesa Renewable Energy SG DD-200 11MW Installation turbines: Cadeler EPC turbine towers: Welcon A/S OEM Supply inter-array cables: Twentsche Kabel Fabriek (TKF) (HKZ I & II) and Prysmisan Group (HKZ III & IV)
Hollandse Kust Noord	CrossWind	2023	759	Turbines: Siemens Gamesa Renewable Energy SG 11.0-200 DD EPCI turbine foundations, inter-array cables: Van Oord EPC monopile foundations: Sif Group Turbine transportation and installation: Cadeler OEM Supply inter-array cables: Twentsche Kabel Fabriek (TKF) EPC transformer jacket foundation: Heerema Fabrication Group

Table 6

Overview and key suppliers for the Hollandse Kust Noord & Hollandse Kust Zuid wind farms.
Source: EICDataStream.

for the 1.4GW Hollandse Kust West Alpha & Beta development, currently scheduled to open in December 2021. Final bids will be accepted until April 2022. The site offers water depths of 21-33 metres, sandy seabed areas and wind speeds of up to 9.81m/s at 100 metres above sea-level. Shell is the first developer to show real interest in bidding in the zone, with the oil giant actively working on designs and a contracting strategy, to put an attractive bid together.

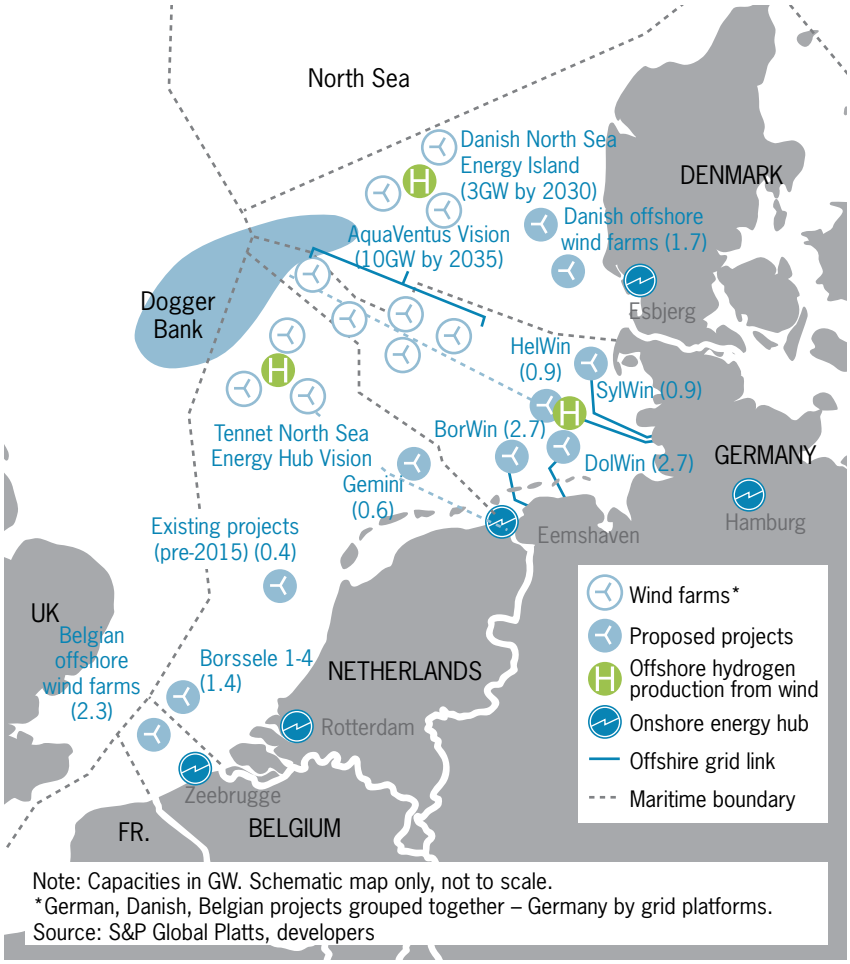
It is understood that the Dutch government will maintain the current 'beauty contest' tender mechanism for the Hollandse Kust Noord zone, which has resulted in zero-subsidy results in the previous years. Future tender rounds could, however, see a change to a pay-to-build model or an alternative auction system. Recent amendments to offshore wind legislation have meant that the government must also now evaluate shifting to a CfD model, as well as consider the future integration of offshore wind and green hydrogen in tender rounds. New regulations have also adjusted the timeframe for site permits, which will now run for 40 years instead of the original 30 years. Existing offshore wind farm owners can apply to an extension to their permits of up to 10 years.

The Hollandse Kust Noord tender will be followed by the 700MW Ten noorden van de Waddeneilanden project for a 2027 commissioning date. The tender is currently pencilled in for Q4 2022, however it is likely to be delayed due to a call for a review of the grid arrangements from ecological groups. After this the focus will be on the significant 6GW Ijmuiden Ver zone and accompanying three 2GW, 525kV offshore grid platform systems (Alpha, Beta & Gamma). The zone is located 62km off the western coast of the Netherlands. The first 2GW of capacity are due to be tendered in 2023, followed by the second 2GW round in 2025. Site assessment activities are underway for both the offshore wind arrays as well as the offshore grid system site and route corridor. DNV and Arcadis will manage the upcoming investigations at the site until December 2024. In April 2021, TenneT launched the consultations for the third 2GW offshore grid connection and confirmed the likely inclusion of this third

connection in October 2021. A tender timeline for the Gamma connection has not yet been disclosed.

The country has started looking into the long-term future for the technology's use. In April 2021 studies were underway for eight new areas off its coast, as potential locations for wind farms post 2030. The new areas have the capacity for 64.9GW of new additions, as published by the Netherlands Enterprise Agency (RVO). The LCoE study conducted with Ijmuiden Ver Noord as the reference saw that all but one of the eight areas could have lowers LCoEs in comparison to the IJmuiden Ver Wind Farm Zone.

With increasing pressure on EU governments to enhance their carbon emission reductions in line with revised EU targets, the Dutch government has confirmed its plans to increase its 11.5GW by 2030 target to 22.2GW. The country is currently on track to miss its 49% carbon emission target compared to 1990 levels by 2030. The increased capacity target will be developed in newly designated zones (1, 2, and 5 East) as well as existing zones. Prior to this announcement, scoping activities were also reportedly underway for additional offshore wind sites of up to 30GW for post-2030 start-up, with tenders expected from 2027 onwards. The country is also looking at up to 4GW of electrolyser capacity to be installed for green hydrogen production within the next 10 years, which could further support the demand for offshore wind energy.



Note: Capacities in GW. Schematic map only, not to scale.
*German, Danish, Belgian projects grouped together – Germany by grid platforms.
Source: S&P Global Platts, developers

Figure 5

Overview of North Sea Energy Hub and Hydrogen Plans.
Source: Platts Power in Europe. Capacities listed in GW.

Denmark

Denmark is pushing ahead with its offshore wind developments in a variety of different formats – from the centralised tenders for the Thor offshore wind farms to an open-door style technology tender and a new energy islands concept. Vattenfall's 605MW Kriegers Flak project started full operations in September 2021, after achieving first power in February 2021 and full turbine installation by June 2021. Following this, the Danish offshore wind market will experience a deployment pause until 2023 - the planned start-up date for the 350MW Vesterhav Nord & Syd developments as well as potential installations from other nearshore and developer-proposed projects. Over 3GW of offshore wind capacity are in development under the developer-led, technology-neutral tenders. European Energy's 240MW

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Jammerland Bugt and 320MW Omø Syd are two such examples, with project designs and permitting currently underway.

Three up to 1,000MW offshore wind projects are scheduled to be tendered and deployed by 2030 under the government's centralised system led by the Danish Energy Agency (DEA). The first two zones on offer are the 800-1,000MW Thor project based 20km offshore Nissum Fjord, and the 1,000MW Hesselø zone located approx. 50km from Grenå and 35 km from Gilleleje, on the country's eastern side.

Pre-qualification for the Thor development was completed in January 2021, resulting in six developers and consortia being chosen to progress in the tender as listed by the DEA:

- SSE Renewables Offshore Windfarm Holdings Limited and Thor OFW K/S (owned by Copenhagen Infrastructure IV Thor OFW ApS and Andel Holding A/S) on behalf of a not yet established subsidiary
- Swan Wind P/S (owned by Eneco Wind B.V. and European Energy A/S)
- Thor Wind Farm I/S (owned by RWE Wind Holding A/S and RWE Offshore Wind A/S)
- Total Renewables S.A.S and Iberdrola Renovables Internacional S.A.U on behalf of a not yet established entity
- Vattenfall Vindkraft A/S on behalf of a not yet established entity

THREE UP-TO-1,000MW OFFSHORE WIND PROJECTS ARE SCHEDULED TO BE TENDERED AND DEPLOYED BY 2030

- Ørsted Wind Power A/S

Results of the tender will be announced on 3 December 2021. The final tender conditions have been published for the bidders and the deadline for submitting bids was 8 November. Commissioning is scheduled for 2025 to 2027. Developers will be responsible for the full implementation of the project, including its transmission infrastructure, and will benefit from a 20-year CfD agreement. The government's CfD subsidy support for the project received EU state aid regulation approval in March 2021, with the project costing the state up to DKK 6.5bn (approx. €870m) across its entire lifecycle. An eight-week consultation for the project's Environmental Impact Assessment (EIA) was launched in February 2021, with information to be made available to the winning developer for the 2022–24 period. From the Strategic Environmental Assessment and public consultation, it was concluded by the DEA that the project can be realised in the dedicated site without any significant environmental impacts.

To accelerate the country's deployment of renewable energy sources, it was decided in 2020 to move the implementation and commissioning of the Hesselø wind farm forward. Operations were due to begin by 2027 (only slightly later than the Thor project), tendering to commence in 2021, and results announced at the end of 2022. However, in June 2021 the DEA temporarily paused the tendering procedure to have more time to analyse the results of the preliminary seabed studies. Having found issues with soft seabed conditions in large parts of the Hesselø site, the DEA is now looking for alternative areas, in the event of the designated site being deemed unsuitable. As of October, the DEA is currently looking into five potential alternative areas:

- A scaled-down Hesselø area + the area south of the current Hesselø area.
- A scaled-down Hesselø area + Kattegat 2, an area west of the current Hesselø area.
- Kriegers Flak 2.
- A scaled-down Hesselø area + Kriegers Flak 2 North, the northern of the two sites that make up Kriegers Flak 2.
- Nordsøen 1 (North Sea 1), the areas south of the Thor offshore wind farm.

With Vattenfall having now developed the Kriegers Flak wind farm, the developer is expecting to have higher chances of securing capacity in the two upcoming auctions for two 1.2GW

sites. Vattenfall is anticipating to leverage its existing synergies between the Hesselø project and Kriegers Flak, and the Thor project and Horns Rev and Vesterhav.

The country's third technology-neutral tender was launched in August 2021 and accepted bids until 22 October 2021. Offshore wind bids will be processed through an open-door procedure, where developers choose their own project location instead of competing for a specific site. The DEA has set a total payment ceiling of DKK 1.2bn (around €161m), and the developers can achieve a fixed price of up to 25 øre/kWh for 20 years through the tender.

In June 2020, proposals were approved for the creation of two so-called energy islands under the country's Climate Action Plan. The North Sea energy island will be created artificially for 3GW of offshore wind or up to 200 turbines to be connected by 2032, while the Bornholm energy island in the Baltic Sea will support up to 2GW of offshore wind capacity. It is noted that the Danish Ministry of Climate, Energy and Utilities has asked Energinet to increase the current area for Bornholm Energy Island. This could allow for an additional 1GW of capacity, and potentially be the new home for the Hesselø project. Energinet secured a permit from the DEA in June 2021 to start preliminary offshore wind investigations at the site of the two wind farms that will connect to the Bornholm energy island. Transmission system operator Energinet is responsible for procurement and works related to environmental and site surveys for both of the islands' wind farms, for which a number of tenders have already been issued. Procurement works will also include the possible power export cable systems, on behalf of the DEA. The authority is currently finalising plans for co-ownership of the offshore wind farms with developers, with pre-qualification to commence in late February 2022 for a result in March 2023. Construction activities under current timelines would be carried out between 2026 and 2028. Energinet will lead on the construction of the grid infrastructure, with installation due between 2029 and 2031. Long-term plans for the energy islands will see connected offshore wind capacity doubled to 10GW.

Poland and the wider Baltics

The Polish government's offshore wind ambitions were fortified with the development of support framework and legislation throughout 2020, culminating in the country's first Offshore Wind Act being signed into law by Poland's President in February 2021. The legislation paved the way for the first CfD auction for offshore wind in June 2021, which was to support up to 5.9GW in projects with subsidies. Under the legislative framework, up to 10.9GW of offshore wind capacity is to be operational or under development by 2027. A second and third round of CfD auctions are scheduled to be held in

Project	Developer	Capacity (MW)	Start-up year	Connection Agreement	Strike Price (PLN/MWh)
Baltyk II	Equinor & Polenergia	840	2025	No	319.60 (~€70/MWh)
Baltyk III	Equinor & Polenergia	600	2025	Yes	319.60 (~€70/MWh)
Baltic Power	PKN Orlen & Northland Power	1200	2026	Yes	319.60 (~€70/MWh)
EW Baltica-2	PGE & Ørsted	1498	2027	Yes	319.60 (~€70/MWh)
EW Baltica-3	PGE & Ørsted	1045	2026	Yes	319.60 (~€70/MWh)
FEW Baltic II	RWE Renewables	350	2027	Yes	319.60 (~€70/MWh)
B-Wind and C-Wind	Ocean Winds	400	2028	No	319.60 (~€70/MWh)

Table 7

Successful planned offshore wind projects for Poland in its first CfD auction 2021.
Source: EICDataStream.

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2025 and 2027 respectively, for 2.5GW of capacity each. In May 2021 the European Commission approved all of the CfD scheme's two phases which will support the projects with €22.5bn. The second phase (auctions from 2025 onwards) will grant aid through open and competitive auctions with the project reference price based on the respective bid. This is in contrast to the first phase which saw aid granted without the auction requirement, due to the limited number of projects. The Offshore Wind Act also outlines measures to streamline the consenting process and requirements for the promotion and engagement of the local supply chain for offshore wind. Following the country's new Act, Poland also signed its Offshore Wind Sector Deal in September 2021. The agreement looks to further support the sector and maximise local content in its upcoming projects. Over 8.3GW of project activities are currently being tracked in the EICDataStream database until 2030.

At the end of March 2021, the Ministry of Climate and Environment instituted a PLN 319.6/MWh (€67.93/MWh) price cap for the upcoming CfD auction. The decision was announced in line with the deadline for bid submissions. The price was increased slightly from PLN 301.5/MWh after fixed prices for 2021, investment requirements and operating costs for the first offshore wind farms were considered. All of the projects that submitted applications in

THE POLISH MARKET WITNESSED SIGNIFICANT DEVELOPER ACTIVITY THROUGHOUT 2020

March 2021 have now secured CfDs totalling around 5.9GW, which can be seen in Table 7. All the projects, representing the most advanced developments, secured awards at the maximum strike price of 319.90 PLN per MWh. Commissioning of the first projects could be achieved as early as 2025. According to the Ministry for Climate and Environment, up to 11GW of capacity could be operational by 2040, at an investment of over PLN 160bn (US$43.3bn).

The Polish market witnessed significant developer activity throughout 2020, with key market players such as Ørsted, Northland Power, Ocean Winds (JV between Engie & EDPR) and Iberdrola joining the already active Equinor and RWE Renewables to exploit the first rounds of development. Besides its 350MW FEW Baltic II project, RWE holds the key to a total of four sites of up to 1.8GW near the Slupsk Bank area in the Polish Baltic Sea. The developer has submitted applications for the FEW Baltic project in the CfD auction round, securing a grid connection agreement in December 2020. The project is supported by Van Oord and Green Giraffe. RWE Renewables, via its Polish subsidiary Baltic Trade & Invest, has also signed a series of LoIs with Polish companies from the maritime sector aimed at strengthening its offshore wind activity in the country. It will also further strengthen the local supply chain by intensifying the collaboration with LOTOS Petrobaltic (LOTOS), the Polish Ocean Lines (PLO) as well as with the Port of Gdynia Authority.

Polska Grupa Energetyczyna (PGE) was joined for its EW Baltica-2 and EW Baltica-3 developments by Ørsted in February 2021 after the two parties officially signed their partnership agreements. The two projects offer approximately 1.5GW of combined capacity at an estimated investment of PLN 35bn, and the EW Baltica-3 project could reach commissioning as early as 2026. It is understood that project designs are still being finalised and a tender has launched for turbine suppliers at both sites. Other procurement procedures are anticipated to launch throughout the rest of the year through to 2022. PGE also holds a cooperation agreement with Tauron and Enea to establish a special purpose vehicle for future offshore wind projects.

Ocean Winds (Engie-EDPR joint venture) initially formed a 50:50 co-development pact with Tauron for the B and C Wind projects totalling up to 400MW. However in July 2021 the agreement had been terminated, as for Tauron the obligations from the signed deal were impractical to fulfil due to the changes in the country's regulatory environment. Ocean

Winds is meanwhile looking to select the port of Leba as its O&M base for the projects.

PKN Orlen's 1.2GW project could see construction commence in 2023-2024 for a 2026 commissioning timeframe. The project developer was joined by Northland Power, who acquired a 49% stake in March 2021 ahead of the CfD bid submission deadline. A location permit and grid connection agreement have been secured and Offshore Wind Consultants (OWC) are currently carrying out a technical advisory work scope for the project, while ODE conducted preliminary technical and construction design. Geotechnical seabed surveys commenced in July 2021 and are to be completed later on in the year. A tender has also been issued for the wind farm's onshore grid connection.

Arguably two of the most advanced projects in the market are Polenergia and Equinor's Baltyk Srodkowy II & III projects. Both developments were submitted as part of the CfD auction, and FID could be reached in 2022-23 for an offshore construction start in 2024. Equinor will lead on the construction and operation of the developments, with Polenergia having been responsible for the permitting process. Supply chain workshops were held in October 2020 to connect possible Tier-1 contractors with local suppliers. Equinor has shown its commitment to offshore wind in Poland through the acquisition of a site at the Port of Leba in May 2021. It will serve the developer as an O&M base and will support the Baltyk offshore wind projects. Meanwhile, SSE Renewables and Acciona Energía have also formed a joint venture to explore Polish offshore wind opportunities.

The Polish offshore wind market is expected to provide significant opportunities for local suppliers, who already possess capabilities in the industry after participating in and supporting developments across Europe, including for cable supply, steel and key fabrication works. The final version of the Government's National Reconstruction Plan confirms that the Port of Gdynia will be developed as a key installation terminal for projects in the Baltic Sea, plans for which have already been included in legislative submissions awaiting government consent. In August 2021 the Government again identified the port as an optimal local for future wind farms, with it being located the closest to the future wind farms planned as part of the first stage of development. The port is scheduled to be ready in time for 2024 offshore construction timelines.

Ørsted signed a LoI with the Port of Gdynia Authority in April 2021 to cooperate on the development of innovative technologies. In July 2021 Vestas announced a collaboration for technical discussions with the Port of Gydnia to also help drive its development as a key infrastructure site. Poland is also planning to develop the ports of Leba and Ustka as hubs to service offshore wind farms, with PGE, PGE Baltica and the City of Ustka signing an LoI to create service facilities for planned offshore wind farms at Ustka port. Meanwhile, NKT has acknowledged the growth spurge in the country and subsequent future demand for offshore and onshore power cables, by planning an execution centre located in Gydnia.

An overall €437m has been included in offshore wind investment proposals for the country's port infrastructure under a draft National Plan for Reconstruction. Following this the Polish government has also allocated over €4bn for offshore wind, green hydrogen and port development as part of this Reconstruction Plan. Further announcements regarding the progression of Poland's market have continued to emerge throughout the year, with Siemens Gamesa and Grupa Przemysłowa Baltic both collaborating together to strengthen Poland's offshore wind capabilities. Mostostal Warszawa, one of Poland's largest construction companies has also announced plans to build an offshore wind foundations factory, which will allow for the transportation of a complete wind turbine from the port using floating docks technology.

Other significant movements for future developments are seen in Iberdrola's partnership with Seawind Holding for up to 7.3GW of offshore wind portfolio in December 2020 as well as Vattenfall's MoU with Polish chemical manufacturer Synthos for the joint exploration of offshore wind opportunities in the Baltic Sea. Ørsted has also paired up with the country's coal power producer ZE PAK to participate

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together in the upcoming CfD auctions in 2025 and 2026. The region as a whole has taken steps to promote the development of offshore wind, with Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, and Sweden signing a joint cooperation declaration for the build-out of offshore wind energy in September 2020. The parties recognise the significance of offshore wind in reaching national climate change targets and will work to realise a level-playing field for investors in offshore wind market access. The respective national TSOs followed suit in December 2020 with an agreement to cooperate on the joint development of an offshore grid in the Baltic Sea. The Baltic Offshore Grid Initiative is aimed at establishing planning principles for a joint offshore grid and carrying out necessary studies and investigations for implementation.

On a national level, several Baltic countries have announced next steps in their offshore wind build-out. **Lithuania** is working on a first 700MW offshore wind project to be located approx. 29km offshore Palanga, across an area of 137.5km2. The site offers water depths of 35 metres and wind speeds of 9m/s and could comprise of up to 16MW wind turbines. Draft legislation to establish a framework on offshore wind development was put before the Seimas, Lithuania's parliament, in September 2020 to facilitate the auctioning of offshore wind zones and implementation of a CfD scheme. The Seimas had instructed the government to evaluate the provisions of the draft laws and present a conclusion. In August 2021, this conclusion for better offshore wind development conditions was adopted by the government. The final step for the bill to become law is for the Seimas to approve the bill. The final legislation will also require EU state aid regulation approval regarding the proposed subsidy mechanism.

A tender is currently scheduled for 2023, with site investigations and EIA activities underway. Ignitis Group and Ocean Winds announced the formation of a strategic partnership in September 2020 to bid in the country's first offshore wind tender. In terms of the supply chain, the Port of Klaipeda will see up to €483m in investment under draft government plans to prepare the site for the production, assembly and storage of wind turbine components and other equipment. A feasibility study to assess the potential for local production of offshore wind components is expected to be conducted in 2022. The Lithuanian government is understood to be pursuing an overall potential target of 3.4GW.

Estonia continues to pursue the 1GW Gulf of Riga (Liivi) project, where a cross-border MoU was signed with Latvia in late 2020 for the joint realisation of the wind farm. In April 2021 Ørsted and the site's developer Eesti Energia signed an MoU to develop large-scale offshore wind opportunities in the Baltic countries together, including the Gulf of Riga project. A location is expected to be finalised in 2021, as Hendrikson & KO and Pondera Consult have secured a contract for a pre-feasibility study, to assess the pre-selected development areas. Survey works have also commenced on potential onshore cable routes by Elering AS and AST. An auction is to follow in 2026 for commissioning by 2030 (subject to a supportive regulatory framework for the technology being in place). Meanwhile, Tuuletraal is developing a 360-380MW project featuring 76 turbines 30km off the coast, with the 90km2 site near Saarema. A long-term extension to increase capacity to 1GW is under consideration. Subject to finalising project designs and permitting, offshore construction could begin in 2026.

Stakes were raised in **Sweden's** offshore wind portfolio when Iberdrola acquired a majority stake in Svea Wind's 9GW pipeline, comprising eight projects, in June 2020. Developments include the 250MW Utposten I wind farm which is at an advanced stage of environmental permitting. The project could reach commissioning in 2029 and will feature up to 26 turbines. The portfolio also includes the Gretas Klackar 2 site, for which administrative processing has commenced. The rest of the eight projects are undergoing environmental studies. Earlier implementation is expected for Vattenfall's development pipeline, where design and consenting activities are ongoing. Projects include the 640MW Kriegers Flak and Kattegat Syd wind farms. The former could see a 2027 commissioning date, subject to ongoing permitting. Preliminary scheduling will see procurement in 2023-2024 for an offshore construction start in 2025. Kattegat Syd is preparing

consent applications, with public consultations for the project's exploration permit initiated in March 2021. The project will feature 80 turbines. Ørsted is also developing the 1.5GW Skane wind farm, for which the environmental report was submitted to the authorities in September 2021.

New proposals are continuing to emerge in the country, with a gradual shift towards the use of floating technology. In May 2021 Zephyr Vind announced plans to build a 1GW-plus offshore wind farm off Sweden's west coast in the southern part of the Skagerrak, featuring both fixed bottom and floating foundations. Public consultations are underway for permit applications to be filed in 2022. The Poseidon wind farm is anticipated to begin operations by 2031. In September 2021 Aker Offshore Wind and Hexicon launched a 50/50 JV in Sweden, after announcing their collaboration on floating wind developments during the year. Both companies already have an early-stage portfolio of projects, including the Kultje, Dyning and Mareld floating wind farms. The country is also preparing for its future growth in offshore wind, as the Government called on the state's TSO Svenska Kraftnät to expand its transmission network within its maritime territory for more offshore wind connections. Advancing offshore wind is still constrained, however, by a lack of targeted offshore wind development frameworks, complex and lengthy planning and consenting processes and higher grid connection costs. Current government estimates place the country's operational capacity

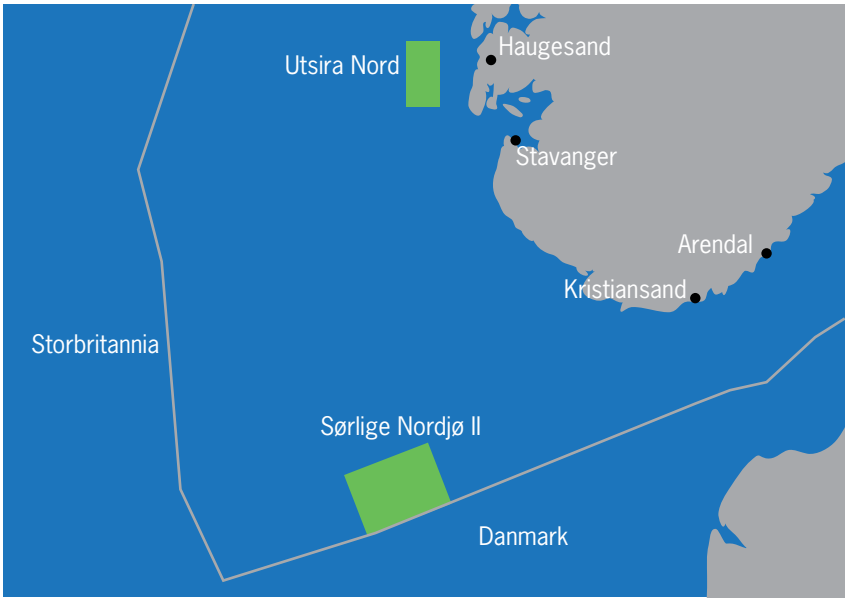

Figure 6

Selected offshore wind sites to be tendered in 2021, including announced developer interest.
Source: Offshorewind.biz; Norwegian Ministry of Petroleum and Energy.

potential at the wide range of 12-25GW by 2050.

Lastly, **Finland** is awaiting the publication of a government report that will set out the country's potential roadmap to 15GW of operational capacity. EIAs are currently underway for Hyotytuuli's up to 500MW extension to the Tahkoluoto project, which could feature 40-45 turbines of 11-16MW capacities. Consent could be achieved in 2021/22 for a construction start in 2023 and commissioning by the middle of the decade. Metsähallitus's Korsnäs offshore wind farm is also in the early planning stages, with AFRY being chosen to deliver the site's EIA and local master plan. Public consultations are ready to begin and is expected to commence on the EIA in Spring 2022. The developer plans to have the 1.4GW site operational as early as 2028 and is currently seeking a partner to jointly develop the project.

Norway

In June 2020, the Norwegian government announced the opening of two offshore wind areas for future development, with a combined capacity of 4.5GW. Utsira Nord spans an area of 1,010km2 offshore Haugesund and offers between 500-1,500MW of capacity. The site's water depths provide opportunities for floating offshore wind development, with the Government proposing to award at least three areas for up to 500MW of floating offshore each.

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Sørlige Nordsjø II borders the Danish sector of the North Sea and is located south-west of Kristiansand across an area of 2,591km2. As the site is in close proximity to oil and gas developments, it indicates future integration and decarbonisation opportunities here. Between 1,000-2,000MW of capacity could be developed in this area. The Government is advocating hybrid solutions in Sørlige Nordsjø II, which will enable power to be brought onshore both in Norway and abroad, and also enable import and export of electricity. The government presupposes that bottom-fixed offshore wind be built without state aid at Sørlige Nordsjø II. An auction for the areas will be announced as soon as the assessment of hybrid projects has been completed. Consultations are underway with the Government to find the best auction model for the zone. The projects in the area are also expected to be delivered without the need for government subsidies.

The application window for the two zones opened on 1 January 2021, with additional guidelines clarified in June 2021 and several proposals for public consultations. The process will start by the end of 2021, unless there are any major changes as a result of responses to the consultation. Several developers and consortia have announced their interest in the zones, listed in Table 8.

Aker Offshore Wind has outlined initial plans for its application and future participation in the Norwegian market, including the 1.2GW Sønnavindar and the 500MW Vestavindar floating offshore wind project for the Sørlige Nordsjø II and Utsira Nord zones respectively. Sønnavindar could feature a mix of fixed and floating foundations. Subject to the tender outcome and consents, a PPA would be sought in Q4 2022, with FID to follow in Q1 2024 for a 2026-2029 commissioning window. The Vestavindar project will focus on floating foundation technology, with a similar timeline to the Sønnavindar development and commissioning in Q4 2026. Following the country opening the Utsira Nord and Sørlige Nordsjø II areas last year, the Government started the process of identifying new areas for offshore wind development in May 2021. The process is expected to take two years.

Construction and fabrication activities began for the 88MW Hywind Tampen floating offshore wind project in late 2020, with first steel cut by Kværner at the Kværner Stord in Norway. Aker Solutions followed with construction of the concrete hulls in February 2021. Commissioning is targeted for the end of 2022. Turbine assembly will be carried out at the Wergeland Base in Gulen. Another floating offshore wind farm progressing in the country is the TetraSpar demonstration turbine under Stiesdal Technologies, which is coming close to the finish line for 2021. Fabrication of the foundation was completed at the end of 2020. Bourbon Subsea Services was contracted to manage the transportation and installation of the demonstrator from the assembly port in Grenaa, Denmark to the METcentre test site offshore Norway. As of the publication of this report, the turbine was installed at the demonstration test site in July 2021 and cable

Utsira Nord	Sørlige Nordsjø II
Shell, BKK and Lyse	
Arendals Fossekompani ASA (AFK) and Ferd AS (Ferd) –> Seagust AS	
Parkwind and Norsea	
Ørsted, Fred. Olsen Renewables and Hafslund Eco	
Iberdrola, TotalEnergies, and Norsk Havvind	
Equinor and Vårgrønn (Eni & HitecVision)	Vårgrønn, Agder Energi and Green Investment Group (GIG)
Aker Offshore Wind, Ocean Winds, and Statkraft	BP, Statkraft, Aker Offshore Wind / Aker Horizons
TechnipFMC and Magnora –> Magnora Offshore Wind	Norseman Wind, EnBW, ASKO Fornybar / NorgesGruppen
RWE, NTE and Havfram	Equinor, RWE Renewables, and Hydro REIN

Table 8

List of developers and/or consortiums that have expressed interest in bidding for Norway's two offshore wind zone auctions Utsira Nord and Sørlige Nordsjø II.. *Source: EICDataStream, offshorewindbiz.*

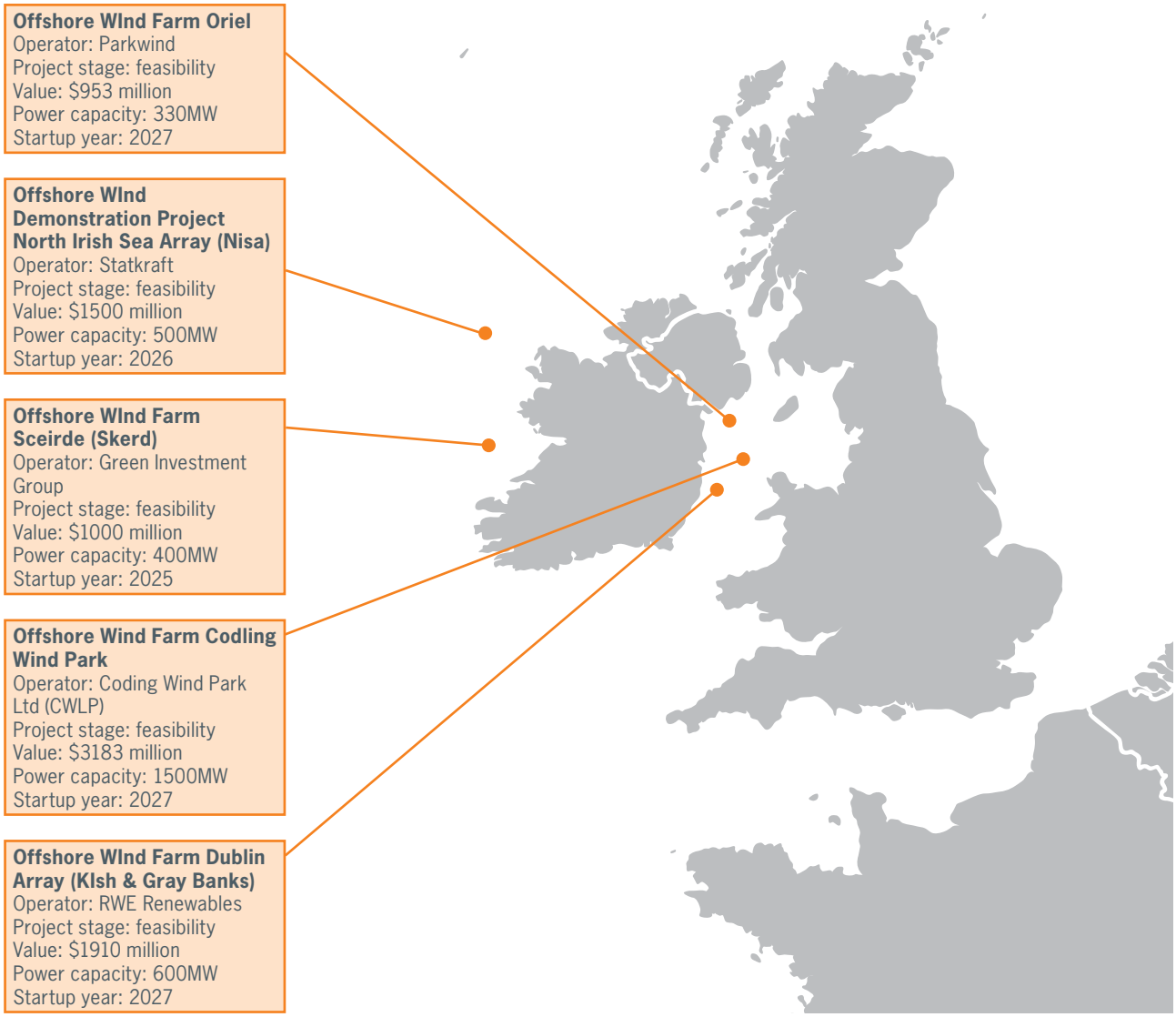

Figure 7

Map of offshore wind projects in Ireland which will be fast-tracked through the permitting process.
Source: EICDataStream.

installation works were completed in August.

While the launch of a first tender process signifies an important step for the country's offshore wind potential, industry players will be waiting for more concrete policy frameworks and ambitions to drive the sector forward. The Norwegian market offers an opportunity for early moves into commercial-scale floating offshore wind as well as the benefitting from decarbonisation alternatives for its oil and gas platforms. The participation of Norwegian companies in European offshore wind projects already highlights the existing capability awaiting to be further exploited.

Ireland

Ireland boasts an impressive offshore wind project pipeline of

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over 22GW of capacity currently being tracked in EICDataStream. The industry is currently pushing for a 2030 target of 5GW. In May 2020, the country announced plans to fast-track seven projects worth over 3GW through permitting in order to jump start the Irish offshore wind sector. The step enabled these seven projects (see Figure 7) to negotiate grid connection agreements and begin EIAs for a formal planning application with Ireland's An Bord Pleanála, ahead of newer developments. Recently, Offshore Wind Limited, a joint venture between Cobra Instalaciones y Servicios and Flotation Energy came together with plans to develop offshore wind farms in the country - once its new legislative framework has been approved and finalised. Its Greystones fixed-bottom wind farm will have a total capacity of 1GW in the waters near Dublin, and its 1.5GW Blackwater site will comprise of floating technology off of the South East Coast. The newly established Irish developer Inis Offshore Wind has also announced plans to develop at least 1GW of capacity by 2030 in five potential 500MW sites off the East and West Coast.

These so-called 'relevant projects' are likely to be the first to bid in the country's designated offshore wind auction for subsidy support that forms part of the Renewable Energy Support Scheme (RESS). Like the Greystones and Blackwater sites, the remaining projects currently at early stages of development are required to wait for the publication of its updated offshore wind and marine spatial planning legislation, that would allow for faster realisation of offshore wind projects by removing the current challenges in place. The Marine Planning and Development Bill was initially due to be implemented in early 2021. However it was only in July 2021 that the Bill was brought to the Irish Parliament to seek enactment. For the upcoming auction to go ahead, the country will need to establish this Bill, along with the Maritime Area Consent (MAC) process, and the subsequent issuing of the MACs to Phase One offshore projects.

Delays have raised concerns within industry on whether proposed offshore wind auction timelines and thus the overall capacity target can be met. The RESS-2 auction, said to include the first offshore wind auction, has now been scheduled for Q3 2022, a year behind schedule. Consultations on the offshore wind auction opened in October 2021 to seek feedback on its Terms and Conditions. Like Scotland, the Irish government took notice of the Crown Estate England & Wales seabed leasing round outcome, prompting fears that development frameworks could be updated accordingly and further delayed. Current proposals aim for a first large-scale offshore wind project to enter operations by 2026, however, consenting guidelines for all non-relevant projects, as well as potentially price structures and caps have yet to be decided and disclosed, making the 5GW target look even more far-fetched. As such, the market's unstable premise is starting to show. Equinor recently pulled out of developing offshore wind in Ireland, due to this regulatory uncertainty. The developer had an agreement with ESB for a handful of projects, which now have an unclear future. First consent calls are unlikely to commence until 2023, with over 30 projects on EICDataStream in the planning stages. However, it is most probable that judicial reviews and the lack of experience from An Bord Pleanála in consenting offshore developments, would push this back even further.

While the outcome of its legislative work is pending, project activities are focused on attaining foreshore licence applications to conduct site investigations and other offshore surveys, as well as progressing project designs. RWE Renewables is looking at turbine sizes of 8-15MW for the 900-1,000MW Dublin Array offshore Co. Wicklow, with tip heights of 240-310 metres. A larger turbine nameplate would result in an increased capacity compared to the originally planned 600MW. Fugro launched the project's geophysical survey campaign in February 2021. It is understood that public stakeholder engagement is underway, and a planning application is expected in 2021. A planning application is also being prepared for EDF Renewable and Fred Olsen Renewables' Codling Bank development, for which public consultations took place in March 2021. An application is expected to be submitted in the first half of 2022. Its onshore and offshore EIAs have been updated since April 2021 through various studies and surveys, with Offshore Design Engineering Ltd (ODE) securing the project's Owner

Engineer contract to facilitate the development process.

SSE Renewables is working on project designs for the 520MW Arklow Bank project, with Ramboll and Gavin & Doherty Geosolutions (GDG) carrying out the concept design scope for the project's turbine foundations. It is understood that monopiles, jackets and gravity base foundations were under consideration for the up to 76 turbines. In October 2020, the developer also began sounding out the market for the construction and installation of the project, including indicative notices for turbine installation vessels and associated services as well as for the provision of transmission and marine works. At present, planning procedures are underway for various components of the development, including the onshore grid infrastructure and construction of its O&M base at the South Dock in Arklow Harbour.

2021 saw a number of new proposals emerge, further strengthening its early-stage portfolio of projects. Ocean Winds (EDPR-Engie JV) revealed plans to develop the up to 800MW Celtic Horizon wind farm off County Waterford which is currently looking to seek a site investigation licence. The developer also announced plans for the 1.6GW Cailleach wind farm 13km offshore Braehead, Co. Wicklow. Aniar Offshore Array, a collective of local onshore wind developers, applied for a foreshore licence to carry out site investigations and surveys for the up to 1GW Aniar wind farm. The complex will be built as two 500MW phases off the coasts, with the first featuring fixed-bottom foundations and the second floating bases.

The country's supply chain opportunities are expected to fall into the laps of the Irish smaller domestic companies. With Ireland's current market outlook looking somewhat insecure for investors, Tier One manufacturers are not likely be attracted to the scene. Ireland's local supply chain scope covers capabilities in the consultancy, civil engineering groups, R&D and geotechnical and environmental services, with many already having experience in the sector. A recent study from the Carbon Trust implies that the market is on track to capture between 22% and 31% of the lifetime investments available from these projects, with most of this coming from the O&M phase of the development process. More education is needed for the supply chain on offshore wind opportunities, and a clear strategy for upcoming subsidy auctions is needed to increase this percentage. To promote a key aspect of supply chain development, the Irish government is looking to carry out a competitive funding round for the development of offshore wind port infrastructure. Port operators would be invited to submit proposals and business cases that outline proposed upgrades to meet offshore wind sector requirements.

France and the Mediterranean

The French government is targeting 8.75GW of offshore wind capacity to be operational or tendered by 2028, as outlined by its updated Multiannual Energy Programme. The market took significant steps towards reaching that target, with key projects reaching FID and progressing with fabrication and construction activities. Examples include Iberdrola's 496MW Saint-Brieuc project, for which financial close was achieved in June 2020. The €2.4bn wind farm will feature 62 units of SG 8.0-167 DD turbines on jacket foundations produced by Navantia-Windar. Installation will be carried out by Van Oord, with Saipem leading on the offshore substation and jacket foundation installation work scope. The offshore substation is being manufactured by Eiffage Métal and Engie Solutions, with electrical equipment delivered by GE Grid Solutions, including 72.5 kV and 225 kV Gas Insulated Switchgear (GIS). First power is scheduled for 2023. Parc du Banc de Guérande's Saint-Nazaire 480MW wind farm is also making construction headway, featuring 80 units of GE Renewable Energy's Haliade 150-6MW turbines. DEME Offshore installed the first monopile foundation at the site in May – the first to be installed for a commercial offshore wind farm in French waters. The jacket foundation for the offshore substation was also installed in August.

The next development focus will be on the Normandy and Brittany tenders that are currently being prepared or already underway, representing approx. 1.25GW in new offshore wind acreage. The up to 1GW Normandy project

could feature up to 80 units of 12MW turbines and will be based 32km offshore the coast of Cotentin and 40km from St-Vaast-La-Houge. The application deadline was set for March 2021, with a competitive negotiation round launched in April. During this process, the project's exact location will be determined as well as an assessment of the bidder's technical and financial capabilities. Six companies and consortia were selected in April to move forward in the site's tender to develop the wind farm:

- Eoliennes en Mer Manche Normandie (a joint venture project company between EDF Renouvelable and Maple Power)
- Joint venture of Enbridge and CPPIB
- Iberdrola Renovables France
- Ocean Winds
- Shell
- A consortium formed by the TotalEnergies and RWE groups
- A consortium of Vattenfall, wpd, and the Banque des Territoires.

The selected candidates will now enter a competitive dialogue procedure with the state bodies. The awarded project is due to be commissioned by 2028. Réseau de Transport d'Électricité (RTE) is responsible for the power export cable infrastructure for French developments. It is understood that a second 1GW tender offshore Normandy could be tendered in 2023.

Public consultations through the country's Commission for Public Debate (CNDP) for the up to 270MW Brittany tender were launched in July 2020. The zone will focus on floating offshore wind developments. A consensus on the proposed site location could not be reached through the discussions, with a final decision now to be made by the French government. Stakeholder engagement and buy-in is considered a crucial factor for French offshore wind development, which have faced significant opposition from local communities and fishing industries. In April 2021 the tendering procedure was launched for the site, with interested parties to express interest by 1 July. Following this, 10 candidates were pre-selected to participate in the tender. The candidates are a consortium formed by CIP and ENI, BW Ideol with Eoliennes Flottantes Bretagne Grand Large (EDF Renewables and Maple Power), a consortium formed by Elicio and BayWa r.e., Equinor, Iberdrola, Ocean Winds, RWE, a consortium formed by Shell, Valeco (a subsidiary of EnBW) and Eolien en Mer Participations (a subsidiary of the Caisse des depots et consignations), a consortium formed by TotalEnergies, Green Investment Group and Qair and a consortium formed by WPD, Vattenfall and BlueFloat Energy. The wpd, Vattenfall, and BlueFloat Energy consortium is bidding a wind farm called Triskéol. Winners will be announced in 2022 and commissioning is envisaged for 2029.Additional tenders for floating developments in the Mediterranean – offshore Occitanie and Provence-Cote d'Azur – are also planned for 2021 and 2022 for up to 250MW each.

While the French offshore wind market is finally moving forward, concerns over potentially lengthy planning and consenting processes remain and the risk of local opposition is not to be underestimated. Developers have been able to make use of key local supply chain facilities, including a Siemens Gamesa nacelle production facility at Le Havre, a GE nacelle facility at Montoi-de-Bretagne and a LM Wind Power blade facility at Cherbourg, making the case for offshore wind benefits to local infrastructure development.

Spain

Several new project announcements were made across the Mediterranean in the past year and the Spanish market has been a perfect example of this. A clear focus for proposed developments has been floating offshore wind technology and supporting the development of local supply chains. The country plans to develop 1-3GW of floating offshore wind capacity by 2030, according to its draft Roadmap for the Development of Offshore Wind and Marine Energies. A first floating offshore wind auction off the Canary Islands could be carried out in 2022, with new development frameworks currently under consideration and siting activities underway. A CfD mechanism is understood to be one option.

The areas off the Canary Islands have already gained the interest

of leading developers Equinor and Iberdrola, with the former announcing a potential 200MW floating project worth up to €860m back in 2019. In February 2021, Iberdrola stated its intent for a 300MW floating offshore wind farm offshore Spain, with a focus on Galicia, Andalusia and the Canary Islands that could lead to an eventual 2GW build-out. Design activities will be carried out in 2021. Applications were also submitted in June 2021 to carry out surveys for the two 490MW wind farms off San Cibrao (Cervo, Lugo) and San Brandán in Galicia, as part of the 2GW build-out. Another example of new proposed floating projects is BlueFloat and Sener's 1GW Parc Tramuntana, off the coast of the region of Empordá. The site will add capacity in two phases of 500MW, with 30-40 floating wind turbines installed per phase, for 2026 commissioning. Ocean Winds and DISA Group have also joined forces to develop floating wind projects in the Canary Islands. As part of the 1-3GW floating announcement, the ministry has stated the need of €500m to €1bn investment into the port infrastructure, to implement these goals.

Italy

Market players in Italy are reportedly awaiting the publication of a decree for future subsidy support for offshore wind in 2022, which could pave the way for an auction in 2023. Industry stakeholders are calling for 300MW to be auctioned. Although the market appears to be making more timid advances in comparison to the rest of Europe, the country has a huge pipeline of 39 project requests awaiting connection consent from Italy's TSO Terna. The projects can be found in the lower region of the Adriatic Sea facing Puglia and total 17GW of potential capacity. Both bottom-fixed as well as floating foundation technology feature in the current project pipeline, with the majority to be anchored in deeper seas.

Construction activities have re-launched at Renexia's 30MW Taranto project – the only project in Italy under construction – after the Senvion bankruptcy led to a change in turbine supplier. MingYang Smart Energy secured a contract in early 2021 for the delivery of 10 MySE3.0-135 turbines, including a 25-year O&M agreement. Offshore construction works have started, where the load-out of monopiles and turbines commenced in September and October 2021 respectively. Commissioning is anticipated for 2022 and further procurement announcements are expected shortly.

The developer is also planning a floating offshore wind development of significant scale 50km off the coast of Favignana in the Sicilian Channel. The 2.8GW project could see construction activities launched in 2025, subject to ongoing consent. Turbines of up to 14MW would be deployed in water depths of 400-600 metres, supported by three HVDC converter stations to connect the project to the onshore grid. Falck Renewables and BlueFloat jointly proposed the 600MW AGNES project 1 which will be developed in two phases (Romagna 1 – 200MW and Romagna 2 – 400MW). The sites will feature 75 fixed-bottom turbines and will also feature hydrogen and floating solar technology. The duo more recently revealed plans for its second project – the 1.3GW Odra Energia floating wind farm off the southern coast of Lecce. Studies are about to commence in preparation for the environmental impact report.

Greece

Similar to Spain, the Greek offshore wind market is expected to heavily feature floating offshore wind technology. The government is in the process of developing a consenting framework for offshore wind build-out, with support from the Hellenic Wind Energy Association. Further details are expected to be issued in 2021, however, activities so far have focused on an area in the Aegean Sea located 12 nautical miles offshore Greek islands with water depths of 80-200 metres. Capacity estimates have suggested a 300-400MW project. In May 2021 Wpd entered the Greek market to develop wind energy here, using its experience in the offshore sector to expand its portfolio. Mytilineos (40%) has also signed an agreement with Copenhagen Infrastructrure Partners (60%) to jointly develop wind farms offshore Greece. Subsidy support for offshore wind could mirror that of onshore renewable energy technologies, which feature a sliding feed-in tariff (FiT) premium as well as additional monthly payments based on the difference between the hourly market price for electricity and the reference value awarded in the auctions.

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Amanda Duhon – Regional Director North & Central America

It has been a long time coming to bring offshore wind to fruition in the US. From proposals of offshore wind developments in the 2000s for projects off the east coast such as Cape Wind, to the Great Lakes and US Gulf of Mexico (GoM), it wasn't until 2016 that the US' first offshore wind project went into production via Ørsted's Block Island 30MW development offshore Rhode Island. At the heart of the US' lag in joining countries such as the UK, Denmark, and other emerging markets such as Taiwan, US offshore wind developers have faced many challenges such as political uncertainty both on a state and federal level, policy barriers such as the US Jones Act and the ambiguous future of Production Tax Credits (PTC), as well as an absent supply chain and fit-for-purpose port infrastructure to bring to fruition a US offshore wind value chain.

However, is the US experiencing the calm before the storm, so to speak? Currently, there is over US$85bn in CAPEX proposed for offshore wind, with a current project pipeline of over 27GW in capacity by 2030. And the National Renewable Energy Laboratory (NREL) states that this capacity surpasses 28GW across the leases awarded to date. 2020 was a year of preparing for that storm, as the US offshore wind sector received much good news and incentives towards a true and active market. The most recent of this has been the Biden Administration's establishment of a 30GW by 2030 offshore wind target and several measures to make this target a reality:

- *$230m in grants for port authorities and other applicants for port and intermodal infrastructure-related projects*
- *$3bn in debt capital availability for the offshore wind industry*
- *$1m in grants for studies on offshore wind's impact on fisheries and local communities*
- *Finalising reviews of 16 Construction and Operation Plans (COPs) by 2025*

There are over 160 EIC member companies active in the wind industry supply chain, including those involved in development activities until the start of construction. These companies provide components and innovation to the wind turbine manufacturers, developers, and asset managers; and many already have a US presence. The US market represents a ground-floor opportunity between long-time partners who are already mutually invested. Significant returns are possible and the opportunity to help determine the direction in which the renewable energy industry will grow is a rare moment in any industry. It is time for companies to seize it.

A key aspect of this progression has been state governments taking a bottom-up approach, which has diffused policy innovation across

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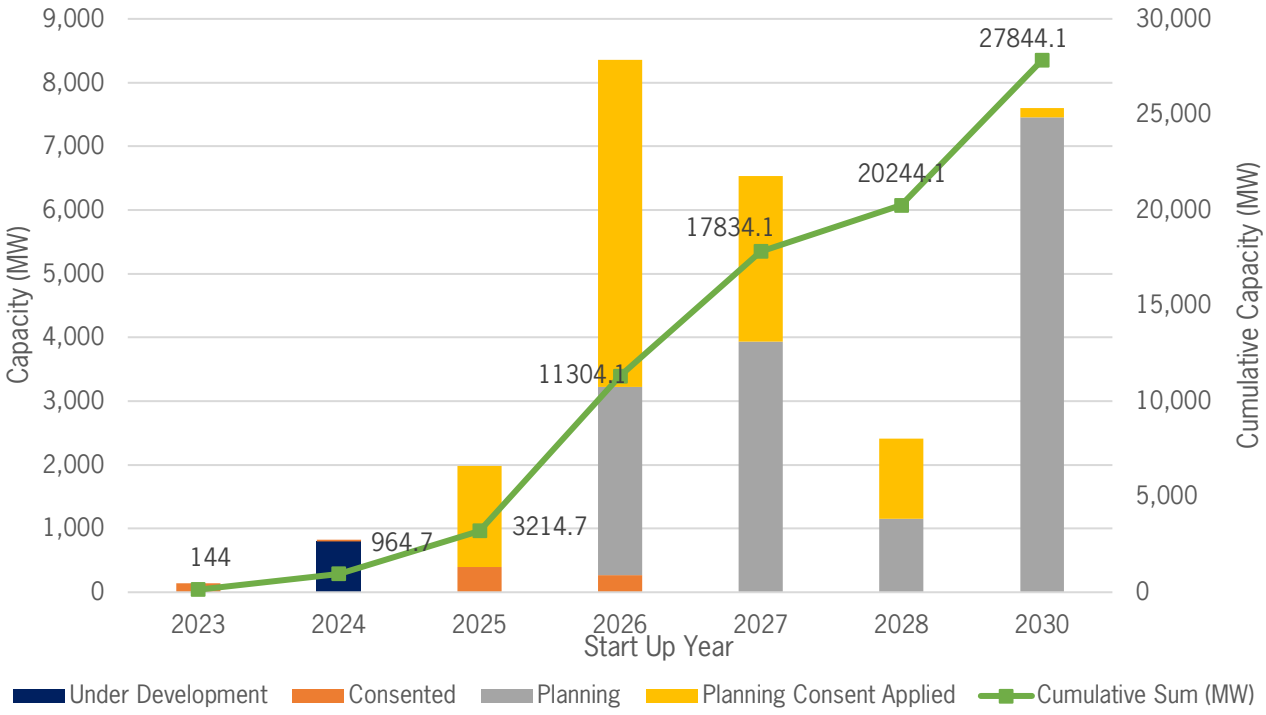

Figure 8

US capacity pipeline by start-up year up until 2030 and status.
Source: EICDataStream.

the North East. For example, in October 2020 the governors of Maryland, North Carolina and Virginia signed a joint Offshore Wind Pact to advance offshore wind supply chain development, share best practices and enhance regulatory certainty. Following this a partnership was formed in May 2021 between NREL, the State of Maryland, the New York State Energy Research and Development Authority (NYSERDA), and the U.S. Department of Energy, to conduct a comprehensive study of the US offshore wind supply chain. The collaborative project aims to form a Supply Chain Roadmap, exhibiting the combined benefits of a domestic supply chain. The governor of Massachusetts confirmed its climate change legislation at the end of March 2021 that will see an additional 2.4GW of offshore wind capacity procured by 2027, increasing the state's target to 4GW overall. The state has also started its largest offshore wind solicitation, for the procurement of up to 1.6GW of capacity. As part of the Massachusetts call, Vineyard Wind has proposed the Commonwealth Wind I and II projects, with capacities of 800MW and 1200MW respectively. Mayflower Wind (50:50 JV between Shell New Energies and Ocean Winds) has also submitted multiple bids with varying economic development packages. The largest bid features a capacity of 1.2GW and a spend of up to $81m to build a strong supply chain as well as an O&M port in Fall River.

Following the launch of New Jersey's 2.4GW offshore wind solicitation in September 2020, over 110 elected state officials signed a letter of support in July 2021 for offshore wind development. Results of the solicitation are yet to be announced, as of August 2021. North Carolina's Governor Roy Cooper has also set an executive order for the development of 2.8GW of offshore wind power by 2030, and 8GW by 2040. The Bureau of Ocean Energy Management (BOEM) has published a Proposed Sale Notice (PSN) for

BOEM LEASING PROCESS

The Bureau of Ocean Energy Management (BOEM) is an U.S. Government agency within the Department of the Interior. The establishment formed in 2010 and is responsible for managing the leasing policy and programme development of all energy projects, including offshore renewable energy. The renewable energy leasing process occurs in four distinct phases, outlined in Figure 9 below.

Planning and analysis	Leasing	Site assessment	Construction and operations
• BOEM publishes call for information and nominations • BOEM identifies priority Wind Energy Areas (WEAs) offshore. WEAs are locations that appear most suitable for wind energy development, or • Process unsolicited application for lease • BOEM may prepare Environmental Assessment for Lease Issuance and Site Assessment Activities	• BOEM determines whether Competitive Interest exists • *If Competitive Interest exists,* BOEM notifies the public and devepers of its intent to lease through Sale Notices before holding a lease sale • *In Competitive Interest does not exist,* BOEM negotiates a lease (note: issuance may be combined with plan approval	• Lessee conducts site characterization studies • Lessee submits Site Assessment Plan (SAP) • BOEM conducts environmental and technical reviews of SAP, eventually deciding to approve, approve with modification, or disapprove the SAP • If approved Lessee assesses site (usually with meterorological tower(s) and/or buoy(s)	• Lessee may conduct additional site characterization • Lessee submits Constructon and Operaiton Plan (COP) •BOEM conducts environmental and technical reviews of COP, eventually deciding to approve, approve with modification, or disapprove the COP. • If approved, Lessee builds wind facility

Intergovernmental Task Force Engagement

Figure 9

Overview of the four stages of BOEM's energy programme.
Source: BOEM.gov.

Upcoming offshore wind lease auctions of anticipation include the New York Bight and New Jersey areas in 2021/2022, with California moving forward as well. It is noted that BOEM appears to have no fixed schedule with no future dates announced as of yet.

a lease sale of the Wilmington East wind energy area located in the Long Bay, offshore North and South Carolina. The site has a potential of 1.5GW and preparations are underway for a supplemental Environmental Assessment (EA).

And in January 2021, Equinor and BP were selected by NYSERDA as the winners of the state's 2.5GW offshore wind solicitation, having bid their 1,260MW Empire Wind 2 and 1,230MW Beacon Wind 1 developments. Alongside this BOEM announced a new priority Wind Energy Area in the New York Bight - an area of shallow waters between Long Island and the New Jersey coast. An environmental review was initiated in March 2021 and a 7GW+ offshore wind lease sale was announced for the area in June 2021. Following this, the draft EA was published in August for the lease areas. The Proposed Sale Notice includes eight lease areas, which would be the first competitive offshore wind lease sale for the Biden-Harris administration. So far RWE and National Grid have formed a

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partnership to bid in the upcoming New York Bight seabed lease auction, with other major players also expected to show interest here in the future.

However, policy progressions are taking a different turn in the State of Maine. The Government has put a ban in place on new offshore wind projects in State waters (which does not affect the installation of transmission infrastructure for projects), whilst potentially allowing for future development in federal waters further offshore. The new law is a compromise by the Government to protect its commercial lobster and recreational fisheries.

The North East coast has a substantial portfolio of upcoming projects in the early planning and feasibility stages of development. A handful of these have reached notable milestones in the recent months. Vineyard Wind's 800MW project in Massachusetts, jointly developed by Copenhagen Infrastructure Partners (CIP) and Avangrid Renewables, is the nation's first commercial-scale offshore wind farm. The project was the first to secure the Record of Decision (ROD) from BOEM in May 2021, the final major step in the federal review process, and now has also secured financial close. The project is starting to announce contracts - with GE Renewable Energy chosen as the turbine supplier from its GE Haliade-X model, DEME Offshore securing the transport and installation contract for the turbines and foundations, and Jan De Nul supplying and installing the inter-array cables. Prysmian Group also has the Notice to Proceed with a €200m contract for the submarine power cable system. The JV were also developing the 804MW Park City and 1.5GW Vineyard Wind South (Phase 2) sites, until Avangrid announced plans to take full control of the projects for $167.5m in September 2021. BOEM has announced that it will begin the environmental review of their Construction and Operations Plans (COPs) and has issued Notices of Intent (NOIs) for the preparation of their environmental impact statements (EISs).

NOIs for upcoming EISs have also been issued to a number of other wind farms by BOEM along the coast, further enhancing the sector's progression. Projects include the 800MW Kitty Hawk wind farm by Avangrid offshore North Carolina and the Revolution project jointly developed by Ørsted and Eversource offshore Massachusetts. Dominion Energy's Coastal Virginia project recently submitted its plans for approval to the Virginia State Corporation Commission, and awarded a series of contracts: EEW Special Pipe Constructions for manufacturing the 176 monopiles, Bladt Industries to supply 176 transition pieces, and DEME Group & Prysmian for the €1.6bn Balance of Plant contract. The contract covers the transportation and installation of the foundations and the substations, and the EPCI services for the inter-array and export cables.

In New Jersey, BOEM has released the NOI for Ørsted's 1.1GW Ocean Wind I to launch its formal environmental review. The state's Board of Public Utilities has also approved EDF & Shell's Atlantic Shores and Ørsted's Ocean Wind II wind farms, with the 2.7GW addition bringing the state's total planned capacity to over 3.7GW. BOEM is set to conduct environmental reviews on the two projects forming Atlantic Shores. Meanwhile, Equinor and BP are developing the 816MW Empire Wind I development featuring around 54 turbines off the coast of New York, where a request has been submitted to delay grid connection for the project. Nexans is the preferred cable supplier and Cobra secured the FEED contract for the project's gravity base foundations. Vestas has also been chosen as the preferred turbine supplier for the Empire Wind I & II projects, for the delivery of 138 V236-15MW turbines. Also off the coast of New York is Ørsted and Eversource Energy's 880MW Sunrise project. The site has seen a number of contracts awarded, including the supply of the HVDC transmission system to Siemens Energy and Aker Solutions – making it the first US project to use the HVDC system. Riggs Distler & Company has also secured a $86m deal to supply the turbine foundations.

The State of Maryland has also started gaining momentum in the industry. The MarWin project featuring 22 turbines is the area's first offshore wind development which has recently secured major labour agreements. Ørsted recently submitted bids to build its proposed 760MW Skipjack Wind 2 project to the Maryland Public Service Commission (PSC),

Project	Locality	Developer	Start- up Year	Capacity (MW)
South Fork (Deepwater One)	New York	Ørsted & Eversource	2023	132
Ocean Wind I	New Jersey	Ørsted & PSEG	2024	1,100
Lake Erie – Icebreaker	Ohio	LEEDCo	2024	20.7
Vineyard Wind	Massachusetts	Vineyard Wind	2024	800
Constitution	Connecticut	Ørsted & Eversource	2024	200
Sunrise	New York	Ørsted & Eversource	2025	880
MarWin	Maryland	US Wind Inc	2025	270
Revolution	Massachusetts	Ørsted & Eversource	2025	704
Mayflower Wind	Massachusetts	Mayflower Wind Energy	2026	804
Empire Wind I	New York	Equinor & BP	2026	816
Park City	Massachusetts	Vineyard Wind	2026	804
Momentum	Maryland	US Wind Inc	2026	1,200
Skipjack I	Maryland	Ørsted	2026	120
Kitty Hawk	North Carolina	Avangrid Renewables	2026	800
Coastal Virginia	Virginia	Dominion Energy	2027	2,600
Vineyard South	Massachusetts	Vineyard Wind	2027	1,500
Atlantic Shores	New Jersey	Atlantic Shores Offshore Wind	2027	2,300
Beacon Wind I	Massachusetts	Equinor & BP	2028	1,230
Ocean Wind 2	New Jersey	Ørsted	2028	1,150
Empire Wind II	New York	Equinor & BP	2028	1,260
Commonwealth I & II	Massachusetts	Avangrid Renewables	2030	800 & 1200
Skipjack 2	Maryland	Ørsted	2030	760

Table 9

List of upcoming fixed-bottom offshore wind developments showing signs of activity.
Source: EICDataStream. Note that some start-up years are expected to be delayed due to ongoing permitting uncertainty.

with the promise of building the region's first cable manufacturing facility with Hellenic Cables as part of the bid. The state will also see the development of the newly proposed 1.2GW Momentum project.

Opportunities for the development of offshore wind are not limited to the Atlantic Coast, nor to traditional foundations. Floating offshore wind has estimated installations of 6-11GW by 2035, potentially making up 25% of US' total offshore fleet. The technology is an emerging opportunity, and although in its infancy in the US, it is already showing strong interest and promise. This has been exemplified by the recent introduction of a floating offshore wind bill in Oregon state's House of Representatives, calling for the establishment of a roadmap to 3GW of operational floating capacity by 2030. Maine has also shown an interest here, where in July 2021 a preferred site for a proposed floating offshore wind research array was selected by the Governor's Energy Office (GEO). Following this the Government submitted an application to lease an area for the proposal, which will feature up to 12 turbines and total up to 144MW.

California has recently seen a surge in announcements, bringing the state even closer to a floating wind boom. In May 2021 the Biden Administration and California

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signed an agreement to build 4.6GW of offshore wind in two areas of deeper Pacific Ocean. The administration foresees leasing three offshore wind areas to support the commercial build out — around 3GW off Morro Bay with 380 turbines and 1.6GW off Humboldt County. Shortly after this announcement, the administration revealed its plans to open more than 250,000 acres off the California coast to wind development, further favouring wind projects to be built in these two areas. Most recently California also signed its Assembly Bill 525; a legislation that will boost offshore wind production and develop a large-scale wind energy plan by 2045. The signing of this Act means that by 1 June 2022, the maximum feasible capacities of offshore wind need to be calculated, to set the State's 2030 and 2045 targets.

In July 2021, BOEM published a Call for Information and Nominations for two new areas - Morro Bay Call Area East and West Extension Area, advancing the federal wind leasing process offshore in California. BOEM has now formally designated both the Humboldt Wind Energy Area and Morro Bay Wind Energy Area and is to proceed with an environmental review of each site. Amongst the state's policy advancements, project milestones have also been seen. BW Ideol's proposed 40MW+ pilot project reached the environmental assessment process in November 2021. The project will feature its Damping Pool® technology and is likely to be California's first wind farm.

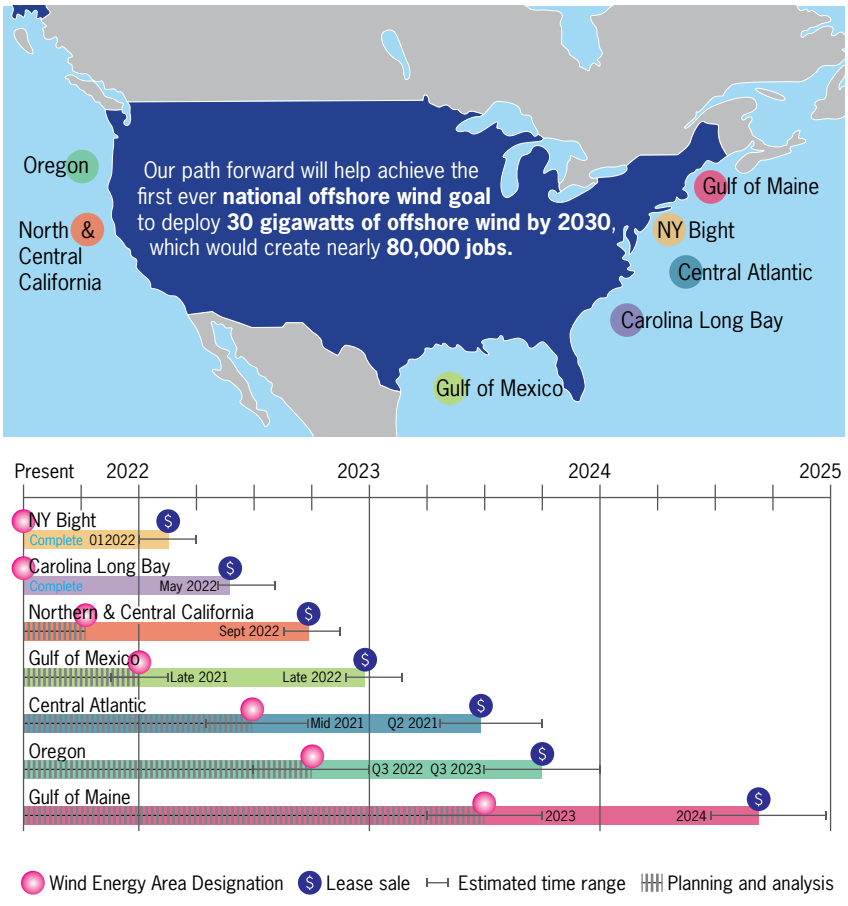

Figure 10

BOEM's proposed leasing schedule for offshore wind developments across the East and West Coast until 2025.
Source: BOEM.gov.

Hawaii is another state with some of the best wind resources and deeper waters only suitable for floating turbines in the US. EICDataStream is currently tracking three developments in Hawaii totalling over 1.2GW, all in the early planning stages, and the NREL is drafting a study funded by BOEM, to investigate the state's offshore wind potential. And in early 2021, Louisiana's Governor John Bel Edwards called upon BOEM to initiate and establish a task force, promoting offshore wind in federal waters of the GoM. The region already has a strong oil and gas supply chain that can play a key strategic role in the US offshore wind sector. BOEM is currently assessing potential opportunities to advance the industry, with a focus on the Western and Central Planning Areas of the GoM, on an area covering almost 30 million acres offshore Louisiana and Texas, west of the Mississippi River to the Texas/Mexican border.

Alongside these leasing and project advancements that were seen due to the support from

its individual state governments, BOEM now has also revealed plans in October to hold up to seven offshore wind lease sales by 2025. Auctions will take place in the Gulf of Maine, New York Bight, Central Atlantic, Carolina Long Bay and Gulf of Mexico, and also along the West Coast in the Oregon and California areas. After advancing the Humboldt Bay and Morro Bay areas, BOEM stated is looking to identify additional sites that would be suitable to lease for offshore wind and further aid the realisation of its 30GW target. The estimated timelines for each auction can be seen in Figure 10.

Ports

Fit-for-purpose port infrastructure is at the centre of successful offshore wind development and has been a much-discussed topic in the US offshore wind market. The sector requires an extensive dockside supply chain for component manufacture and vessel accessibility. Several investments into the US port development have been made or announced, including US$250m for New Jersey's Paulsboro Marine for the establishment of a monopile foundation fabrication site, the nation's largest offshore wind manufacturing hub. Ocean Wind and EEW commenced construction of the facility in April 2021, with expected production in 2023. Construction also commenced on the New Jersey Wind Port for staging, assembly and manufacturing services, with completion set for early 2024 latest. The port has currently received 16 offers from key developers and turbine manufacturers, including Ørsted, Atlantic Shores, Siemens Gamesa Renewable Energy, Vestas and GE Renewables.

Arthur Kill Terminal LLC is creating the Arthur Kill Terminal project, an offshore wind energy staging and assembly port under development in Staten Island, New York. Rhode Island has earmarked US$40m for fabrication, staging and operations at its ProvPort and Quonset Point, with Ørsted and Eversource establishing a manufacturing facility for foundation components at ProvPort. The New Bedford Marine Commerce Terminal has also issued leases for the Mayflower and Vineyard Wind developments. Other states such as Connecticut and Maryland have proposed investments of US$35m for New London State Pier and US$13.3m for Tradepoint Atlantic, respectively, while New Hampshire announced a joint commission in

PRODUCTION AND INVESTMENT TAX CREDITS

Prior to the launch of offshore wind in the US, many states pushed forward with Renewable Portfolio Standards (RPS) requiring various percentages of renewable energy be added to the state grids in a certain timeframe. Solar and onshore wind grew in exponential capacities, pushing the federal government to take forward the Production Tax Credit (PTC), providing a credit of 1¢–2¢ per kilowatt-hour for the first 10 years of electricity generation for utility-scale wind and solar. Future developments became dependent upon the PTC, which seemed to be in danger every year during federal budget planning, being extended by one year at the very last minute; year-on-year since its original passing. With the emergence of the burgeoning offshore wind sector, the federal government went on to pass the Investment Tax Credit (ITC), providing a credit for 12%–30% of investment costs at the beginning of offshore wind and distributed wind projects, with up-front tax benefits. In December 2020, the US Congress passed a year-end spending package for both the PTC and ITC, providing a provision for ITCs at 30% for offshore wind through 2025 for a term time of 5 years. The extension of the ITC provides certainty for developers planning construction by the end of 2025 and is likely to spur further development initiatives in this timeframe, to make the most of the credit benefit. This also fits in with the timeline of the current project portfolio, with many developments scheduled to commence works around 2024. The PTC will also continue to apply at 60% (1.5¢ per kilowatt-hour) for any project that commences construction by the end of 2021. However, the wind PTC is still scheduled to phase out from 2022, meaning that developments that begin construction after 2021 will not be eligible for the credit. This could potentially change, should the Treasury Department's latest 'Green Book' proposal – a detailed explanation of the Biden administration's tax proposals for the upcoming fiscal year – obtain approval from Congress. It calls for an extension of production tax credits for facilities entering the construction phase after 31 December 2021 and before 1 January 2027.

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Challenges

Regulatory Certainty

Until the recent election of Joe Biden as President of the US, there was little to no federal support of establishing the at-scale deployment of offshore wind in the US. Policy was left mostly to the state government with the exception of the alternative Investment Tax Credit (ITC) and the Jones Act. In early 2021, the Biden Administration announced a 30GW by 2030 target, as well as key supporting measures. Earlier initatives to drive federal support for the sector included a Climate Solutions Act introduced by members of the House of Representatives in 2020 calling for 12.5GW by 2025 and up to 25GW by 2030. With the permitting process now completed for the Vineyard Wind project, developers will also have gained greater clarity on critiera used in the consenting process, promising a hopefully smoother process for projects currently in development.

The Jones Act

Federal law which requires goods shipped between US ports to be transported on US-built ships, owned by US entities, and operated by US citizens or permanent residents. As the US does not currently have a fit-for-purpose fleet of vessels for various construction phases, this could represent a significant barrier. Alternative strategies including feeder barges from shore or Canadian port infrastructure will need to be developed as a short- to medium-term solution. This could particularly be an issue during the mid-2020s, when installation figures are due to jump to 5-6GW of capacity deployed annually. However the first Jones Act-qualified installation vessel from Dominion Energy has been chartered for the Revolution and Sunrise wind farms. With this milestone reached, unlocking further barriers on this front is looking slightly more promising. Construction costs remain a pivotal issue for developers, however, as the investment required by a US-built wind turbine installation vessel is estimated to be 50% higher than a similar unit built in Asia.

Supply chain

Promoting local supply chain development will be crucial to realising the US's offshore wind potential, especially as competition for fabrication and vessel resources is expected to pick up globally towards the middle and end of this decade. Port and infrastructure announcements from developers and state governments have been frequent, though a lack of concrete contract awards and projects passing the lengthy consenting phase has arguably made initial investments into fabrication sites and factories difficult. The announcement of preferred supplier agreements with key turbine manufacturers such as Siemens Gamesa has brought movement into this, however, with the turbine supplier agreeing to build the US's first blade facility in Virginia. Similarly Nexans has now opened the region's first high-voltage subsea cable plant in South Carolina, and Ørsted is investing in Maryland's first steel fabrication centre – thanks to the emergening development prospects in the region.

Transmission Infrastructure

A large build-out of electric cabling is needed to meet the targetted 30GW capacity. At present, offshore wind developers are responsible for building and linking the individual transmission lines to the network, and state solicitations bundle the transmission and generation. However, there are limited interconnection points near coast and no integrated approach on transmission plans between grid operators, federal agencies and states. A bottleneck of projects applying for grid access is anticipated as offshore wind continues to accelerate, despite the possibility to repurpose some infrastructure originally built for power plants. Discussions now consider the need for transmission networks for offshore wind farms built by independent developers. Transmission developer Anbaric Development Partners has played a vital role in pushing for this, and has bid 19 offshore transmission systems (Broadwalk Power Link) to PJM Interconnection's New Jersey solicitation. Ørsted and Public Service Enterprise Group also submitted several proposals./ Meanwhile Anbaric has proposed the Downstate Clean Powerlink in response to the New York ongoing solicitation.

March 2020 for the discussion of offshore wind port development in the state. Similarly, Massachusetts has set aside $100m to invest in offshore wind port infrastructure, and as part of the Commonwealth proposal, Vineyard Wind has signed an agreement to establish Salem Harbour as the state's second major port. Virginia is working on a lease agreement with Dominion Energy for the Portsmouth Marine Terminal to support the pre-assembly of the foundations for the CVOW wind farm.

Clarisse Rocha – Director – Americas

The EIC is currently tracking over 47GW of offshore wind capacity in the Brazilian market, spread across 23 early-stage developments. Consent and EIA activities are already underway. Reports initially suggested that a first auction could be held in 2022, however industry experts have the opinion that an auction would only kick off at a later date. Similar to Norway, the UK and the US, existing oil and gas supply chain capabilities could find application in a future offshore wind market, with a strong onshore wind sector potentially providing opportunities for diversification and overlap as well. While issues remain to be addressed, the entry of key players such as Equinor and Iberdrola, as well as the large scale of the proposed projects, point to a future offshore wind market with significant promise.

Back in 2001, Brazil decided that wind farms were essential for the country's electric power matrix. Severe droughts at the time rendered numerous hydro power plants ineffective, which led to a nationwide electricity supply crisis. Facing the urgency of complementary sources of power, government authorities introduced an incentive programme aimed at boosting the development of onshore wind farms. Allied with optimal geographical conditions and an increasing appetite from developers and supply chain players, this initiative kickstarted the development of the onshore wind segment in the country, eventually propelling Brazil to the world's top 10 ranking of wind power capacity.

Two decades later, a similar story is about to unfold. While widespread blackouts are now a thing of the past, new opportunities and challenges have arisen. Climate change and the urgency to reduce CO2 emissions, combined with major technological advances over the years, has made offshore wind an increasingly attractive prospect in Brazil. Generally dismissed as unimportant for the country a mere five years ago, the offshore wind segment is now gaining traction as major developers, state governments and lawmakers realise the country's great offshore wind potential and the business opportunities involved.

Brazil's potential in the energy sector is – quite deservedly – frequently associated with the oil and gas market. Offshore wind, however, can be as enticing as pre-salt oil reserves. Brazil's Energy Research Office (EPE) estimates the country's offshore wind potential at 700GW in water depths of up to 50 metres. Brazil's North East region – already a hotspot for activity in the onshore wind market – leads in terms of potential, but development opportunities can also be found in the country's South and South East regions.

Indeed, Brazil's massive offshore wind potential has drawn attention from international players. In January 2020, Iberdrola's Brazilian unit Neoenergia started the environmental licensing

process for three offshore wind projects – each in a different Brazilian region – totalling 9GW of installed capacity. A few months later, Equinor followed suit by announcing the 4GW Aracatu offshore wind farms in south-eastern Brazil. Chinese offshore turbine supplier Mingyang Smart Energy, meanwhile, has announced an MoU with the Ceará state government for the installation of a local manufacturing plant. In June 2021, developer Ocean Winds also started the environmental licensing process for five offshore wind developments totalling over 15.2GW of capacity – the Maral, Ventos do Atlântico, Vento Tupi and Tramandai offshore wind farms and the Ventos Do Sul floating wind farm. Further development strategies also continue to arise, with the state of Rio Grande do Norte recently signing an agreement with Enterprize Energy to identify and develop opportunities for offshore wind, alongside green hydrogen and ammonia projects. According to EICDataStream, Brazil currently has 23 offshore wind projects with a potential CAPEX exceeding US$137bn.

Offshore wind in Brazil is still a novelty and a clear government policy for the sector has yet to be introduced. However, steps are being taken in the regulatory sphere to facilitate the development of offshore wind farms in the coming years. Ibama, the federal environmental regulatory agency, has recently released reference terms for offshore wind farms, providing more clarity for the licensing of new developments. A draft bill creating a licensing framework akin to offshore E&P concessions is currently being reviewed by Brazilian lawmakers. More recently, the Bolsonaro administration announced plans to introduce new regulations by decree instead of new legislation. A finished document is expected between late 2021 and early 2022.

Brazilian offshore wind projects, while still in early stages, provide significant opportunities and challenges for suppliers of goods and services. Thanks to a public financing policy for wind farms featuring equipment produced locally, Brazil already has a robust supply chain for the onshore wind sector. Investment will be needed to upgrade and adapt this manufacturing capability in order to serve the offshore segment. The same applies to logistics: the transport and installation scopes of an offshore wind project will require a revamped port infrastructure as well as suitable vessels. Offshore wind also presents a great diversification opportunity for the local O&G supply chain, whose expertise and capabilities can be used in the development and execution of offshore wind projects.

Offshore wind is indeed the next frontier in Brazil's clean energy trajectory. Despite current regulatory, supply chain and infrastructure challenges, projects already announced in the country attest to the development potential of the local offshore wind market. The Brazilian Wind Power Association (ABEEólica) estimates that the first large-scale offshore wind farms in the country could start operations in 2027. Provided necessary conditions are in place, these facilities could be the first of a series of offshore wind developments across Brazil, potentially mirroring the country's success story in the onshore wind segment.

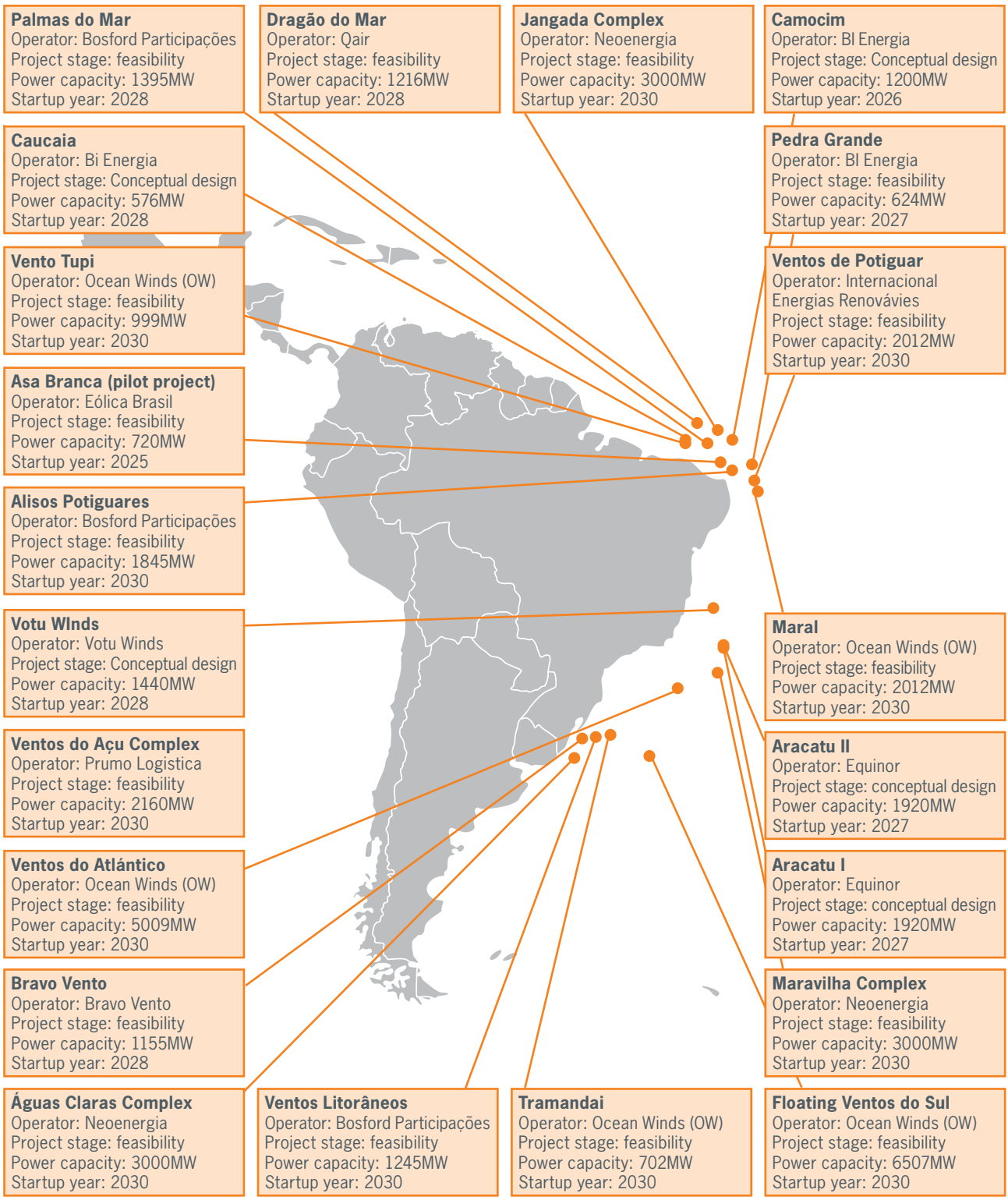

Figure 11

Map of proposed offshore wind developments in Brazil.
Source: EICDataStream.

ASIA–PACIFIC

Azman Nasir – Regional Director Asia-Pacific

In view of the decarbonising trend of the oil and gas market, non-fossil-fuel-based energy has emerged at the centre of the energy transition. Asia Pacific, known for its heavy reliance on fossil fuels, is now strongly venturing into low-carbon and zero-carbon energy sources on the way to a net zero target across key countries. Across the region, we are seeing significant renewable energy targets being set. South Korea for example, has a policy of "Renewable Energy 3020" targeting 20% renewables in the power mix by 2030, while China, Japan and Taiwan are on the fast track with renewables targets of 35%, 36% to 38%, and 25% respectively by 2030. India on the other hand, is aiming to generate 226GW of renewable energy by 2022 and 450GW by 2030, whereas Vietnam has also jumped on the bandwagon with a target of nearly 130GW by 2045. These trends have not gone unnoticed in the energy supply chain. At the EIC's Asia-Pacific office we've witnessed a clear growth in interest in renewable energy topics and events, across a variety of technologies including offshore wind, onshore and solar PV as well as emerging innovations such as green hydrogen production and carbon capture and storage.

Reliable renewable energy sources allow the region to make use of its favourable environmental conditions – from abundant sunny weather to significant coastlines and wind speeds. It is, therefore, not surprising that Asia Pacific is the fastest-growing region for offshore wind. According to EICDataStream, the region's share of CAPEX for offshore wind is predicted to grow from 8% in the last decade to 37% in the next 10 years. This translates to about a whopping US$300bn worth of opportunities in the pipeline. Europe, which was a clear leader at 7%, is now expected to reduce to 47% of global CAPEX share in the next decade as emerging regions pick up pace. The immense growth in the region is driven mainly by China, which is anticipated to overtake the UK and Germany within the next decade in terms of total installations. Other key markets include Japan and Taiwan, which plan to achieve 10GW and 15GW of offshore wind installations by 2030 and 2035 respectively.

Aside from the "power duo", South Korea and Vietnam are becoming the next big thing in offshore wind, targeting to bring online 12GW and 10GW of offshore wind by 2030. Vietnam is in fact, one of the most promising emerging offshore wind markets globally with more than 500MW of offshore wind projects in the short-term pipeline before November 2021 FiT. In terms of individual project capacity, its Thang Long Offshore Wind Farm alone is expected to generate 3.4GW of wind energy by 2025. Australia on the other hand, albeit still new, has strengthened its commitment in offshore wind with the allocation of US$3.65m in support of the development of a policy, regulatory framework for offshore clean energy infrastructure.

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With the increasing demand in offshore wind energy, innovations are pivotal to reduce costs and increase efficiency. As the need for larger and more efficient turbines, as well as Power-to-X solutions and energy storage grow, so does the need for more green financing. However, this can only be done if backed by policies at national and even regional level, in which the region is generally still lacking. Localisation strategies aimed at consolidating the supply chain can play a vital role in ensuring that the offshore wind industry develops into a competitive, yet sustainable market.

Vietnam

Blessed with a long coastline with good wind speeds, Vietnam has a potential for 160GW of offshore wind. The sector is poised for significant growth and has continued to witness significant interest from both domestic and foreign entities. As of 2021, more than 204MW of offshore wind capacity has been installed in Vietnam. Based on the assessment by the World Bank and DEA for the Power Development Plan 8 (PDP 8) development, moving forward, Vietnam has proposed to raise its offshore wind energy target for 2030 to 10GW, from the previous 6GW planned. This ambitious target is primarily driven by Vietnam's goal to achieve 20% of renewable energy in the energy mix by 2030, with a long-term goal to achieve 40% by 2040.

According to ESMAP, Vietnam has 261GW and 214GW of technical potential for fixed-bottom and floating wind, respectively. World class wind resources lie off the southwest coast, mainly near Binh Thuan and Ninh Thuan provinces, where average wind speeds exceed 10m/s in water depths of less than 50m. The area extends to the south with wind speeds falling to 7m/s. This area alone

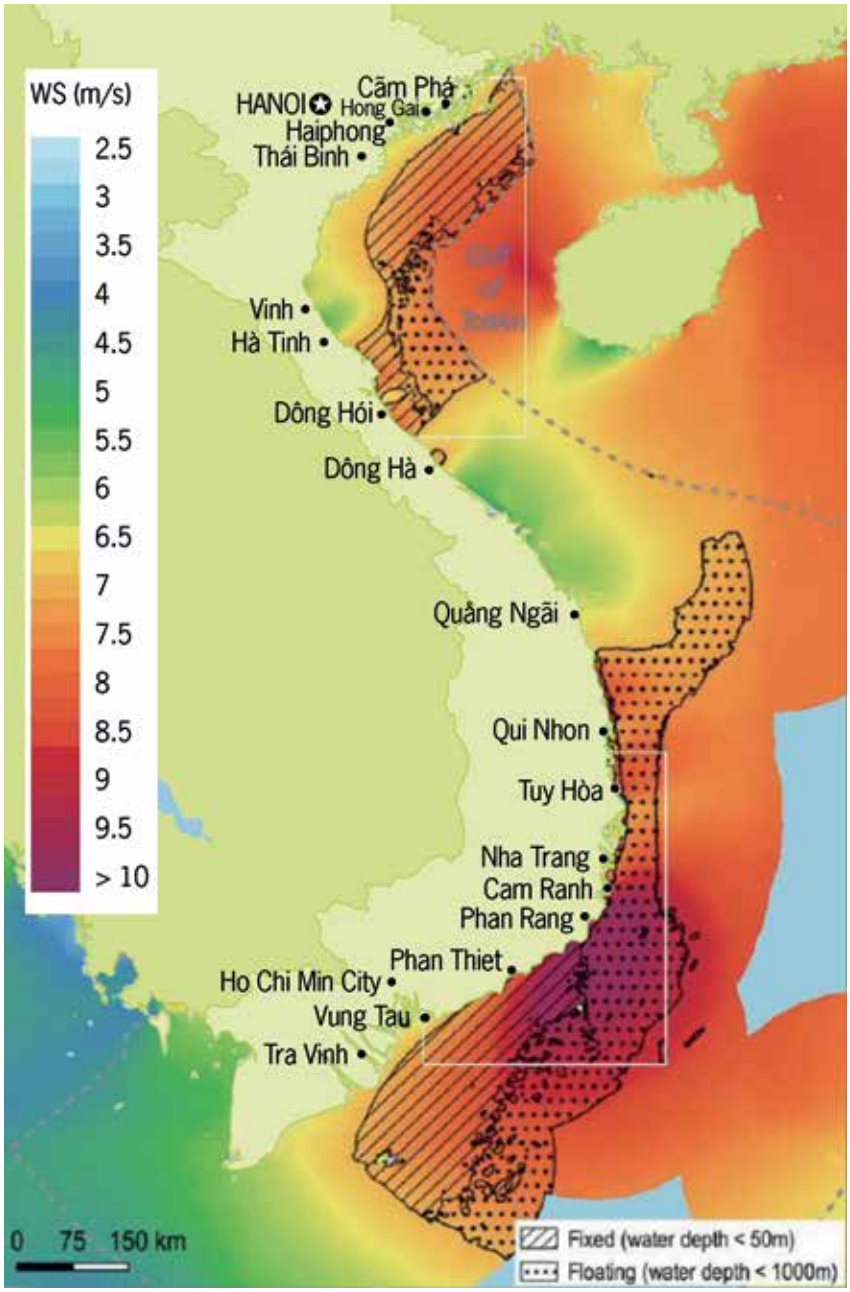

Figure 11

Offshore wind technical potential within 200km of the shoreline.
Source: ESMAP.

has technical potential for 165GW of fixed offshore wind. Whereas in the northern region at the Gulf of Tonkin, the area has windspeeds between 7m/s to 8.5m/s with technical potential of 88GW and 39GW for fixed and floating offshore wind, respectively. Towards the central south region, there is also potential of 175GW for floating wind.

The existing local supply chain in Vietnam is expected to benefit from the growing sector, including some capabilities for certain types of foundation fabrication, local blade manufacturing, installation services, design & construction of onshore electrical assets as well as O&M. The country harbours a skilled engineering workforce with expertise in shipbuilding and the oil and gas sector which can be integrated into the offshore wind industry. Although there are no Vietnamese operated jack-up vessels, there are other heavy lift vessels from the oil and gas sector that could also carry out foundation and substation installation. While certain components such as wind turbines is expected to continue to rely on import, further investment in local facilities might kick start other areas of the offshore wind supply chain. Foreign players such as GE, have also shown serious commitments in the sector and has established a wind turbine generator facility in Hai Phong.

In terms of policy, initially, the wind FiT scheme is expected to expire on 1 November 2021 and the sector will transition to a competitive bidding auction scheme, which will create a downward pressure on costs, with more transparency benefits for better planning purposes. However, the Ministry of Industry and Trade (MOIT) has proposed a two-year extension, although the impact on the offshore wind segment will be relatively less significant as compared to onshore wind due to the longer time frame required for development. Regardless, this extension will allow the industry to gain more experience and establish a stronger local supply chain before shifting to the auction scheme. As part of the plan to extend the FiT scheme, in December 2020, MOIT has also proposed a new FiT rate for intertidal/nearshore projects, which will see a 13.6% reduction in the tariff. However, this drastic reduction will likely hinder the growth of the sector and derail investment, particularly in new and planned wind projects.

Nearshore/intertidal wind projects are seeing a rise in the country and most of the projects have a capacity of around 50MW. These projects are located on marine coastlines, including rocky shores and sandy beaches. Typically, the water depths in nearshore areas are up to 20m whereas in intertidal zones, the water level can change massively between 5m to 15m during high and low tide. In November 2020, Vietnam announced the development of its largest intertidal wind farm, with a 350MW capacity consisting of four wind farms located off Nangen County in Ca Mau Province. Another project in Ca Mau Province is the 75MW Tan Thuan nearshore wind farm which entered commercial operations on 30 October 2021 and is the largest nearshore project to be put into operation in Vietnam so far.

In July 2020, Copenhagen Infrastructure Partners (CIP) and Vietnam's Asiapetro and Novasia Energy have signed an MoU with Binh Thuan People's Committee for the development of the 3,500MW La Gan offshore wind complex off the coast of Binh Thuan Province. The $10bn wind farm will be developed in different stages with the first 1,000MW to be operational by 2024, followed by further 600MW phases to come online between 2026 to 2030. The FID is expected to be made after the official release of PDP8. In November 2020, the contracts for the floating LiDAR and Environmental and Social Impact Assessment were awarded to AXYS Technologies and NIRAS Group, respectively. Also, a consortium between Vietsovpetro, PTSC G&S and Fugro has been awarded the offshore geotechnical survey services contract for the project in July 2021.

Another large-scale offshore wind development in Vietnam is the 3,400MW Thang Long offshore wind project which is being developed by Enterprize Energy in five 600MW phases and one 400MW phase. The first phase will feature 64 MHI Vestas 9.5MW wind turbines, with 10MW and 12MW turbines planned for the subsequent phases. The project is targeted to start generating electricity by the end of 2025, with full completion expected in 2028. It is the only offshore wind project in Vietnam that has received approval from the

Status	Project	Location (Province)	Operator	Start-up year	Capacity (MW)
Planning consent applied	Thang Long	Bin Thuan	Enterprize Energy	2025	3,400
	Ben Tre	Ben Tre	Mainstream Renewable Power	2026	500
	Phu Cuong (Phase 2)	Soc Trang	Mainstream Renewable Power	2030	1,000
Planning	Soc Trang 7 (Phase 2)	Soc Trang	Soc Trang Energy JSC	2022	90
	Phu Cuong (Phase 1)	Soc Trang	Mainstream Renewable Power	2023	400
	Ca Mau 1 Intertidal	Ca Mau	Vietnam Construction and Trading Corporation	2024	350
	Phu Cat and Phu Dinh	Binh Dinh	PNE Wind	2026	2,000
	La Gan	Bin Thuan	Copenhagen Infrastructure Partners	2029	3,500
Under construction	Soc Trang (Phase 1)	Soc Trang	Soc Trang Energy JSC	2021	30
	Ben Tre 10	Ben Tre	Gulf Energy Development	2021	310
	Bac Lieu (Phase 3)	Bac Lieu	Superblock	2021	142
	Ca Mau Nearshore	Ca Mau	Superblock	2022	100

Table 10

List of selected offshore wind projects in Vietnam.
Source: EICDataStream.

Government of Vietnam and the MOIT to conduct surveys and to be included in the PDP8. In July 2020, Enterprize Energy signed an MoU with Vietsovpetro and Petroleum Equipment Assembly & Metal Structure Joint Stock Company (PVC-MS JSC) for the EPCI work scope which include the design, fabrication, transportation and installation of wind turbines, substation foundations as well as the offshore transformer station.

In December 2020, a new large-scale offshore wind project entered the pipeline which will be developed by PNE AG and project discussions have been conducted with the Binh Dinh Provincial People's Committee. The plan is to build a 2,000MW offshore wind farm in the waters of the Phu Cat and Phu Dinh districts at Binh Dinh Province. The project will feature between 154 and 166 turbines and will be developed in phases. The first 700MW phase could begin construction as early as 2024 and is valued at approximately $1.6bn while the overall development could cost up to $4.8bn.

Mainstream Renewable Power and Phu Cuong Group entered a JV agreement in 2017 to develop the 1,400MW Phu Cuong offshore wind project in Soc Trang Province. The first 200MW of the project received PDP7 approval in June 2020 and the second 200MW is expected to be included in PDP8. The site survey for the remaining 1,000MW is underway. For the first 200MW, financial close is targeted to be achieved by the fourth quarter of 2021 with construction to follow thereafter. Commercial operation for Phase I is slated for 2023.

Further growth prospects of the offshore wind industry in Vietnam are very promising. However, much of the wind potential is concentrated at remote areas, with lower population and power demand, such as the coastal areas of the southern central and central region. Meanwhile, the load demand is mainly saturated in the southern region. Hence, a significant amount of investment is required for the enhancement of the grid infrastructure, which remains the biggest bottleneck for renewable development.

Apart from that, the transmission development has long been under the domain of the state-owned power company, Electricity of Vietnam (EVN). However, the state has limited budget and lacks resources, which hinders grid expansion. Hence, this intensifies the need to privatise the country's transmission business in order to meet the PDP8 targets in the

Status	Project	Location (Prefecture)	Operator	Start-up year	Capacity (MW)
Under Construction	Noshiro Port	Akita	Akita Offshore Wind Corporation	2022	84
	Akita Port	Akita	Akita Offshore Wind Corporation	2022	55
Planning	Ishikari Bay	Hokkaido	GIG & HEPCO	2023	112
	Goto (floating)	Nagasaki	Goto City Offshore Wind Power Generation	2023	16.8
	Kashima North and South	Ibaraki	Wind Power Energy K.K	2025	159.6
	Hibikinada	Fukuoka	Hibiki Wind Energy	2025	229

Table 11

List of selected offshore wind projects.
Source: EICDataStream.

future. Also, with the sheer growth of offshore wind development, there lies a need to mandate a nodal regulatory body to act as a single point of contact to streamline the permitting as well as consent processes for projects.

Japan

According to Japan's 5th Strategic Energy Plan released in 2018, the country has a renewable energy target of between 22% to 24% of the country's energy mix by 2030. The country's offshore wind industry is poised for significant growth and could help in meeting its clean energy targets. According to the International Energy Agency, the offshore wind sector is estimated to have enough technical potential to satisfy its entire power needs nine times over. Furthermore, with its long coastline, the offshore wind sector is very much essential to the country due to its densely populated nation which has limited onshore space for solar and wind development.

Japan has a target to install 10GW of offshore wind by 2030 with a long-term goal of achieving between 30GW to 45GW by 2040. Under the Green New Deal, the government has also earmarked a $19.2bn green technologies fund to help stimulate innovation in the clean energy sector to meet its target of becoming carbon neutral by 2050. These targets are the prime catalyst for the country's offshore wind sector, with the need to reduce the dependency on fossil fuel as well as foreign electricity, especially from the Middle East. The Ministry of Economy, Trade and Industry (METI) also aims to annually approve three to four offshore wind projects, with a combined capacity of 1,000MW, starting from 2021.

There are no large offshore wind farms in Japan. As of 2020, Japan has around 78MW of offshore wind installed capacity generated from a few pilot projects. The country has about 12GW of projects in the development pipeline and most are still in the early planning or EIA stages. Projects that are moving forward include the Akita and Noshiro port offshore wind farms which are currently under construction with commercial operation expected to begin in 2022.

Despite its small land area, Japan is the world's sixth largest maritime nation by the size of its exclusive economic zone. The country has nearshore deep waters with 80% of its offshore wind potential located in sea-depths of more than 100m. This makes floating technology a more viable option, compared to bottom-fixed foundations. Japan has the potential to become a hub for floating wind farms and a leader in this nascent technology.

Japan's first auction was held on 24 June 2020, which was for a floating wind farm in Goto City in Nagasaki Prefecture. Goto was one of the zones that was previously nominated as a promising area in 2019. The capacity for the development is

required to be at least 16.8MW. The auction was closed on 24 December 2020 and the winning bidder was announced in June 2021. METI selected the Goto City Offshore Wind Power Generation LLC consortium which is led by Toda Corporation, alongside ENEOS Corporation, Osaka Gas, Kansai Electric Power, INPEX and Chubu Electric Power to develop the floating wind project. Since the subject of this public tender is floating offshore wind power, the operator selection process did not include the cost competition element because the price has been fixed at $34cents/kWh. Other local players that are venturing into the floating segment include Marubeni and Acacia Renewables which was acquired by Iberdrola in September 2020.

In July 2020, METI identified ten areas which have reached a certain preparatory stage. Four of the areas, Aomori North and South, Happou town and Noshiro city as well as Saikai city, have been dubbed as promising areas. In November 2020, Japan officially launched its first round of tenders for bottom-fixed offshore wind farms for four designated areas, Yurihonjo and Noshiro in Akita as well as Choshi City, off Chiba Prefecture. The closing date to submit proposals was on the 27 May 2021. Major energy players including the consortium of Ørsted, Japan Wind Development Co. (JWD) and Eurus Energy, the consortium of Ørsted and TEPCO Renewable Power and the consortium of JERA, Equinor and Electric Power Development (J-Power) are bidding for the auctions. Companies such as

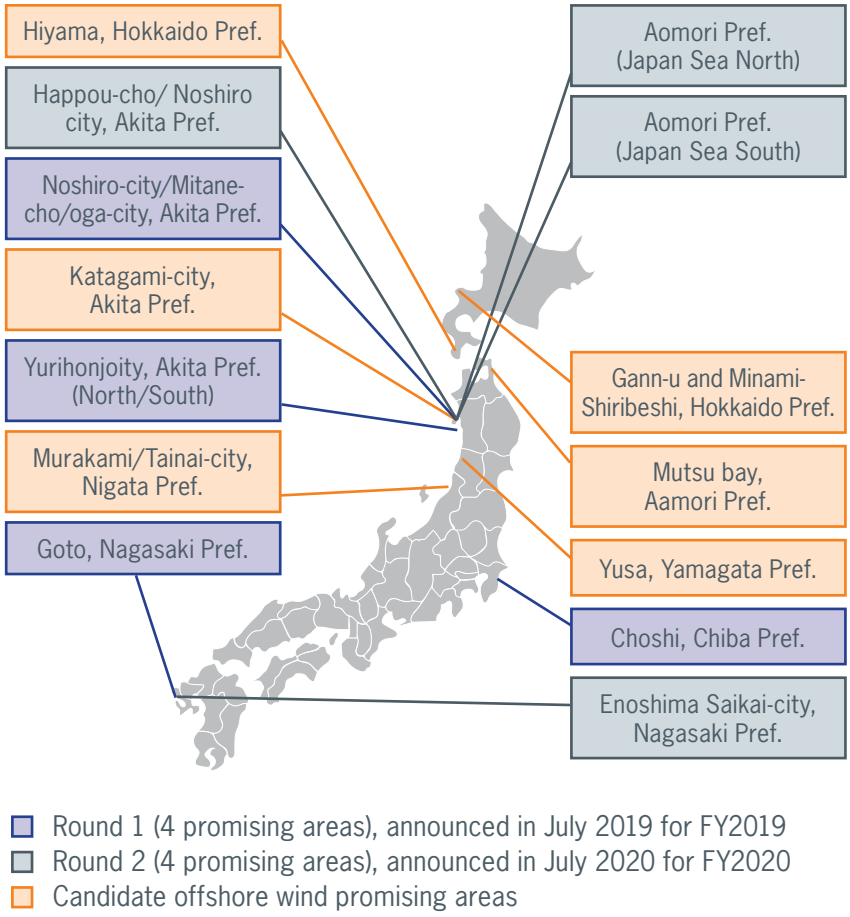

Figure 13

Promising areas in Japan in promotional zones (FY 2019 and FY2020). ***Source: METI.***

Kyuden Mirai and RWE have submitted plans to METI for the Yurihonjo City project, with a proposed capacity of 840MW, to take part in the tender. Auction results are expected to be released by quarter four of 2021.

METI has also released round two for subsidy applications in March 2021 for projects that promote domestic investment which reinforce supply chains and lower supply disruption risk. The application period was closed on 7 May 2021. Round two is more centred around the green and digital sectors as compared to the first round of subsidy which was held in July 2020.

In September 2021, METI named four offshore wind promising areas, in addition to the existing three offshore wind promising areas. The new promising areas include Akita, Yamagata and Niigata in northern Japan and one

Project Approval	RMB/kWh	Requirement
Approved before the end of 2018	FiT: 0.85 (US$0.13)	Fully connected to grid before the end of 2021
Approved in 2019	Auction ceiling price: 0.80 (US$0.12)	
Approved in 2020	Auction ceiling price: 0.75 (US$0.11)	

Table 12

National Development and Reform Commission's latest notice on offshore FiT.
Source: National Development and Reform Commission.

in the Pacific Ocean, off Chiba. For these areas, the preparation process will start immediately. Initially, the plan was to identify and auction off areas capable of generating 1GW of offshore wind power each year but only the 360MW Happo-Noshiro, off Akita, was selected for auction in Round 2. The public auction for the Happo-Noshiro project is likely to begin in early 2022.

In terms of the supply chain, Japan can benefit from its strong industrial capabilities, maritime experience as well as designated offshore wind ports. However, there are still certain gaps in its supply chain such as planning and project management, marine coordination and installation, which is insufficient to support a substantial ramp-up and drive down of costs. There are no strict local content requirements in Japan but supply chain companies looking to enter the market will have to address language barriers and cultural differences, lack of transparency in procurement and project timelines. The Japanese market continues to be very protective in nature and foreign companies are advised to partner with local entities.

A potential barrier to offshore wind in the country is the lengthy permitting process. Generally, the EIA processes could take up to five years and are costly, which reduces the sector's competitiveness, leading up to a slower market growth. Furthermore, major wind resource areas and supply chain bases are located at low demand centres for electricity. Hence, this intensifies the need to enhance local grid capability to integrate offshore wind sources and supply electricity to high demand areas.

China

The U.K. still reigns as the number one offshore wind market in terms of cumulative installations in 2020, but China is not far behind, with just under 10GW. The country has been the major market for offshore wind installations in the Asia Pacific region. It had more than 2.3GW of new installations in 2019, making it the largest added capacity globally. In 2020, more than 6GW of new offshore wind capacity was added globally with over half of the installations coming from China. The country managed to add 3.06GW of new offshore wind capacity in 2020, maintaining its place as the global lead for capacity additions for a third consecutive year. China is predicted to continue its dominance in the sector until 2025 but its market share is expected to gradually reduce once projects from the other growth markets get connected.

The sheer growth of the offshore wind sector in China over the past few years has been driven largely by its clean energy targets, policy support and technology advancement. The country is targeting peak carbon dioxide emissions by 2030 and carbon neutrality by 2060. In line with its targets, China plans to add a further 52GW of offshore wind capacity by 2030.

Although China was the first country to be hit by the COVID-19 crisis, there was minimal impact on the offshore wind sector and business continued as usual. According to the Chinese Wind Energy Association, 12GW of offshore wind projects were under construction as of September 2020. This is beyond China's 10GW target to be installed or put into construction by 2020,

under the 13th Five Year Plan. In addition, Guangdong, Fujian and Zhejiang has given key provincial project status to another 14GW of planned capacity, indicating a huge project pipeline for future sector growth. The expansion in the country's offshore wind sector is set to boost demand for mineral materials, such as rare earths, which are used in wind turbine magnets.

In terms of policy, China's first offshore wind tariff was set in 2014 at 0.85 yuan/kWh (US$0.13/kWh), which was more than coal-fired power with an average of 0.42 yuan/kWh. The attractive wind tariff has since propelled the sector forward. In May 2019, the Chinese National Development and Reform Commission (NDRC) changed its offshore wind tariff from a fixed price to guide price. The projects approved in 2019 is required to enter auctions where price competition is a central element, with a wind cap price of 0.80 yuan/kWh (US$0.12/kWh). This represents the Chinese government's first electricity price cut from offshore on-grid wind facilities. The cap price was further reduced to 0.75 yuan/kWh (US$0.11/kWh) for projects approved in 2020. New wind farms will not be eligible to receive central government subsidies from 2022, except for projects approved before the end of 2018 and grid-connected by the end of 2021. This resulted in an installation dash as developers rushed to meet the tariff deadline. Nearly 40GW of capacity are in the project pipeline but only a fraction of it is expected to be completed before the tariff expires. These upcoming wind farms will mainly be developed in four Chinese coastal provinces, namely, Guangdong, Jiangsu, Fujian and Zhejiang.

Several of China's coastal provinces have taken the initiative to put in place respective targets and policies to provide support to the offshore wind development. Jiangsu province, which has the largest offshore wind capacity in the country, has set forth plans to install 12GW between 2021 to 2025. Guangdong province launched the country's first local subsidy scheme for offshore wind to aid projects that are facing the loss of national subsidies at the end of 2021. The authorities are also offering support to the manufacturing aspect in the efforts to establish a local supply chain, including large-scale turbine production. Subsidies will be provided for local offshore wind projects in 2022 and 2023, covering a total of 4.5GW worth of new capacities. 2.1GW will be built in 2022 at a subsidy of 1,500 yuan/kW, which will then be reduced to 1,000 yuan/kW for capacities built in 2023. Guangdong targets to develop 4GW of offshore wind capacity by the end of 2021 and ultimately, 15GW by the end of 2025.

With China's massive pipeline of projects, future offshore wind farms will be developed in deeper waters further from shore and borders between provinces will become increasingly harder to define. Hence, establishing inter-provincial coordination is crucial to sustain the rapid growth of the industry. Furthermore, the installation dash to meet the subsidy deadline has caused a bottleneck on the supply of offshore wind installation vessels. In addition, with the exposure to rough climate, typhoons and high seas, the window for installation activities is short. Hence, these factors could limit the potential volume of project delivery before the tariff deadline. In the efforts to address the limitation, Chinese yards are currently building nine new offshore wind installation vessels for domestic use, seven of which will have a jack-up design, while the remaining ones are ship-shaped and bottom-supported. Five of the vessels are expected to be delivered in 2021 and the rest are planned for completion in 2022.

Aside from support policies, technological advancement has also played a key role in the rapid growth of the offshore wind sector in China. Initially, the country has been highly dependent on imported offshore wind turbines. However, the type of wind turbines from Europe were not always suitable for areas with different seabed conditions and exposed to typhoons, which led to a higher cost in engineering. Hence, China began designing and manufacturing their own turbines to better cater to the country's needs, with better reliability and lower costs. Evidently, China's first 10MW offshore wind turbine was successfully connected to the grid in July 2020 at the Xinghua Bay Wind Farm (Phase II) off the Fujian province. After Dongfang Electric's turbine passes the test and verification on-site, it will be mass-produced and gradually promoted

Status	Project	Location (Province)	Operator	Start-up year	Capacity (MW)
Under construction	Dalian Zhuanghe IV	Liaoning	China Huaneng Group	2021	350
	Yuedian Yangjiang Shayu	Guangdong	Guangdong Yudean Group	2021	300
	Changle Waihai Area A	Fujian	Fujian Funeng Strait Power Generation Co. Ltd.	2021	300
	Yangjiang Shaying Phase III - A1	Guangdong	China Three Gorges New Energy	2021	300
	Xuwen North	Guangdong	State Power Investment Corporation	2021	300
	Fuqing Xinghua Bay Phase 2	Fujian	China Three Gorges New Energy	2021	280
	Jiazi I	Guangdong	China General Nuclear Power Group	2022	500
	Changle Waihai Area C	Fujian	Fujian Funeng Strait Power Generation Co. Ltd.	2022	500
Planning	Caofeidian Phase 1	Hebei	Huadian Power International Corporation	2022	100
	Laoting Yuetuo	Hebei	China Guodian Corporation	2022	300
	Caofeidian Phase 2	Hebei	Huadian Power International Corporation	2023	100
	Shantou Zhongpeng I	Guangdong	CNOOC Rongfeng Energy	2025	1,000

Table 13

List of selected China offshore wind projects.
Source: EICDataStream.

and installed at Fujian's offshore wind farms. With the sheer capacity of the domestic market, China's turbine manufacturers including China Shipbuilding Industry Corporation (CSIC), Envision, Goldwind, Ming Yang and Shanghai Electric may potentially become one of the most dominant in the industry without the need to succeed overseas. The upcoming wave of developments in China will provide these local manufacturers the opportunity to lead global offshore wind order rankings in the future.

China has so far focused on supporting local players and establishing a strong domestic supply chain. The country remains protected with limited opportunities for international players as compared to the other growth markets. The sector is mainly dominated by large, state-owned enterprises such as China Three Gorges (CTG), China General Nuclear, Longyuan, Huaneng and State Power Investment Corporation. Among European turbine manufacturers, only Siemens Gamesa has managed to indirectly enter the market through a licensing agreement with Shanghai Electric. Oil and gas players are also venturing into the offshore wind sector. In September 2020, China National Offshore Oil Corporation (CNOOC) launched its first offshore wind farm off Jiangsu province. The national oil major also issued a green development action plan which calls for renewed efforts to develop offshore wind farms.

China continues to have huge ambitions for its offshore wind sector, which has led to Chinese players being more open to forging partnerships with foreign entities to tap investment, expertise or even both. EDF has ventured into China's offshore wind market when the company acquired a stake in a 500MW offshore wind farm off Jiangsu province. French energy major, TotalEnergies has shown interest in exploring potential partnerships for offshore wind development in China with development giant, CTG, in which floating offshore wind was also part of the discussion between the parties. In September 2021, CTG has completed its 5.5MW floating wind turbine at its pilot project off the coast of Guangdong Province, becoming a pioneer in the sector.

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Moving forward, China has released a draft of its 14th five-year plan in March 2021, outlining the country's upcoming economic priorities. The plan includes the need to cut energy intensity by 13.5% by 2025. This reduction would mean to grow the country's gross domestic product (GDP) faster than its energy consumption. In addition, China is also planning to cut emissions intensity by 18% before 2025. This upcoming five-year plan could act as a new strategic transitional period of the offshore wind in China and drive the rapid expansion of the industry.

Taiwan

Taiwan has ideal conditions for offshore wind developments with wind speeds of 10m/s to 12m/s within the Taiwan Strait and has been receiving a significant amount of international interest. The country has two projects currently in operation, which are the Formosa 1 Phase 1 and Phase 2 wind farms, representing a combined installed capacity of 128MW.

Taiwan is well underway to achieve its 5.5GW offshore wind target by 2025, with an ambitious long-term goal to add a further 15GW by 2035. This is in line with Taiwan's target to fully phase out nuclear power plants before 2025 and achieve 20% of renewable power in its energy mix by 2025. The country has also set forth a goal to reach net-zero emissions by 2050.

One of the key drivers of the sector in Taiwan is the government's policy and commitment. The initial initiative that was implemented in the earlier stages was an attractive 20-year ladder FiT scheme of 5.850NT$ to create economies of scale and drive down cost for subsequent phases. In April and June 2018, Taiwan's Ministry of Economic Affairs (MOEA) held its first two offshore wind auctions. The selected projects with a combined capacity of 5.5GW were allocated through two different procedures. The first 3.5GW was allocated through a selection procedure, whereby 0.7GW and 3GW were planned to be completed by 2020 and 2025, respectively. Whereas the remaining capacity, to be commissioned by 2025, was allocated through competitive bidding. However, on 30 January 2019, a 5.71% cut in offshore wind tariff's was implemented, reducing it to 5.516NT$/kWh. The revised ladder tariff will have a lower rate for the first 10 years and an increased rate for the second 10 years.

MOEA plans to hold its highly anticipated third round of offshore wind auctions, beginning with 3GW, in 2022. The projects selected in the third auction round are expected to be commissioned between 2026 and 2027. The subsequent rounds will add a further 3GW each in 2023 and 2024, to be commissioned within 2028-2029 and 2030-2031, respectively. The auctions will be carried out in a two-stage selection process. The first stage comprises of a qualification review, which will EIAs, localisation commitments, and technical and financial capabilities of the project proponents. Stage two involves price bidding with a potential price cap applied. The project size is expected to be limited to a maximum of 0.5GW per bid and 2GW per developer.

With the upcoming auction rounds, international and local developers are gearing up to participate in potential offshore wind developments. Northland Power has submitted applications for two new proposed developments, which are the NorthWind and CanWind projects. The wind farms will have a combined capacity of up to 1.8GW located off the coasts of Taichung and Chang Hua county. Another player eyeing the auctions is the Danish firm Copenhagen Infrastructure Partners (CIP) through its local development company, CI Wind Power Development Taiwan, who announced six proposed sites for wind farm projects with a total installed capacity of 6.3GW in the waters off Hsinchu, Miaoli, Changhua and Taichung. With the huge influx of interest from developers, the country's offshore wind project pipeline is well over 28GW ahead of the tenders.

As wind resources nearer to shore gradually reduce and concerns for environmental protection and local fishing industry increase, the offshore wind developments will need to shift towards deeper areas. The floating offshore wind sector has the potential to unlock deeper waters in Taiwan. The Taiwanese government has yet to implement a policy for floating wind, but developers have started making the move to venture into the floating segment. In October

Status	Project	Location (County)	Operator	Start-up year	Capacity (MW)
Under construction	Changhua (South) Phase I	Chang Hua	Taiwan Power Company	2021	110
	Yunlin	Yunlin	WPD Offshore GmbH	2022	640
	Formosa 2	Miaoli	JERA	2022	376
	Guanyin	Taoyuan	WPD Offshore GmbH	2022	350
	Changhua 2a	Chang Hua	Ørsted	2022	295
	Hai Long 2 & 3	Chang Hua	Northland Power	2025	1,044
Planning	Changhua 3 (Northwest)	Chang Hua	Ørsted	2025	583
	Formosa III - Haiding 3	Chang Hua	JERA	2026	720
	Formosa 4-1	Miaoli	Swancor Renewable	2029	1,360
	CanWind	Chang Hua	Northland Power	2029	900
	NorthWind	Taichung	Northland Power	2029	900
	Huaping	Keelung	EnerVest	2030	2,600

Table 14

List of selected Taiwan offshore wind projects.
Source: EICDatastream.

2020, Swancor Renewable Energy and Taiwan's Metal Industries Research & Development Centre signed a MoU to cooperate on floating wind technology and support the local supply chain development for floating wind. Prior to the MoU, Swancor was already considering deploying floating wind turbines at its 4.4GW Formosa 4 offshore wind project off Miaoli County. It is a likely bidder for the next auction but the delay in the tender design is currently stalling the EIAs and application process for the project. CIP has also put forward plans to adopt floating technology for three of its wind farms with a combined capacity of 3.3GW. Aside from Swancor and CIP, EnerVest Co. Ltd., a subsidiary of the German InfraVest Group, has also filed plans to develop three large-scale floating offshore wind projects in a 1000km2 area near Pengjia, Mianhua and Huaping. However, the proposal has received objections from the local fishermen and governments due to the area being a traditional fishing ground. Hence, no-go zones are being considered for Round 3 auction and will be discussed as part of the consultation rounds.

Taiwan is seen as a key hub for non-Asian developers and service providers in the shorter term. The country is relatively an open market and has been receiving a significant influx of foreign participation with more than 75% of the developers for the offshore wind projects being European or Western. Among the EU-based players is WPD, which was one of the first international investors to be allocated with capacity in the country. The company's Yunlin offshore wind project is currently under construction with another that will begin construction in 2021 and three other projects that are planned. RWE Renewables is also developing the Chu Feng offshore wind project, with its partners Asia Cement Corporation. Energie Baden-Württemberg AG (EnBW) has also chosen Taiwan as its first offshore wind venture beyond Europe alongside Macquarie and JERA to develop the 2GW Formosa III project. In November 2021, Ørsted showcased its first jacket foundation 100% built in Taiwan, which will be installed at Greater Changhua 1 and 2a. Siemens Gamesa has also set up its first nacelle assembly factory outside of Europe and first in Taiwan, which will support Ørsted's Changhua projects.

Although a large part of the offshore wind supply chain involves foreign players, a partnership with local companies is still

vital to satisfy the Taiwanese government's localisation requirements for certain projects. Numerous partnerships have been established between foreign and Taiwanese entities which includes MHI Vestas joining forces with domestic players such as Swancor, Shihlin Electric as well as CS Wind and Chin Fong. On top of that, DEME Offshore and CSBC has also partnered up for its first floating heavy-lift installation vessel in Taiwan.

Division	Current Weighting	
REC weighting for Offshore Wind Power	Coastline distance of 5km or below	2.0
	Coastline distance of 5-10km	2.5
	Coastline distance of 10-15km	3.0
	Coastline distance exceeding 15km	3.5
Offshore Wind Power + Energy Storage System		4.0

Table 15

REC weight value for offshore wind projects.
Source: MOTIE.

The developers and investors have been experiencing uncertainties in the market, but the upcoming auction has provided a clearer roadmap to meet the country's offshore wind targets. This will restore confidence and strengthen the commitment of supply chain companies such as MHI Vestas and Siemens Gamesa Renewable Energy who are developing facilities in Taiwan which could act as regional supply bases in the future. With an emerging local supply chain, a strong alliance with local turbine assembly from leading global turbine manufacturers as well as support from the international equity and debt finance providers, Taiwan has the potential to become the regional hub for the offshore wind sector.

South Korea

Offshore wind is expected to drive South Korea's ambitious renewable energy targets with a plan to achieve 12GW of offshore wind capacity by 2030. This accounts for around 68% of the total wind energy target. Most of the offshore wind projects are centred in the South and North Jeolla provinces due to favourable geographic and weather conditions. South Jeolla alone holds up to 60% of South Korea's offshore wind potential, with 9.4GW out of the total 15.5GW potential. Currently, more than 90% of the proposed projects are in these provinces with the bulk of the projects in the early planning stages. Investors for the projects include both private and publicly owned national investors, with international sponsors holding major stakes in several large-scale offshore wind farms.

The offshore wind sector is a significant part of the country's Green New Deal plan through which it aims to achieve at least 20% of renewable energy in its energy mix by 2030. The plan is to kickstart the economy after the COVID-19 pandemic and at the same time set a path for the country towards net-zero by 2050. The government has earmarked US$7.7bn (KRW9.2tn) to be invested in wind, solar and hydrogen by 2025. The deal has a target to achieve 12GW of offshore wind and 32GW of solar capacity by 2030.

In the efforts to meet the country's renewable targets, the Ministry of Trade, Industry and Energy (MOTIE), as the primary governmental authority responsible for energy related matters, has set out support policies for renewable energy. The Renewable Portfolio Standard (RPS) scheme, pursuant to the Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy, has been implemented since 2012. The RPS is a policy mechanism that requires companies with generation capability of 500MW or more to generate at least 9% of gross power generation from renewable energy sources. The scheme attracts private investment in renewable energy development through renewable energy certificates (REC) transactions, which are a certification for renewable energy supplies. One REC is issued based on 1MWh by weighting the amount of renewable energy generated. There are 23 large power generation companies that

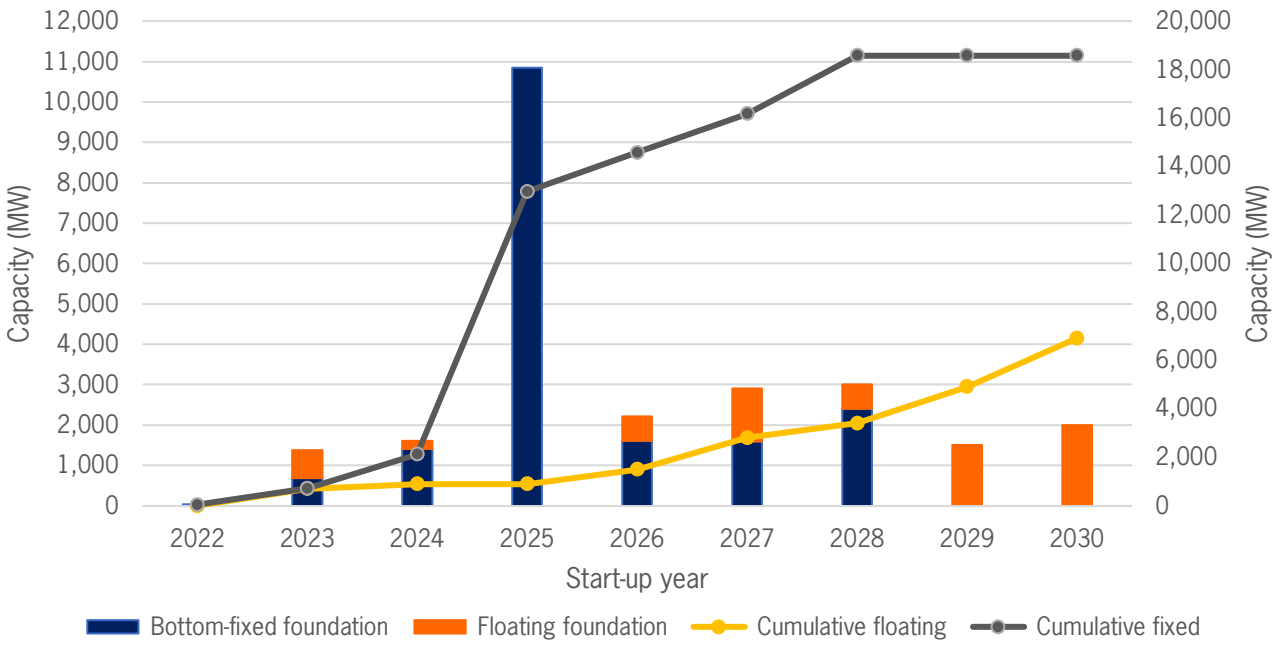

Figure 14

Overview of South Korea offshore wind project capacity additions according to start-up year.
Source: EICDatastream.

are subject to this obligation. The RECs are issued by the New and Renewable Energy Centre and sold to the obligated power generation companies. The weight value depends on the coastline distance and floating offshore wind projects are eligible for higher weightings considering the longer distance from shore.

In February 2021, the South Korean government announced a major part of the country's effort to reduce reliance on fossil fuel. The plan is to develop an offshore wind farm with a generation capacity of up to 8.2GW at the Sinan region in South Jeolla province. An all-domestic line-up of companies, Korea Electric Power Corp. (KEPCO), SK E&S and Hanwha Engineering & Construction Corp., as well as local manufacturers Doosan Heavy Industries & Construction Co., CS Wind Corp. and Samkang M&T Co. are involved in the wind farm, pledging $42.8bn (47.6tn won) to the development. The proposed project comprises of three phases, with the completion for the 4.1GW phase one slated for 2025, phase two for 2.1GW by 2027 and phase three for 2GW by 2030.

The offshore wind sector in the country has also been attracting international players including, Ørsted, Equinor, Shell and Northland Power. In late 2020, Ørsted announced plans for up to 1.6GW of offshore wind projects off the coast of Incheon City. Four floating LiDAR units were deployed in early 2020 but the development is still subject to ongoing planning, permitting procedures as well as an FID. Northland Power is also looking to venture into the country's offshore wind sector. The company closed the acquisition of wind developer, Dado Ocean Wind Farm Co Ltd and identified additional offshore wind development sites which could increase the capacity to approximately 1GW.

South Korea is expected to become a major market for floating offshore wind technology, with plans to develop at least 4.6GW of floating wind capacity by 2030. Most of the proposed floating offshore wind farms are

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Status	Project	Location (Province)	Operator	Start-up year	Capacity (MW)
Planning	Gangdong Maritime	Ulsan	SK Engineering & Construction	2023	136
	Wando	South Jeolla	Korea South-East Power Co (KOEN)	2025	200
Consented	Sinan Hauido	South Jeolla	Hanwha Engineering and Construction	2025	396
	Ansan	Gyeonggi	Seohae Green Power	2026	200
Planning	Ulsan City (GIG)	Ulsan	Total	2026	500
	TwinWind	Ulsan	CoensHexicon	2026	600
	Firefly	Ulsan	Equinor	2027	800
	Incheon City	Seoul	Ørsted	2027	1,600
	Dado Ocean	South Jeolla	Northland Power	2028	1,000
	Jeollabuk-do	North Jeolla	Doosan Heavy Industries & Construction	2028	2,400
	Ulsan City	Ulsan	Korea Floating Wind Power (KFWind)	2029	1,500
	Sinan	South Jeolla	Korea Electric Power Corporation (KEPCO)	2030	8,200

Table 16

List of selected South Korea offshore wind projects.
Source: EICDataStream.

centred around Ulsan Province, predominantly due to the shipyard arrangements, maritime expertise and port facilities. Shell has been involved in the development of a floating offshore wind farm in Ulsan since September 2019, alongside its partner CoensHexicon. In September 2020, TotalEnergies and GIG have partnered up to develop five floating offshore wind turbine projects near Ulsan and South Jeolla, with a capacity of up to 2GW. Also in Ulsan, a consortium was formed in February 2019 by Equinor, Korea National Oil Corporation (KNOC) and Korea East-West Power plans to develop a 200MW floating offshore wind project. EDP Renewables, Aker Solutions and Korea Floating Wind Power (KFWind) have also formed a consortium in October 2019 to develop a 500MW floating wind farm. Korean engineering companies, SK Engineering & Construction and POSCO are also venturing in the floating segment and have signed a MoU in April 2021 to develop a new floating offshore wind foundation.

In terms of local capabilities, the country has a strong manufacturing and shipbuilding experience. There are about 750 companies which are involved in components fabrication, shipbuilding and offshore plant construction in the country, with further plans to establish clusters in the south-east region. Many of the companies are starting to invest in diversifying their portfolios away from their core industries. South Korea also benefits from expertise in cable manufacturing, towers, forgings, R&D facilities and large-scale manufacturing such as foundations, substation components and vessels. However, there are still gaps in the local supply chain such as in local vessel availability, particularly for installation activities. Although the wind sector supply chain is experienced in the onshore wind segment, it still lacks the expertise for large-scale offshore wind farm development.

Similar to the offshore wind growth markets in Asia, the sector has been receiving strong opposition from the local fishing community due to the potential harm it would inflict to their livelihoods. Project owners are solely responsible to obtain approval from the residents which makes it difficult to obtain the necessary permits, leading to significant delays in the project development. Hence, in the efforts to raise awareness towards the importance of the

sector, the MOTIE, Ministry of Oceans and Fisheries (MOF) and the Ministry of Environment (MOE) have jointly issued a plan for offshore wind power generation in collaboration with local residents and the fishing industry in July 2020. This aims to promote a more rapid development of large-scale offshore wind projects and trickle-down benefits to local stakeholders.

EMERGING MARKETS

Australia

With five projects in the pipeline and plenty of distractions in the Asia-Pacific region, Australia has not necessarily been on everyone's offshore wind radar. The 2GW Star of the South project is gradually progressing under Offshore Energy and Copenhagen Infrastructure Partners, with the onshore transmission route now selected. In late 2020, Star of the South was joined by Pilot Energy's proposed 1.1GW Mid-West offshore wind farm, located within the WA-481-P oil and gas exploration permit, in the Northern Perth Basin. In April 2021, Australis Energy announced plans to develop an offshore wind farm with a generation capacity of 300MW in Geographe Bay, Western Australia. The offshore wind farm could feature up to 37 turbines of 8MW to 15MW capacities. The company is also planning to develop two offshore wind farm projects in Victoria and South Australia, with generation capacities of 495MW and 600MW, respectively. The initial proposals for the projects have been submitted to the WA Environmental Protection Authority.

While legislative and overall political support for offshore wind specifically has so far been missing, the Australian government announced in October 2020 that US$3.8mn (AU$4.8mn) would be allocated in the 2020-21 Federal Budget to the establishment of an offshore renewable energy regulatory framework. The framework will apply from 3 nautical miles (5.6km) from the coast out into Australia's exclusive economic zone. Separately, the state government of Victoria pledged US$84.7mn (AU$108mn) of the 2020-21 clean energy budget to support the realisation of renewable energy and hydrogen projects, including the Star of the South project, as well as the assessment of transmission infrastructure requirements to connect developments. Industry association Offshore Wind Australia has called for the introduction of an auction system to move offshore wind developments forward and it is understood that government considerations are underway on how to build-out the technology. While opportunities exist, competition with onshore renewable energy, such as onshore wind projects and the low prices they offer, is expected to be very high.

India

Initial targets announced by the Indian government over two years ago of 5GW installed capacity by 2022 and 30GW by 2030 seems no longer viable, with the industry still awaiting a government framework on the first offshore wind tender round, initially proposed for offshore Gujarat. Latest reports suggest that the focus has now shifted onto areas offshore Tamil Nadu, owing to improved site conditions and wind resources. The Global Wind Energy Council's Taskforce on offshore wind is working with the Indian authorities to establish a roadmap for offshore wind build-out in the country, for which research activities could begin in 2021. Uncertainty still remains over environmental impacts and their assessment, a potential tender structure as well as financing and subsidy support. While it could take considerable time to address ongoing issues, offshore wind in India continues to be on the horizon.

Philippines

The Philippines's current peak demand is estimated to stand at 15.6GW and it is estimated that another 43.7GW of new power capacity will be required by 2040. The country has a target to achieve 35% of clean energy in its energy mix by 2030, with over 2GW of capacity expected

continued over …

ASIA–PACIFIC

from the wind sector. In June 2021, the Philippine Department of Energy (DOE), with support from the World Bank Group, has launched the Philippine Offshore Wind Roadmap project. The aim is to establish short and long term offshore wind targets, formulate strategies to successfully integrate offshore wind in the government's renewable energy portfolio as well as set forth recommendations on policies that are necessary to foster a conducive business environment for offshore wind investors. According to the World Bank, the Philippines has a technical potential of 18GW and 160GW for fixed-bottom and floating wind, respectively. It has one of the highest floating potential among the emerging markets globally. Hence, it plans to ramp up its floating offshore wind development to meet country's increasing power demand and renewable energy targets.

The country's first renewable energy auction, the Green Energy Auction programme, is set to be held in 2021 for an initial capacity of 2GW. The DOE is currently working on instruments such as the green energy implementation agreement and the terms of reference. The auction is a competitive process for the procurement of renewable energy. However, there are some concerns over the possibility of the auction being a price-based bidding instead of technology-specific, which may lead to cheaper technology such as PV solar winning the bulk of the auction capacities.

Compared to the other growth markets, the Philippines currently has yet to develop a local supply chain. Hence, the country will look to source technology from European companies. This could be seen as an advantage mainly to international developers since there is no local content requirement, which often becomes a hurdle for the other growth markets when it comes to establishing a local supply chain.

The country currently has two proposed offshore wind farms in the project pipeline. In March 2020, Triconti Windkraft Group, a Filipino-Swiss-German partnership has been awarded a service contract by the Department of Energy for the development of the country's first offshore wind projects. The company holds the rights to the studying and development of the Aparri Bay and Guimaras Strait offshore wind farms which have a combined maximum capacity of 1.2GW. Pre-feasibility studies for the projects are currently underway.

THE MIDDLE EAST – DELIVERING AN OFFSHORE WIND SUPPLY CHAIN

THE MIDDLE EAST

Ryan McPherson - Regional Director, Middle East, Africa, Russia & CIS

Renewable energy in the Middle East has been on the rise in the recent years, narrowing the gap with oil and gas spending - and this is anticipated to continue this surge throughout 2021-2022. The energy transition landscape is well underway here in the Middle East with significant investments into solar and latterly hydrogen projects helping to balance the energy mix, where the hydrocarbon element still dominates proceedings.

Against this backdrop is the advent of offshore wind; and whilst wind power installations slowed in the Middle East and Africa in recent years, based on how the region is moving it can be assumed that the industry will show signs of growth over the next five years. However, this widespread growth will be dependent on more friendly market and regulatory conditions.

The potential growth in the region is an area of great excitement and challenge as industry players position themselves for an array of opportunities. Led by the 2019 announcement, Eni will build a 500MW floating offshore wind farm in Saudi Arabia alongside Plambeck Saudi, part of Abu Dhabi-based Plambeck Emirates, as the Kingdom expands its renewable energy projects as part of its Vision 2030 mandate. The development is part of the new 5GW 'Wind Market' concept, which has been proposed to Saudi Arabia. In Bahrain, the country's Sustainable Energy Authority (SEA) announced plans in 2018 to develop its first offshore wind farm with a total capacity of 50MW. The project is part of its plans to install 50-100MW of onshore and offshore wind, to make the most of Bahrain's good wind regime and shallow waters. Pursuing offshore wind in the country will as such be a cost-competitive option to diversify its energy generation source.

Meanwhile, the region could see the installation of its first offshore wind turbine through the new floating wind project, Floating WINDdesal (FWD). The turbine will be a part of a desalination project that combines a seawater desalination plant and a wind turbine, both supported by a floating semi-submersible structure. The project is being implemented by a group of European companies - Thyssenkrupp Industrial Solutions, CRIST Shipyard, SYNLIFT Industrial Products, Prysmian Group, Boll & Kirch Filterbau, AEROVIDE, StoGda Ship Design & Engineering, EMS Maritime Offshore. The country of its deployment is yet to be specified.

Other countries in the region are slowly taking initial steps into the sector. Tunisia marked its first move with Government officials taking part in an offshore wind training course run by the Netherlands. Focus was made on political framework settings and organising tenders.

Turkey has previously called for applications on a 1.2GW project in

2018, which was later postponed due to insufficient data and overwhelming requirements. The country's current potential for offshore wind stands at 90GW. Due to its strong onshore wind local capabilities and its political stance on energy transition, anticipations for its offshore wind sector boom are still high.

Local supply chains are already being developed with proper frameworks and stable bankable pipelines. This can be seen through the likes of Lamprell and Petrofac. The former of whom was selected by Subsea 7's renewables business unit Seaway 7 for the delivery of 30 foundations for the Seagreen 1 offshore wind farm in the UK.

Under the contract, Lamprell will manufacture jackets, transition pieces and suction caissons and will deliver the jackets to Seaway 7 at its deep-water quayside in Hamriyah port, from where Seaway 7 will transport them to Scotland.

The UK listed, UAE based company recently started delivering its share of jacket foundations for the Moray East offshore wind farm and has supplied a part of jacket foundations for the East Anglia ONE offshore wind farm.

Thus, whilst the full potential of the offshore wind sector has not been fully utilised in the region this is a growing area with many exciting developments coming in the near future, with the UK supply chain continuing to lead the way in knowledge and delivery of projects on a global scale now is the time for further regional co-operation.

THE RISE OF AZERBAIJAN

The Caspian Sea is well known for having one of the best wind resources, alongside its favourable water depth conditions for fixed-bottom turbine installations. However, the industry still holds the same opinion it has had for the past several years: there will be little offshore wind activity in its surrounding markets (Kazakhstan, Azerbaijan and Turkmenistan) any time soon. This is because of the lack of political commitment to the sector and its readily accessible and energy dependence on fossil fuels. In 2015, plans were released to the Government to install an 198MW offshore wind farm within an oil production area off the coast of Pirallahi Island, built by SOCAR (State Oil Company of the Azerbaijani Republic). However, little movement has occurred on the project since. Despite this, Azerbaijan has recently taken huge strides towards the technology's inclusion in its energy landscape. Movement began in April 2021, when the country's Ministry of Energy signed an MoU for offshore wind development with the World Bank's International Finance Corporation. The partnership's study will include assessing Azerbaijan's potential for offshore wind, the formation of a roadmap and tender management plan for future projects, and auxiliary investments. BVG Associates is working alongside the duo for the development of this roadmap. Preliminary studies by the World Bank's Energy Sector Management Assistance Program (ESMAP) indicates a technical potential of 157GW of offshore wind in the country, with 35GW and 122GW allocated for fixed-bottom and floating wind respectively.

In alignment with the announced capacity statistics, the country shortly revealed plans in July 2021 for a pilot floating offshore wind farm by SOCAR and Technip Energies. The site will power upstream operations in Azerbaijan's sector of the Caspian Sea and, should it go ahead, would become the country's first installed offshore turbine. Regardless, despite this sudden boom in movement in the country, the market is still too early in its infancy to specifically predict a build-out schedule or future growth rates for upcoming opportunities.

THE MIDDLE EAST

INDUSTRY INSIGHT WITH PETROFAC

by Mark McAndrew: SVP Operations – Head of Offshore Projects E&C

Petrofac

Petrofac is a leading international service provider to the energy industry, with a diverse client portfolio. It has been designing, building, managing, operating, and maintaining energy infrastructure for clients across traditional and new energy sectors for 40 years.

It began supporting the renewables sector in 2009 and has since delivered more than $1.5 billion of renewable sector projects. Committed to Net Zero, its current project pipeline spans offshore wind, Carbon capture, utilisation and storage (CCUS), H2, Waste to Fuel/Waste to Energy and emissions reduction.

Current challenges and opportunities in offshore wind?

One of the challenges for offshore projects globally is balancing a need to maximise in-country value whilst consistently lowering costs. Contractors must address how to use their expertise but also deliver on a local basis. For a company like Petrofac, it means finding a way to successfully blend UK-based engineering and consultancy expertise, with the capabilities and cost-based advantages of a lower-cost execution centre, such as those in the UAE. Flexible business models are key to addressing this challenge; Petrofac applies this approach to projects across the energy sector, not just offshore wind and other renewable projects.

Recent and upcoming project activities and markets Petrofac is focusing on?

Petrofac has been building a successful track record in offshore wind transmission systems. To date, it has specialised in the engineering, procurement, construction, installation and commissioning (EPCIC) of HVDC and HVAC offshore and onshore substations for major offshore wind farms. Most recently, it has successfully delivered the EPCI of the BorWin3 HVDC platform in Germany, which began transmitting 2020. It is currently supporting TenneT on the EPCI for the Hollandse Kust Zuid (HKZ) Dutch offshore grid connection Alpha and Beta HVAC platforms in the North Sea. In 2020 Petrofac was awarded a contract to design, supply and install the HVAC onshore and offshore substations for the Seagreen offshore wind project in the UK. As well as these large-scale EPCI projects, its engineering and consultancy team are expected to complete the design for a floating offshore wind concept in 2021.

Criteria and process for supply chain engagement – and is this different from your oil and gas supply chain?

Exporting our technical competence has been key to oil and gas projects in the past. Alongside this, Petrofac's large-scale oil and gas EPC projects in the Middle East have also focused on increasing in-country value for its clients. It uses cost-effective, innovative, and tailored delivery models to support this market - this approach underpins its track record for safe and reliable delivery focused on driving in-country value in the region.

Petrofac has an annual procurement spend of between $2-$3 billion. Over 400 buyers, expeditors, logistics specialists and material controllers support its project delivery around the world. It can procure directly or via third-party agencies who are engaged on a case-by-case basis. Local delivery has always been central to how Petrofac works, and it collaborates with local suppliers to develop local capabilities wherever possible.

Supply chains for oil and gas and offshore wind projects are similar; Petrofac has been able to leverage its vast experience to the benefit of its large-scale renewable projects. But there are differences too. For offshore wind it has run specific supplier engagement sessions to promote the participation of local suppliers and services providers to support its EPC offering. By joining working groups and supply chain groups in various regions, including the UK, it has been able to actively participate and seek new suppliers across the value chain.

THE FLOATING OFFSHORE WIND MARKET

THE FLOATING OFFSHORE WIND MARKET

The floating offshore wind sector's progression towards commercialisation continues to gain momentum, with the period of demonstration gradually coming to an end. The focus now is on increasing the volume of projects at commercial large-scale, which will enable further significant cost reduction and allow floating wind to compete with other energy generation. There are, however, significant barriers yet to overcome, including supply chain development, shipyard availability and quayside space, financing and regulation. To overcome these barriers there is now a need for policymakers to help create the conditions needed for this sector to develop by mobilising the supply chain and technology companies through subsidy and other supportive legislative mechanisms. However, the challenge will be whether enough support will be provided for this sector to become commercial.

According to a report by DNV in December 2020 it is predicted that by 2050 installed floating offshore wind capacity will have increased from approx. 100MW today to 250GW, representing 20% of the offshore wind market and producing around 2% of the world's power supply. As more large-scale projects come online the cost of floating wind will reduce by almost 70% to a global average of €40/MWh in 2050. Despite significant cost reductions, reports estimate that bottom-fixed projects could remain narrowly price-competitive.

In terms of operational capacity, the UK and Europe continue to lead the way with the 30MW Hywind project in Scotland and the 25MW Windfloat Atlantic project in Portugal successfully deployed so far. In addition, the 2MW Kincardine floating wind project, also in Scotland, has been expanded to a 50MW pre-

Project Name	Operator	Start Up Year	Capacity (MW)
Wave Hub Demonstration Project (Pembrokeshire)	Wave Hub	2024	90
Orion	Cerulean Winds	2024	-
Katanes	Katanes Floating Energy Ltd	2025	200
Dyfed	Dyfed Floating Energy Ltd	2025	200
Blyth (Phase 2)	EDF Renewables	2025	60
Erebus	Blue Gem Wind	2026	96
Dounreay Tri	Copenhagen Infrastructure Partners	2027	100
Twin-Turbine Demonstration (Bechtel-Hexicon)	Hexicon AB	2028	40
Valorous	Blue Gem Wind	2028	300
Scotia Ventus	Univergy International	2028	500
Gwynt Glas	DP Energy	2029	300
WhiteCross	Offshore Wind Limited	2030	100
Llŷr and Llŷr 2	Floventis Energy	2030	200
Cornwall & Isles of Scilly	Cornwall and Isles of Scilly Local Entreprise Partnership (CIOS LEP)	2030	1,000
Salamander	Simply Blue Energy	2030	200
Northern Horizons	Aker Offshore	2030	10,000
Dolphyn	Environmental Resources Management (ERM)	2035	4,000

Table 17

List of floating offshore wind projects under development in the UK.
Source: EICDataStream.

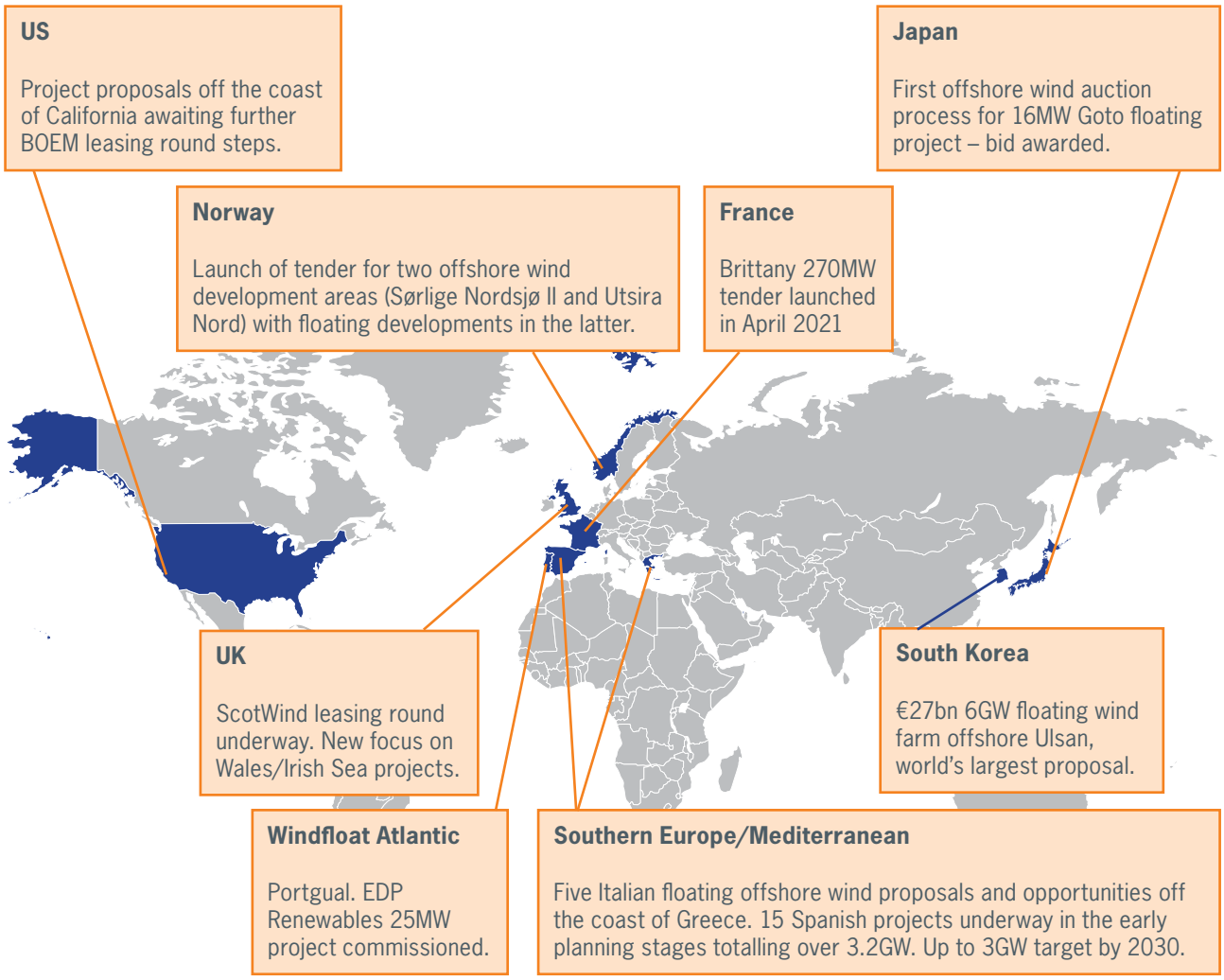

Figure 15

Geographical summary of upcoming areas of interest for floating offshore wind. Please note that more information on the regions' floating activity can be found in their specific sections in this report.
Source: EICDataStream.

commercial facility. In July 2021, the Crown Estate selected three floating projects in the Celtic Sea – the Whitecross, Llŷr and Llŷr 2 sites – in its new leasing opportunity for early commercial-scale projects. The opportunities present in combining floating offshore wind and green hydrogen production has resulted in a few upcoming projects exploiting this pairing. Projects include the 200MW Salamander, Orion, and the 10MW Dolphyn site that will eventually increase to 4GW. The most recent green hydrogen and floating wind proposal, Northern Horizons, is also the UK's largest to date. Aker Offshore Wind, Aker Clean Hydrogen and DNV are proposing 10GW of floating turbines, to produce green hydrogen for a net-zero hydrogen refinery in Shetland. Alongside the push the technology has seen from the ScotWind Leasing Rounds, more projects are being proposed, as seen in Table 17.

New projects are also being planned in France, Norway, Spain, Italy and Greece. In Norway, construction has started on the Hywind Tampen project, which will be the world's largest floating offshore wind farm located at

THE FLOATING OFFSHORE WIND MARKET

Kværner Stord. This will be the first floating offshore wind project to supply renewable power for oil and gas platforms with Siemens Gamesa supplying the turbines and the service providers including JDR Cable Systems, Subsea 7, and Wood Group. In France, the Qair 30MW EolMed project is scheduled to be installed for 2023 with Vestas supplying the turbines, Prysmian Group & Assos Subsea developing the export submarine power cable system and BW Ideol its Damping Pool® floating foundations. Vestas is also the preferred supplier for the 30MW Eoliennes Flottantes du Golfe du Lion (EFGL) which is due online in 2022 and the 30MW Groix & Belle Ile floating wind project scheduled for 2023. EFGL has also awarded an EPCI contract to DEME's subsidiary SDI and JDR Cables for the 66 kV export cables. The Mediterranean region has also seen a sudden upsurge of proposals announced for floating offshore wind projects. Spain in particular has formed a strong portfolio of proposed floating wind farms, as seen in Table 18. Analysis by WindEurope estimates that 330MW of floating offshore wind capacity could be installed by 2022 and up to 7GW by 2030.

There is increasing movement in the US, Japanese and South Korean markets as they start to open up to larger scale floating offshore wind developments, with predictions currently indicating that by 2050 up to 50% of floating capacity will be produced in the Asia-Pacific region. For the Japanese market in particular, floating foundation technology will be critical for the offshore wind sector, with an estimated potential of up to 500GW of capacity.

Project Name	Operator	Capacity (MW)	Start-Up Year
Eólico Gofio	Greenalia SA	50	2025
Bilbao	Saitec Offshore Technologies	45	2025
Parc Tramuntana	BlueFloat Energy	1,000	2026
Dunas	Greenalia SA	50	2026
Mojo	Greenalia SA	50	2026
Cardon	Greenalia SA	50	2026
Guanche	Greenalia SA	50	2026
Gran Canaria Este	EDP Renováveis	144	2026
Iberdrola Complex - Spain (Iberdrola)	Iberdrola	300	2026
Canary Islands	Equinor	200	2027
CanArray I & II	EnerOcean	180	2027
San Borondón	Iberdrola Renewables	238	2027
San Cibrao	Iberdrola Renewables	490	2028
San Brandán	Iberdrola Renewables	490	2028
Mar de Ágata	BlueFloat Energy	300	2028

Table 18

List of Spanish floating offshore wind projects under development in the early planning & feasibility stages.
Source: EICDataStream .

The last year has seen increasing interest from major oil and gas players, as they attempt to diversify their hydrocarbon portfolio, offering the sector decades of experience in managing major offshore development projects, global supply chains, contracting, purchasing and operations. While not all capabilities and equipment may be directly translated into the floating offshore wind market, oil and gas developers offer key benefits for the sector, including lessons learned from offshore operations in deeper waters as well as the necessary balance sheets to drive the market forward. Examples include Equinor and Saipem, while TotalEnergies acquired a 20% stake in the 30MW EolMed project mentioned earlier. TotalEnergies joined Simply Blue Energy in 2020 for the development of the 96MW Erebus project in the Celtic Sea, while also entering the South Korean offshore wind market with a 2.3GW portfolio acquisition. The two companies have also launched the JV TotalEnergies SBE US, to specifically focus on floating wind farms in the US. However, several significant differences between the sectors exist, including different loads, dynamic cables, the need for less redundancy and the requirement to produce high volume at low costs, which has not been a hallmark of

the hydrocarbon sector. Another challenge will be whether this involvement leads to further standardisation and cost reduction or results in increasing complexity and cost increases for floating offshore wind.

As well as being attractive to operators, floating technology also provides an opportunity for the existing hydrocarbon supply chain, particularly companies that have experience in the marine and subsea element of offshore oil and gas. For example, companies that provide subsea mooring equipment and subsea asset inspection have valuable experience and technology, which can be utilised for floating offshore wind. However, companies transitioning or diversifying from the oil and gas sector must be aware that the potential profits are much smaller than what they may have been used to and entering this market will require significant commitment especially in floating, where returns on investment will be long-term as the sector is only now entering commercial scale. If these companies are looking for short-term success, then fixed-bottom offshore wind should be the target, but as many of these supply chain companies are now entrenched, the difficulty of breaking into the market may increase. By entering into floating now at a relatively early stage, these companies can become active players in the future floating offshore wind supply chain.

As floating projects begin to move to large scale the manufacturing, storage and handling of floating foundations and turbines require significant yard area. There is now an identification that the existing port and shipyard capacity, especially in Europe, is far below what is needed to meet the requirements for the future. The UK has set a target of 1GW floating wind capacity by 2030, alongside the 40GW of bottom-fixed capacity, and £160m (US$207.3m) has been set aside for the development of large-scale floating offshore wind ports and infrastructure in Scotland and Wales to realise these ambitions. The Scottish Government also announced £49m in funding for the development of a new deep-water terminal in the Outer Hebrides for berthing and unloading facilities for renewable energy components.

Additionally, there have been agreements between individual shipyards and ports with renewable developers and contractors to build capacity. For example, Ideol signed a LoI with the Port of Cromarty Firth in Scotland to cooperate in the floating offshore wind sector. This agreement will see Ideol and its future local construction partners use the port's land and firth berthing sites and further cooperation for developing facilities and infrastructure to establish a concrete hull serial manufacturing yard for incoming floating wind projects. BW Ideol has also signed an agreement with Ardersier Port Authority, to manufacture concrete floating wind foundations at the port. Shepherd Offshore has signed a partnership with North Tyneside Council to pursue redevelopment of the Swan Hunter Shipyard for the offshore wind sector. Many ports and shipyards view floating offshore wind as a significant opportunity to obtain both private and public investment, which would in turn benefit the regions in which they are located. There is also now a growing acceptance that there was a missed opportunity for the UK supply chain in regard to developing a manufacturing supply chain for large fixed-bottom offshore wind components. Local content requirements mandated by government and subsidies could encourage investment in these ports and shipyards, potentially facilitating the growth of a UK-based supply chain for floating offshore wind in the future. The challenge is whether this opportunity will be taken or again be missed.

THE FLOATING OFFSHORE WIND MARKET

ADDRESSING INSURABILITY IN FLOATING OFFSHORE WIND EARLY ON CAN HELP SPEED UP COMMERCIAL DEPLOYMENT

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WORLD FORUM OFFSHORE WIND

Since the majority of offshore wind locations worldwide are not suitable for bottom-fixed projects, either by reason of water depth or soil conditions, floating offshore wind (FOW) is projected to become one of the major future energy production technologies.

At the anticipated scale of growth, it is imperative that FOW technologies achieve commercial scale readiness and become bankable. However, bankability is only achievable once sufficient insurability of the technology is demonstrated. As such, making sure that projects can obtain sufficient coverage by insurers should be a priority. Indeed, to achieve insurability means for FOW projects to have understood the uncertainties surrounding the technology, lowered the risk exposure, and lowered the probability of failure/damage. Reaching sufficient insurability will decrease the total cost of risk and levelized cost of energy, and finally secure the commercial growth of the technology for the long-term.

Certification agencies for FOW are providing recommendations, but to follow them does not automatically mean that a project will be sufficiently insurable. At this stage, we are facing issues at the:

Design phase: More industry standards have yet to be developed or updated. The applicability of existing standards from other industries has to be checked and agreed upon. A particular design uncertainty is the mooring system.

Manufacturing/installation phase: Insurers need to rely on knowledgeable developers and suppliers; thus, new standards will have to be communicated to and followed by the whole industry.

O&M phase: Insurers need to be informed about the projects' risk analysis and mitigation strategies.

As the whole industry works on new standards and integrity management strategies, the level of conservatism attributed to one phase will affect the efforts required (and therefore the costs) in another. The main question that has to be answered is: What are the minimum standards necessary to make floating offshore wind insurable and bankable?

The Floating Offshore Wind Committee (FOWC) of the World Forum Offshore Wind has created an Insurance Subcommittee with the aim of answering this question. Open to members only, it brings together technical and commercial experts from the FOW industry and specialists from the risk & insurance industry. Cooperation with the ORE Catapult and Carbon Trust helps achieve complementary results. Collaboration with WFO FOWC's Moorings and O&M Subcommittees, led respectively by David Timmington (Griffin-Woodhouse Ltd.) and Ilmas Bayati (PEAK Wind) ensures the parameters and considerations set out for mooring systems and operation & maintenance in FOW take into account insurability and bankability questions.

The FOWC "Insurance" Subcommittee recently released a whitepaper especially destined for the insurance industry with the aim of providing insurers with a higher level of comfort as they get involved in floating offshore wind. The report is the result of one year's worth of monthly meetings of the Subcommittee. Additional analyses were carried out to provide transparency in some technical areas.

Turbines, including different floating platform concepts, have not been perceived as a

major obstacle to achieving an enhanced level of insurability. It was nevertheless considered of high importance to have the turbine and floating platform design integrity independently reviewed and evaluated.

Major differences have been identified in the risk perception of moorings, dynamic cables and repair and maintenance concepts. To achieve sufficient and long-term insurance coverage, the Insurance Subcommittee recommends that projects follow an approach that will mitigate the losses below the property damage and business interruption deductible. This could be achieved either by *(n-1)* redundancy concepts or by a proactive spare parts strategy (in particular for cables and moorings) combined with sufficient defects liability provisions in the supply and Installation contracts. In their White Papers which will be published by the end of 2021/beginning of 2022, the O&M and Moorings Subcommittees will provide a deeper insight into the Mooring Integrity Management and O&M concepts specifically developed for FOW.

World Forum Offshore Wind (WFO) is the world's only organisation 100% dedicated to fostering the global growth of offshore wind energy. WFO's international members represent the complete offshore wind value chain including utilities, manufacturers, service firms and other non-profit organisations. WFO is registered as a non-profit association (e.V.) in Germany with offices in Hamburg, New York, Taipei and Tokyo. WFO's unique profile facilitates access to governmental and international forums in order to open new markets and to advocate for global offshore wind growth. www.wfo-global.org

Skowronnek & Bechnak Japan Co. Ltd. are international risk & insurance advisors focusing on offshore wind with 28 GW project experience based in Hamburg and Tokyo supporting new markets and technologies with risk and insurability analysis. www.sbadvisors.de

About the EIC

Established in 1943, the EIC is the leading trade association for UK-registered companies working in the global energy industries. Our member companies, who supply goods and services across the oil and gas, power, nuclear and renewable sectors, have the experience and expertise that operators and contractors require.

As a not-for-profit organisation with offices in key international locations, the EIC's role is to help members maximise commercial opportunities worldwide.

We do this in a variety of ways from providing detailed project information and regional market insight; to showcasing specialist skills and connecting suppliers with buyers; through to running tailored training courses and events that inform and engage the industry.

The services we offer play an important part in supporting over 750 member companies to do business in a competitive marketplace.

EICDataStream

Our projects database, EICDataStream, provides extensive information on over 10,750 active and future projects in all energy sectors. By tracking the full project life-cycle from feasibility to construction and then completion, it helps members to identify opportunities and plan their business development strategies.

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