

Market Outlook



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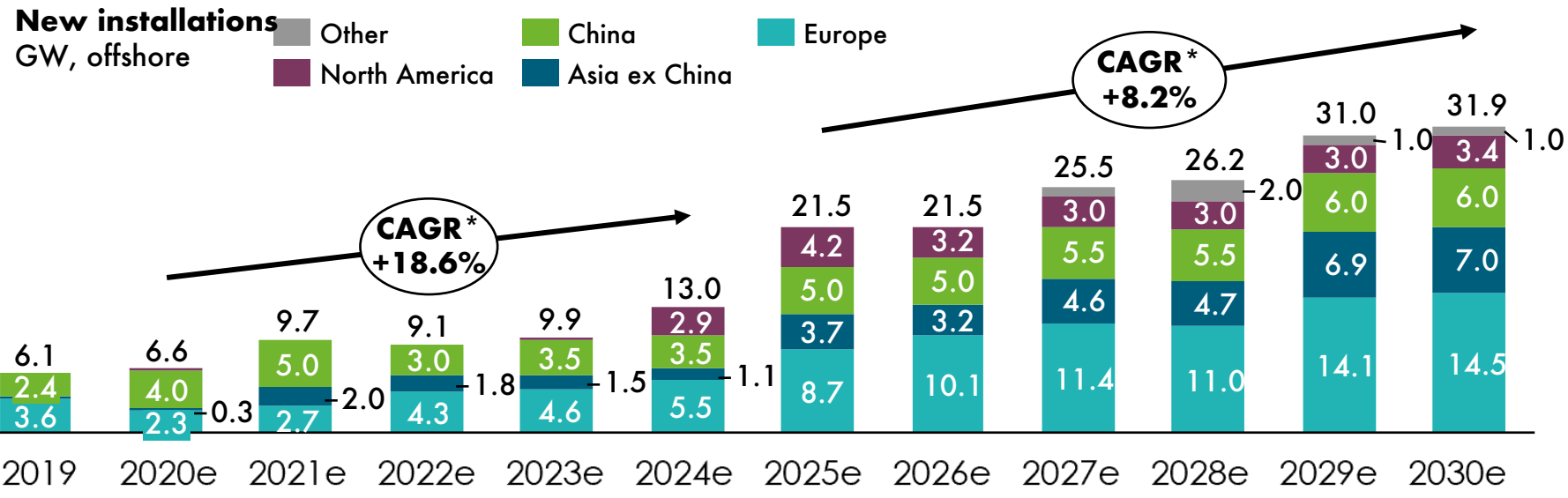
GWEC Offshore Market Outlook to 2030

Global offshore wind growth to 2030

The global offshore wind market outlook to 2030 has grown more promising over the past year as governments raise their ambition levels and new countries join the market. With an average annual growth rate of 18.6 percent until 2024 and 8.2 per cent up to the end of the decade, new annual installations are expected to sail past the milestones of 20 GW in 2025 and 30 GW in 2030.

GWEC Market Intelligence expects that over 205 GW of new offshore wind capacity will be added over the next decade. Three-quarters of this new volume will be installed in the latter half (2025-2030), as projects currently in planning get connected to the grid.

Offshore wind already accounted for 10 percent of global new wind power installations in 2019. Buoyed by expansion into new markets and acceleration of the global energy transition, GWEC Market Intelligence foresees offshore wind playing an increasingly important role in the overall growth of the global wind market, and expects offshore wind to contribute more than 20 percent of total wind installations by 2025.



* CAGR = Compound Annual Growth Rate
Source: GWEC Market Intelligence, June 2020

As the world's largest regional offshore wind market, Europe is expected to maintain steady growth, but new installations outside Europe, predominantly from Asia and North America, are likely to surpass Europe in 2020 for the first time and continue exceeding volume in Europe through 2030. In the near-term (2020-2024), the majority of growth outside of Europe will primarily come from China and Taiwan, with the contribution

from the US becoming sizeable from 2024 when the first utility-scale offshore project comes online.

Our near-term offshore wind market outlook was built using a bottom-up approach and is based on GWEC Market Intelligence's global offshore wind project database, which covers projects currently under construction, global auction results and announced offshore wind

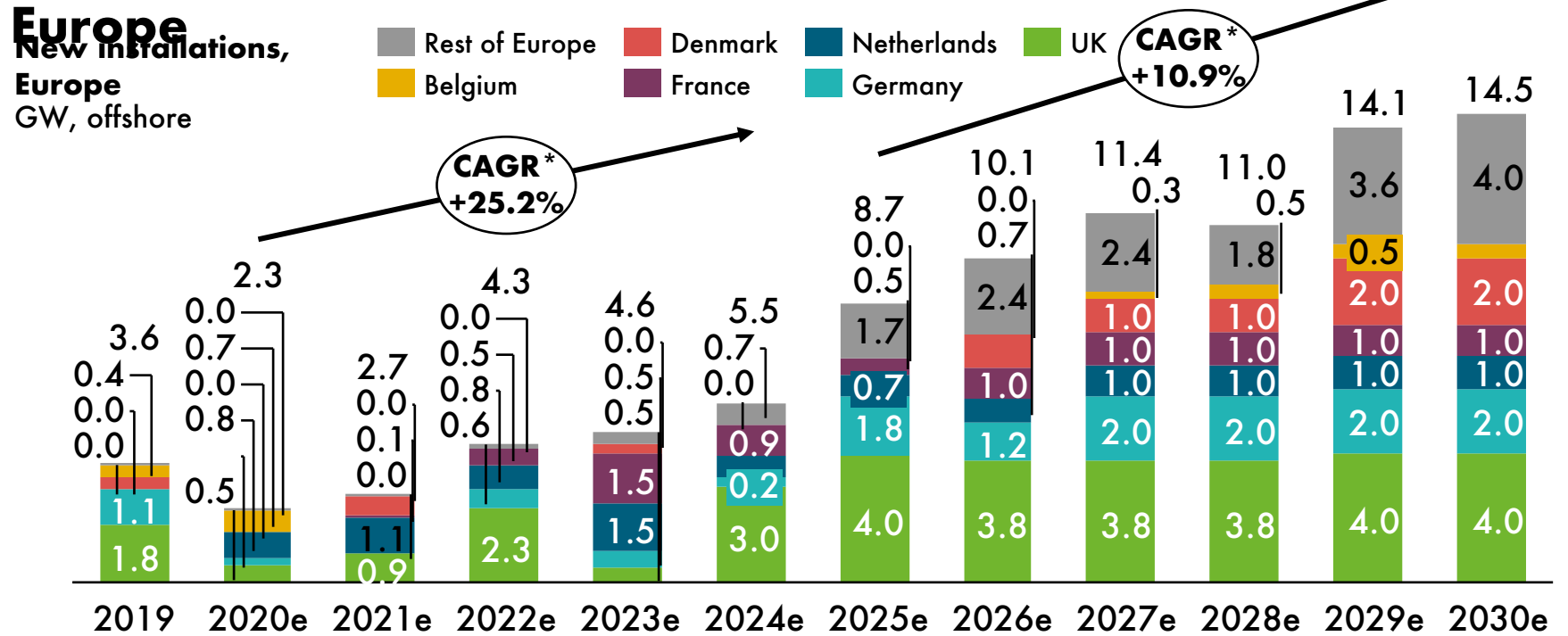
tenders worldwide. For the medium-term market outlook, aside from existing project pipelines, a top-down approach has also been used, which takes into account existing policy, support schemes and national level offshore wind targets.

Europe

Europe is the birthplace of the offshore wind industry. Since the world's first offshore wind turbine was installed in Denmark in 1991, Europe has been taking the lead in both offshore wind installations and turbine technology innovation. After three decades of research and development in Europe, offshore wind has established itself as a cost-competitive power generation of choice for governments and a mature industry. Through collaboration among European markets and experienced stakeholders, a robust offshore wind supply chain has been built in countries neighbouring the North Sea and Baltic Sea. In the past decade, the European offshore wind market enjoyed double-digit annual growth (11 percent), making it the world's largest regional market as of the end of 2019.

Looking at potential growth in the decade ahead, GWEC Market Intelligence forecasts that the European offshore wind market will continue to grow strongly, as new offshore wind projects are both cheaper to build and operate than new nuclear power and gas-fired power plants, making it a core energy source to help Europe to meet its NDCs and achieve carbon-neutrality goals by 2050.

Global offshore wind growth to 2030 in



* CAGR = Compound Annual Growth Rate
Source: GWEC Market Intelligence, June 2020

The European Commission estimates that total offshore wind installations between 240 and 450 GW will be needed by 2050, making offshore wind a crucial pillar in Europe's power mix.

In GWEC Market Intelligence's pre-COVID market outlook, 2020 and 2021 were expected to be relatively quiet years, with new installations below 3 GW in Europe.

This growth forecast is unchanged in our post-COVID scenario. After a slow start in the beginning of 2020s, however, the European offshore market is likely to bounce back in 2022 when all the UK's CfD 2 projects will come online. New installations in Europe are likely to reach 8.7 GW in 2025.

Taking into account recently increased or proposed offshore

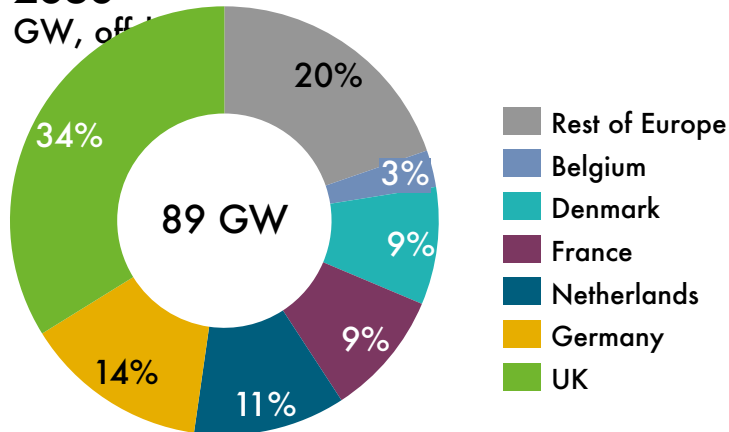
wind targets from established markets and activities in new European markets, such as those around the Black Sea, GWEC Market Intelligence expects more offshore wind to be built in the second half of the decade. New installations are likely to exceed 20 GW in 2026 and then potentially reach 15 GW by 2030.

Europe (cont'd)

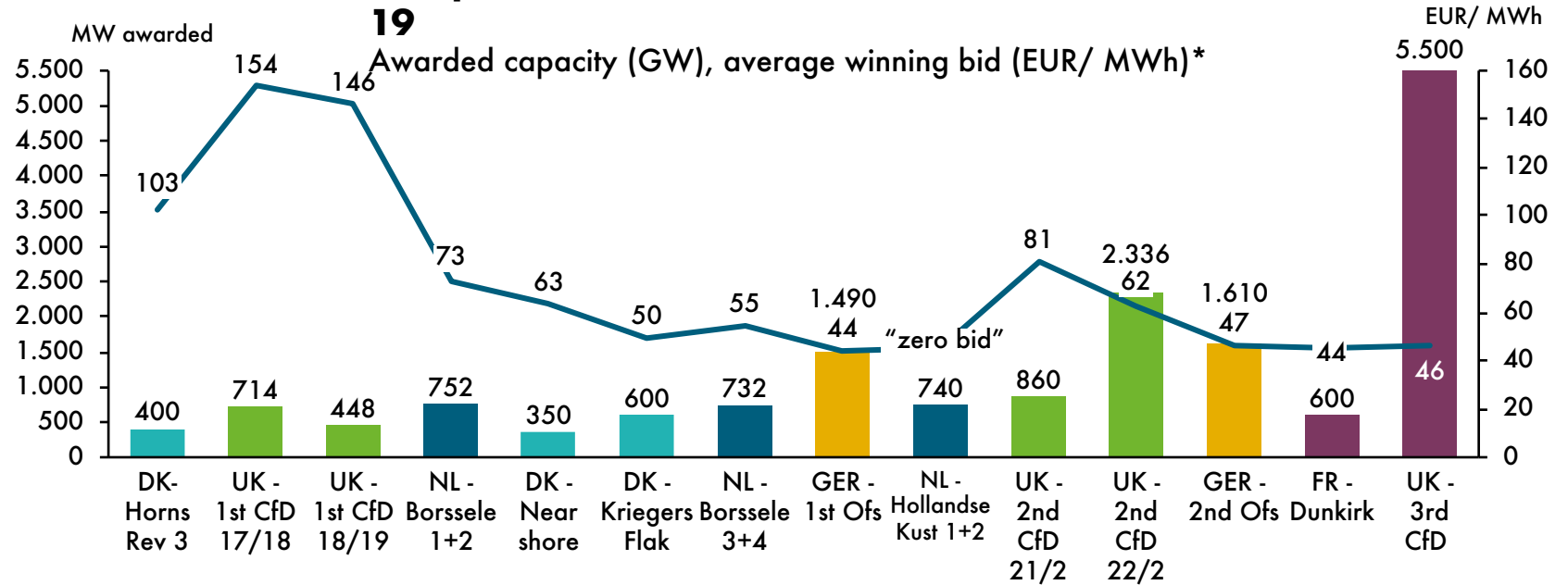
The United Kingdom

As the world's largest offshore wind market, the UK continues to tell a successful story through its 2019 Sector Deal, reached between the government and industry, through its new government target of 40 percent of UK power from offshore wind by 2030, and through the 30 percent cost reduction achieved from CfD Rounds 2 to 3. CfD Round 4, which seeks to award up to 8.5 GW of projects, is underway with Invitation to Tender (ITT) Stage 1 submission period concluded. In early June, Crown Estate Scotland also launched the ScotWind seabed leasing round for offshore wind projects, followed by the UK Committee on Climate Change (CCC)'s recommendation to the government in June to deliver at least 40 GW of offshore wind by 2030.

Total added between 2020 and 2030



European executed offshore tenders/ auctions 2015-19



• Tenders above 100 MW capacity and no innovation auctions, tenders in order of execution from 2015 to the end of 2019
Source: GWEC Market Intelligence, GWEC Auction Database May 2020

Germany

The German wind industry has been struggling with the federal government's conservative offshore wind target. The good news is that Germany's Federal Cabinet has approved the amendment to the Offshore Wind Act (WindSeeG) in June 2020. Not only does the bill increase the 2030 offshore wind target from 15 GW to 20 GW, but it establishes a long-term offshore target of 40 GW by 2040. The amendment has been welcomed by the industry, as it brings in volume, scale, jobs and long-term visibility.

France

The Multiannual Energy Programme (Programmation pluriannuelle de l'énergie (PPE)) that came into force in April 2020 shows that France will tender up to 8.75 GW of offshore wind capacity from 2020 to 2028. The PPE also increases the intended operating offshore wind capacity to between 5.2 GW and 6.2 GW by 2028. The 2023 operating capacity target is 2.4 GW. From 2024 onward, France will tender 1 GW per year of either fixed-bottom or floating wind capacity, depending on the cost.

Denmark

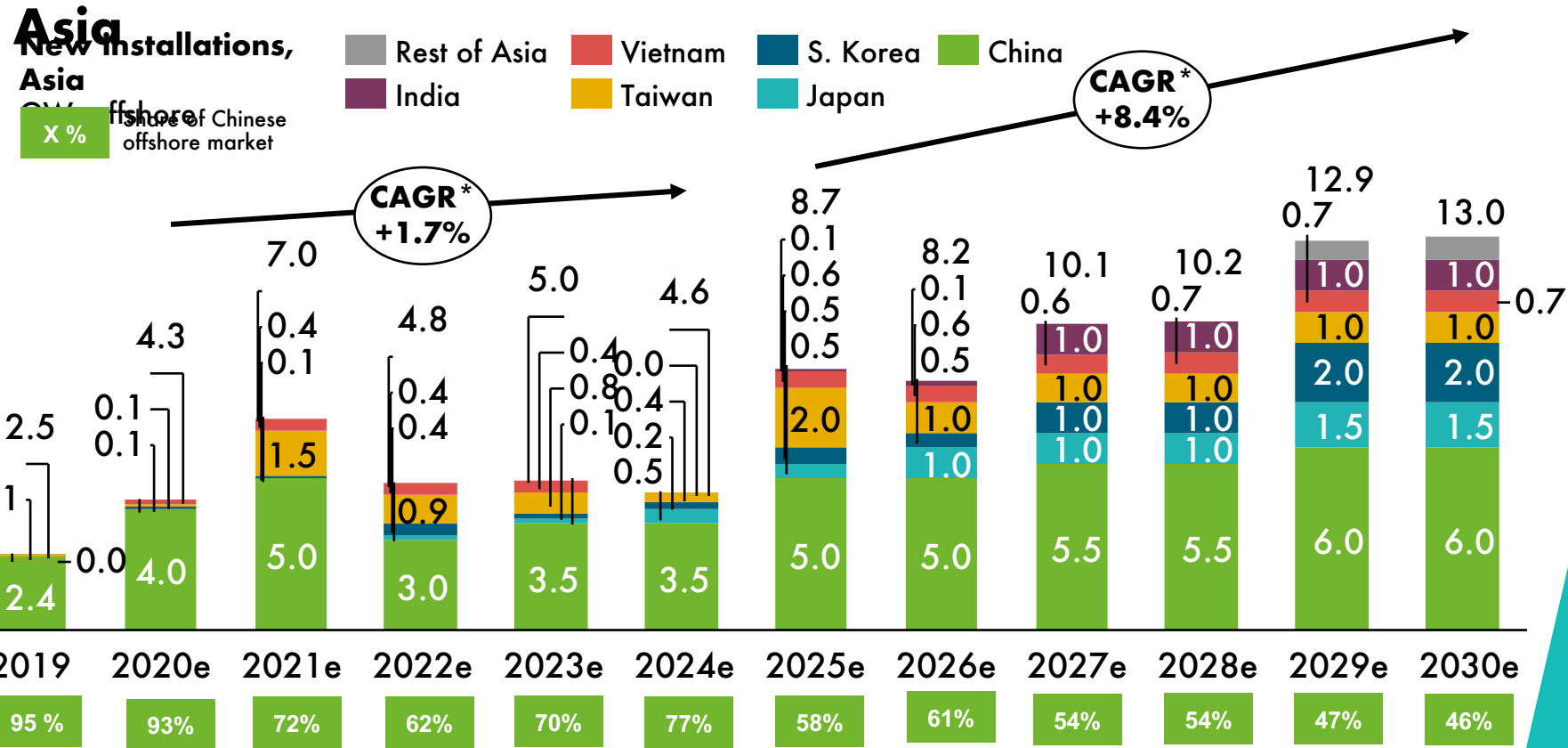
In June 2020, the Danish parliament approved a new Climate Action Plan which calls for the development of two "energy islands," one in the North Sea and one in the Baltic Sea (with a combined capacity of 5 GW planned by 2030) and also approves the development and construction of one more wind farm in the Baltic Sea with capacity of up to 1 GW.

Japan built Asia's first offshore wind project with two units of V47-660kW turbines in 2003. However, the Asian offshore market was not ready to take off in earnest until 2014, when the Chinese central government released the National Offshore Wind Development Plan (2014-2016). In 2017, China passed the 1 GW annual installation milestone; one year later, it surpassed the UK as the world's top market in new installations.

GWEC Market Intelligence's latest market outlook predicts that China will continue to dominate the Asian offshore wind market in the first half of this decade, with more than 70 percent market share. Taiwan is expected to be the largest offshore market in Asia after China in new installations in the same period.

However, the scales will tip from 2025, when more utility-scale offshore wind projects get connected in Japan, South Korea and Vietnam. GWEC Market Intelligence forecasts that China's market share in this region is likely to drop to 58% in 2025 and will continue to decline when offshore projects expand to new markets with high resource potential, like India and the Philippines, towards the end of the decade.

Global offshore wind growth to 2030 in Asia



* CAGR = Compound Annual Growth Rate
Source: GWEC Market Intelligence, June 2020

The average annual growth rate in Asia will stay at the level of 1.7 percent in the first half of this decade, but is likely to increase to 8.4 percent in the second half. The top five markets in this region in new installations in this decade will be

China (52 GW), Taiwan (10.5 GW), South Korea (7.9 GW), Japan (7.4 GW) and Vietnam (5.2 GW).

Excluding China, the Asian offshore wind market is still at the early stage of development. Each market is facing the challenge of developing a local supply chain

and the necessary competencies and capabilities to build an offshore wind industry. The early experience from Taiwan has proven that collaboration with European partners across markets in this region is essential for success.

Asia (cont'd)

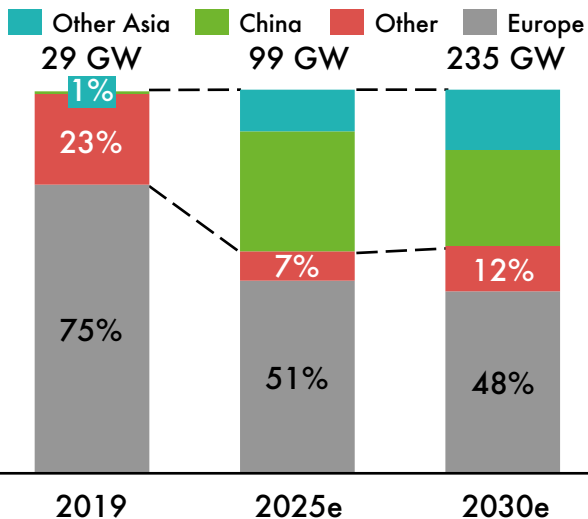
GWEC Market Intelligence predicts that Europe will remain the largest regional offshore wind market in terms of total installations by 2025 and 2030. Nevertheless, Asia's share of the global market is expected to grow from 24 percent in 2019 to 42 percent in 2025, where it is likely to remain until the end of the decade.

China

China was the world's No. 3 offshore market in total installations as of the end of 2019 (after the UK and Germany). At present, project developers and investors are rushing to commission their projects before the end of the 2021 deadline in order

Total installations

Percentage and GW, offshore



to capitalise on the 0.85RMB/kWh FiT for offshore wind. Considering extraordinary volume of new capacity (4-5 GW/year) will be built in 2020 and 2021, GWEC Market Intelligence expects China will surpass the UK as the world's largest offshore market in total installations by 2021, if not 2020. However, new installations will decline dramatically from 2022, when the central government will terminate the subsidy for offshore wind. Annual offshore wind growth in China in the future will depend on whether subsidies provided by provincial governments will be available and whether offshore wind industry can reach grid parity before 2025.

Taiwan

With 128 MW offshore wind capacity online at present, Taiwan is positioned to become the second-largest offshore wind market in this region. It will connect 5.5 GW of new offshore wind by 2025 and another 10 GW will be tendered by the government through the Round 3 auctions for commissioning by 2035, providing the long-term visibility needed to generate a local offshore wind industry and supply chain.

South Korea

Although the "green growth" strategy announced almost a decade ago has failed to boost its offshore wind development, the Democratic Party led by President Moon Jae-in seems intent on reviving the green agenda. To reach the "Renewable Energy 3020" target of 20 percent renewables in the power mix by 2030, South Korea is targeting 12 GW of new offshore wind capacity to be built by the end of this decade.

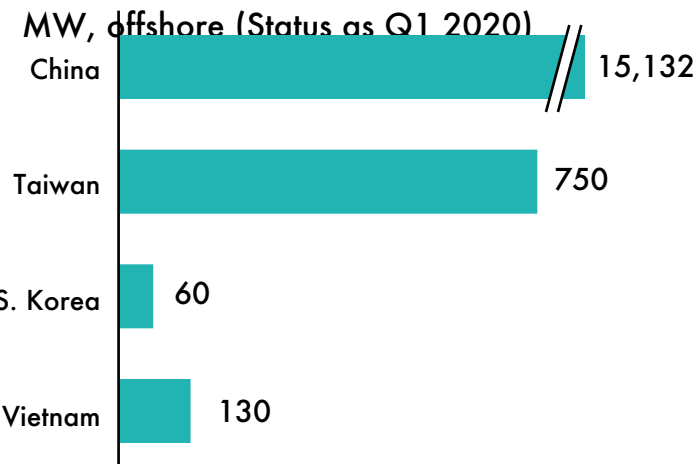
Japan

The development of Japan's offshore wind sector has been stymied by a lack of ambitious targets and a cumbersome permitting and licensing framework, but there has been a growth in momentum at both the policymaking and industry level since 2017. In July 2020, the government nominated four offshore wind zones and launched the first offshore wind auction for a floating offshore wind farm offshore from Goto City. GWEC Market Intelligence expects the Japanese offshore wind market to take off from the middle of this decade.

Vietnam

More than 500 MW offshore wind projects in the pipeline were expected to come online before the current FiT deadline of November

Projects under construction 2020*



* Construction defined as beginning of foundation work
Source: GWEC Market Intelligence, May 2020

2021. Taking into account the recent announcement of a FiT extension to the end of 2023 followed by an auction system from 2024, which was officially sanctioned by the Prime Minister in June, GWEC Market Intelligence predicts a total of 5.2 GW offshore wind capacity to be built between 2020 and 2030.

North America

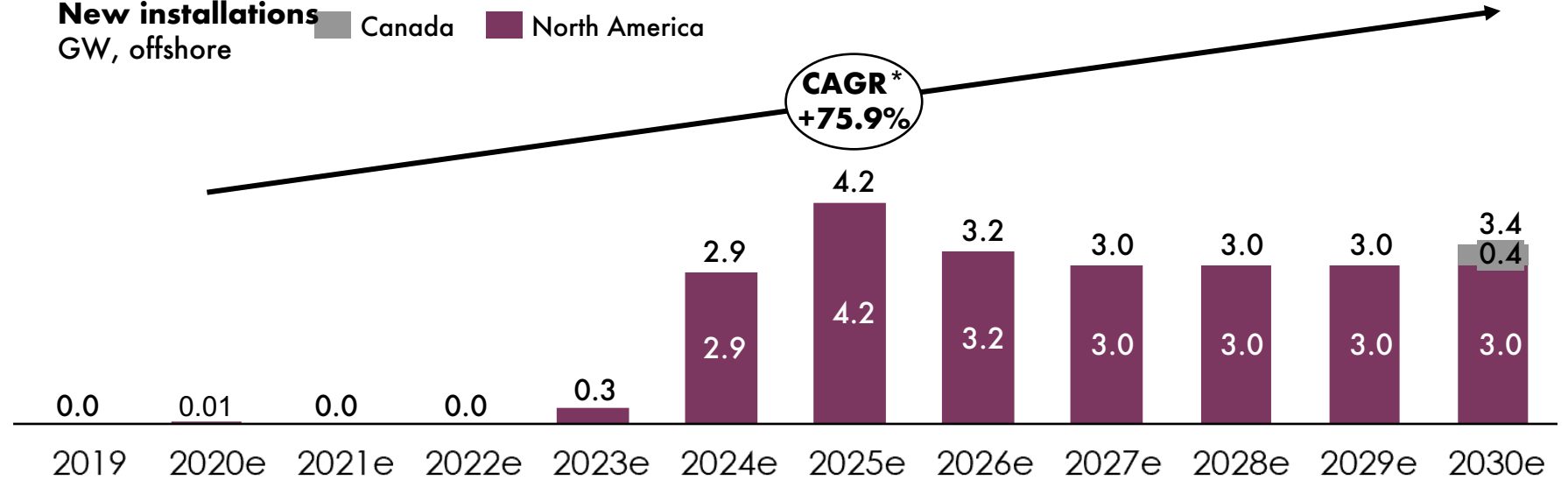
North America installed its first test offshore wind turbine, a 1/8th geometric scale of a 6 MW turbine, off the coast of Maine in 2013, and connected its first commercial wind project to the grid in Rhode Island in December 2016. As of the end of 2019, 30 MW of offshore wind capacity was spinning in North America, making it the only region with commercial offshore wind outside of Europe and Asia.

Based on GWEC Market Intelligence's global offshore wind project pipeline, no utility-scale offshore wind project will come online in North America before 2024. In total, 23 GW of offshore wind is predicted to be built in this region in this decade, of which less than 1 GW is expected to come from Canada, despite its high technical resource potential.

Offshore wind growth to 2030 in North America

New installations
GW, offshore

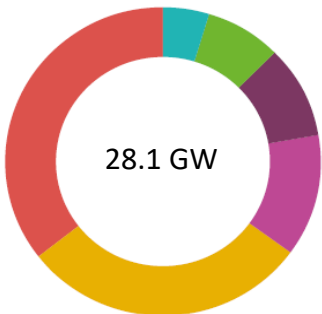
Canada North America



* CAGR = Compound Annual Growth Rate
Source: GWEC Market Intelligence, June 2020

United States

Offshore wind development targets in the US



- Maryland 1.2GW (2030)
- Connecticut 2GW (2030)
- Virginia 5.2 GW (2034)
- Massachusetts 3.2GW (2035)
- New Jersey 7.5GW (2035)
- New York 9GW (2035)

The sole demonstration project in the US, a 12 MW pilot project in Virginia, was completed in June 2020 as the first offshore wind project to be approved by the Bureau of Ocean Energy Management (BOEM) and installed in federal waters. However, the level of offshore wind development activity remains impressively high. As of the end of 2019, BOEM has auctioned 16 active commercial leases for offshore wind development that could support more than 21 GW of generating capacity.

On the state level, the East Coast cluster consisting of Maine, Connecticut, Massachusetts, New York, New Jersey, Delaware, Maryland, Virginia and North Carolina is driving strong demand for offshore wind energy with the total announced offshore wind procurement targets reaching 28.1 GW as of Q1 2019. GWEC Market Intelligence predicts a total of 22.6 GW of offshore wind could be built in the US by the end of this decade. To realize such potential, however, the following key challenges need

to be addressed:

- Slow project permitting processes have delayed the ramp-up of the US offshore wind industry, which has more than 2,000 GW of technical resource potential and must be streamlined.
- Establishing a local supply chain and fostering investment and long-term planning in grid and port infrastructure must be achieved across states through a collaborative approach.

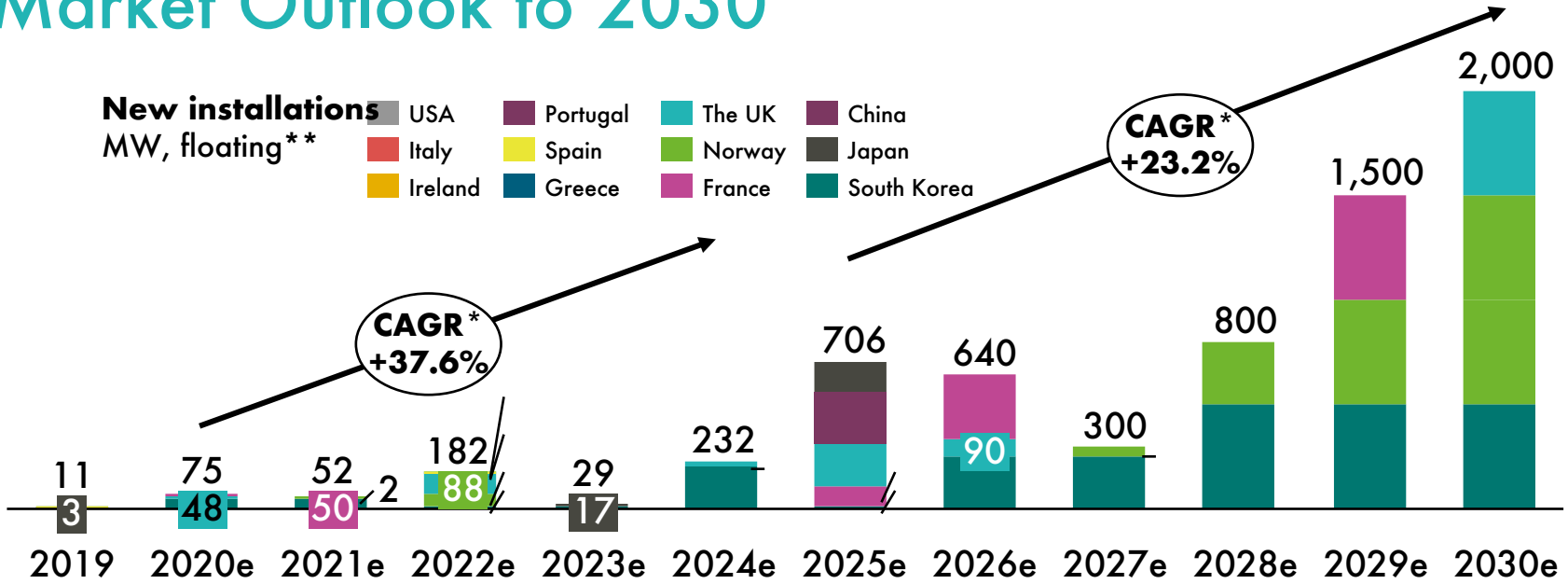
Floating Offshore Market Outlook to 2030

The world's first MW scale floating offshore wind turbine was grid-connected by Equinor in Norway in 2009. As of the end of 2019, a total of 66 MW of floating wind capacity has been installed worldwide.

After a decade of development, floating offshore wind is no longer simply an R&D area. With more oil majors such as Shell and TOTAL starting to focus on floating wind, this sub-section of offshore wind is ready to progress quickly to full commercialisation.

At present, the 2030 floating offshore wind forecast ranges from 3 GW to nearly 19 GW, depending on how quickly LCOE can be brought down to an affordable level and its adoption by new markets.

GWEC Market Intelligence predicts 6.2 GW of floating wind is likely to be built in the next 10 years. This outlook is primarily based on the existing



* CAGR = Compound Annual Growth Rate ** Note: this floating wind outlook is already included in GWEC's global offshore wind forecast
Source: GWEC Market Intelligence, June 2020

Global floating offshore wind resource map



Source: Q FWE

global floating offshore project pipeline as well as announced investment plans. Out of the 6.5 GW floating wind installations, we expect less than 10 percent to be built in the first half of this decade; the majority of new volume will come online in the latter half, when large-scale floating wind projects tendered through auctions are expected to be installed.

Currently, the UK, Portugal and Japan are the top three markets in

total floating wind installations. By the end of this decade, South Korea, France and Norway are likely to replace those markets as the top floating markets. Considering the tremendous wind resources available at shallow water depths, at present we expect only demonstration floating wind projects to be built in China.

Floating wind's current contribution to total wind installations is fairly small, but it will play an increasingly important role toward the end of this decade,

accounting for 6 percent of global new wind installations in 2030. GWEC Market Intelligence expects that floating wind will prevail when it is commercially viable as another foundation solution, rather than a sub-sector of offshore wind. Consolidation of floater designs and modularisation of production will be the keys to bringing down LCOE. GWEC launched its Floating Offshore Wind Task Force in July 2020 to unlock future potential.

Impact of COVID-19 on Global Offshore Wind Market

The COVID-19 pandemic has shocked the global energy sector, forcing projects to suspend work to comply with social distancing regulations, challenging the investment conditions of markets bracing for economic recession and slashing power demand by **up to 10%** in some regions in 2020. The size of that decline is around seven times greater than during the 2008-2009 global financial crisis, according to the IEA, and has hit demand for oil, natural gas and coal the hardest.

But renewable energy will see an overall increase in its share of global power generation this year, due to its cost-competitiveness and priority dispatch in many markets. And the offshore wind sector, with longer project development timelines, will largely be shielded from the short-term supply chain disruptions which impacted project execution in onshore markets across the world. In 2020, the wind capacity lost to the pandemic is estimated by GWEC Market Intelligence at around 15 GW – most of the downgrade will affect onshore wind, with volume shifting to come online by 2021 instead.

Impact of COVID-19 on global offshore outlook

Over the next five years, the leader for offshore wind installations by far will be Mainland **China**, where 19 GW is expected to be commissioned off the coasts of Jiangsu, Fujian, Guangdong, Zhejiang,

Hebei and Liaoning provinces. Driven by an offshore wind FIT for projects which will be grid-connected by 2021, the market has sufficient runway and production capacity to rebound from the slowdown in activity during the first half of 2020. The delay for offshore wind project construction in China is estimated at six months, due in part to restrictions on imported bearing materials from Europe and imported blade materials like balsa wood and PVC from Ecuador and Italy.

Since the grid-connection deadline extension proposal sent by the local wind industry to the National Energy Administration (NEA) seems unlikely to be approved at the time of writing, the Chinese offshore industry is currently running in full steam in project construction. Based on the latest offshore wind market dynamics and feedback from leading suppliers and developers in China, GWEC has kept its 19 GW pre-COVID forecast unchanged for China for the next five years.

In **Europe**, the expected new installations in 2020 and 2021 were already low in our pre-COVID outlook. The projects scheduled for commission in both years are currently under construction in the UK, Germany, the Netherlands and Belgium. GWEC members report that construction work is proceeding during the pandemic, with the two big projects Borssele I & II and Seamade generating first power in April and July, respectively.

2020 was on track to be a record year in global wind history with more than **76 GW** to be installed. However, the **COVID-19 crisis**, which disrupted global wind supply chains and project construction execution, is expected to lead to a more modest **61.4 GW** this year, **19 percent** lower than our pre-COVID forecast made in Q1 2020. Most of the impact will be felt by the onshore wind sector, and new wind installations are likely to bounce back to make **2021 a record year** with annual installations reaching **77.7 GW**.

In addition, the market leader, the UK, has maintained its offshore wind auction timeline for 2021, with the industry even **calling** to accelerate procurement through annual Contract for Difference auctions. Germany, the No. 2 offshore market in Europe, recently raised its offshore wind capacity target to 20 GW by 2030 and 40 GW by 2040, and **implemented** a law streamlining permitting procedures for wind projects. The government is also making offshore wind a cornerstone of its national hydrogen economy strategy.

In **the US**, the 12 MW Dominion Virginia demonstration project was successfully installed in June 2020, but the combination of prolonged lead time to secure federal permits, especially the Construction and Operations Plan (COP) from BOEM, and the effects of the COVID-19 pandemic have delayed projects previously scheduled for commissioning in 2022 and 2023. Thus, GWEC Market Intelligence has pushed back the commissioning year for those projects by one year.

Green Recovery

The pandemic has highlighted the opportunity to make wind power a cornerstone of economic growth and recovery packages. [GWEC's global statement on "Re-building Better" for the future](#), signed by leading wind companies and associations representing 98 percent of installed onshore and offshore wind power worldwide, highlights wind power as a source of affordable, clean and zero-carbon electricity, which can bring significant socioeconomic benefits to local communities (see page XXX "Driving millions").

By mid-2020, as lights around the world flickered back on and assembly lines restarted, global carbon emissions have already [sharply rebounded](#). It is critical for the health, welfare and prosperity of the global community that the clean energy transition becomes a core component of economic stimulus and growth packages. Studies show that investing in renewables will have a multiplier effect on economic growth: \$1 spent to advance the global energy transition returns \$3-8, [according](#) to IRENA, while clean energy infrastructure construction generates [twice as many jobs](#) per \$1 million spent as fossil fuel projects.

[Read the Global Industry Statement!](#)



Wind Power a cornerstone of the Global Economic Recovery

"Re-building Better" for the future

Wind power is a key building block for economic recovery from the impact of COVID-19, which will enable governments to renew critical infrastructure for a sustainable future. The wind industry will help to deliver the jobs, clean and affordable power and energy security needed for a sustainable economic recovery.

Offshore wind offers compound value for investment, with high capacity factors and [average global costs declining](#) more than 50 percent over the last decade. In decarbonisation terms, 1 GW of offshore wind power avoids more than 3.5 MT CO₂ – giving it [more potential for carbon avoidance](#) as a technology to displace fossil fuels than even onshore wind, solar, hydro or efficient gas power.

Keeping global warming within 1.5-2 degrees of pre-industrial levels will require at least 100 GW of new onshore and offshore wind capacity to be installed on an annual basis through 2030, with the accompanying scale-up of investment. True "green recovery" by national and regional governments will enable this magnitude of deployment, through higher capacity targets, transparent pipelines and policy measures to resolve the severe existing bottlenecks

around permitting and licensing of new projects. Increasing investment to undertake modernisation of grid and transmission infrastructure will also be key to integrating large volumes of offshore wind.

Driving Millions of Sustainable Jobs in the Energy Transition

At a time when governments are considering maximum impact per dollar of economic stimulus, it is worth highlighting that offshore wind farms have greater labour requirements than onshore wind farms, due to more complex construction, assembly and installation activities.

Offshore wind offers a range of job opportunities across the value chain – from project planning and financing to manufacturing and transport to construction and operations and maintenance (O&M). A 2020 [study](#) by the American Wind Energy Association found that the sector offers “good, well-paying jobs requiring a diverse technical workforce spanning an estimated 74 occupations... [including] electricians, welders, turbine technicians, longshoremen, truck drivers, crane operators, ironworkers, pipe-fitters, pile drivers, engineers, mechanics, scientists, and offshore equipment and vessel operators.”

Based on data from IRENA, gathered during a 2018 study of nearly 30 stakeholders, GWEC estimates that **17.3**

direct jobs (defined as one year of full-time employment for one person) are created per MW of generation capacity over the 25-year lifetime of an offshore wind project. * With nearly 51 GW of new offshore wind capacity forecast to be installed worldwide by 2024, that equals nearly **900,000 jobs in offshore wind created over the next five years** – a figure which can only increase if offshore wind deployment scales up.

For near-term local employment, a [study](#) by GWEC, Global Wind Organisation and Renewables Consulting Group found that 2.5 persons were required to construct and install 1 MW of offshore wind – an indication of potential job creation for already licensed projects.

Once the wind farm is connected, jobs in operations and maintenance (O&M) last over the lifetime of the project – roughly 25 years for offshore wind. O&M spans a variety of needs, from contract management to wind turbine maintenance to offshore logistics. As well, remote automated control is increasingly employed in O&M, via a SCADA system, radio telemetry and artificial intelligence applications. These areas require highly skilled workers with a background in data science, mechanical and computer engineering and telecommunications.

Maximising local economic activity will require policymakers to make strategic choices on how existing workers can be leveraged for high-growth areas. Where possible, re-skilling offshore oil and gas workers for the growing wind sector should be a priority to encourage low-carbon economic growth and competitiveness. This is also a fair response to labour market disruptions from the energy transition and pandemic, including dislocation of jobs for offshore oil and gas workers.

Outside of manufacturing turbine components, offshore wind generates jobs in the manufacturing of steel for foundations, substations and installation vessels, sub-sea cables to evacuate electricity from offshore farms to onshore grids and trucks and vessels for transport of equipment and workers. All these areas can leverage the capabilities and supply chains of the offshore oil and gas sector.

Potential short-term investment areas to support a just and inclusive transition include targeted education and training schemes, industrial upgrades and promotion of public-private partnerships. Long-term investment areas include supplier development programmes and national roadmaps to develop industrial clusters in strategic areas of need.

17.3 direct jobs (defined as one year of full-time employment for one person) are created per MW of generation capacity over the 25-year lifetime of an offshore wind project. *

Nearly 900,000 jobs in offshore wind are likely to be created over the next five years.

*This is a generalised calculation for demonstration purposes only, and does not account for technology evolution, application of various platforms or installation technologies, economies of scale, productivity rates or learning excellence. Comprehensive studies are required to determine job creation potential for offshore wind for specific markets.

Looking Beyond 2030

Beyond the next decade, key government and industry bodies are setting their sights even higher for offshore wind. The EU's staggering **450 GW aim by 2050** foresees industrial clusters in the North Sea (with nearly half of the targeted capacity), Atlantic Ocean, Baltic Sea and southern European waters. Installations will be mainly concentrated in the UK, Netherlands, France, Germany, Denmark and Poland, with several other EU markets home to double-digit volumes.

The Ocean Renewable Energy Action Coalition (OREAC) is a global group of leading offshore wind developers, technology providers and stakeholders including GWEC, launched in December 2019 in response to the UN High Level Panel for Sustainable Ocean Economy's call for ocean-based climate action. OREAC envisions offshore wind reaching **1.4 TW of installed capacity by 2050**, driven by the sector's ability to drive investment, generate jobs and severely cut emissions worldwide. This goes far beyond current forecasts from international institutions, but according to OREAC,

reaching this ambitious target would be possible with strong collaboration between government and industry, policy stability, market transparency and responsible development, allowing offshore wind to thrive among other sustainable ocean uses.

World Bank's ESMAP Offshore Wind Development Program, launched in March 2019, targets the acceleration of offshore wind development in non-OECD countries around the world. As a partner of this programme, GWEC works with the World Bank to engage policymakers on recognising and delivering the offshore wind potential in their market through national roadmapping and workshops. (see page xx)

Progress made over the next ten years will lay the foundation for how high and how far offshore wind can scale in the decades beyond. With strong economics, exciting technology evolution and growing interest from coastal markets around the world, offshore wind is set to be a game-changer in the global energy transition.

