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IEEFA.org

Offshore Wind Ready to Be Key Part of Energy Mix Globally

Top European Developers to Drive Down Costs in Asia Pacific

Executive Summary

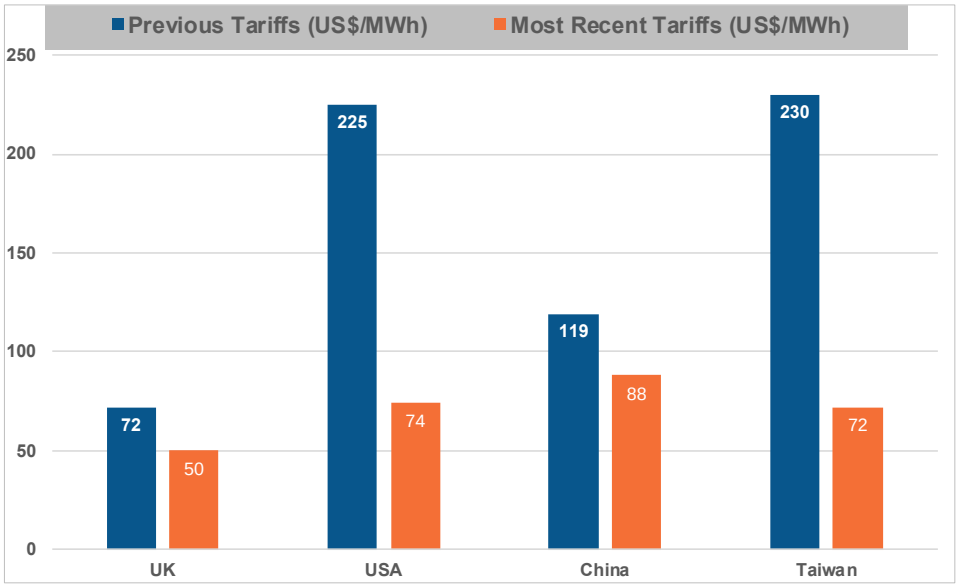
There is massive offshore wind power potential to be harnessed in emerging and developed countries at a cheaper rate than building and maintaining new fossil fuel plants.

While offshore wind has had slower beginnings, renewable energy power sources—onshore wind and solar—have attained grid-parity with thermal power sources—coal, gas and oil—in an increasing number of developed and emerging markets, particularly where thermal fuels are imported.

Today, offshore wind is gradually becoming viable as a third alternative source of sustainable, zero emissions renewable energy.

Offshore wind has seen a dramatic decline in project costs due to its low externalities, improvements in wind turbine technologies, innovative financing models, and healthy international investment. These cost decline benefits are reflected in reduced wholesale electricity tariffs of offshore wind globally.

Figure 1: Global Decline in Offshore Wind Tariffs

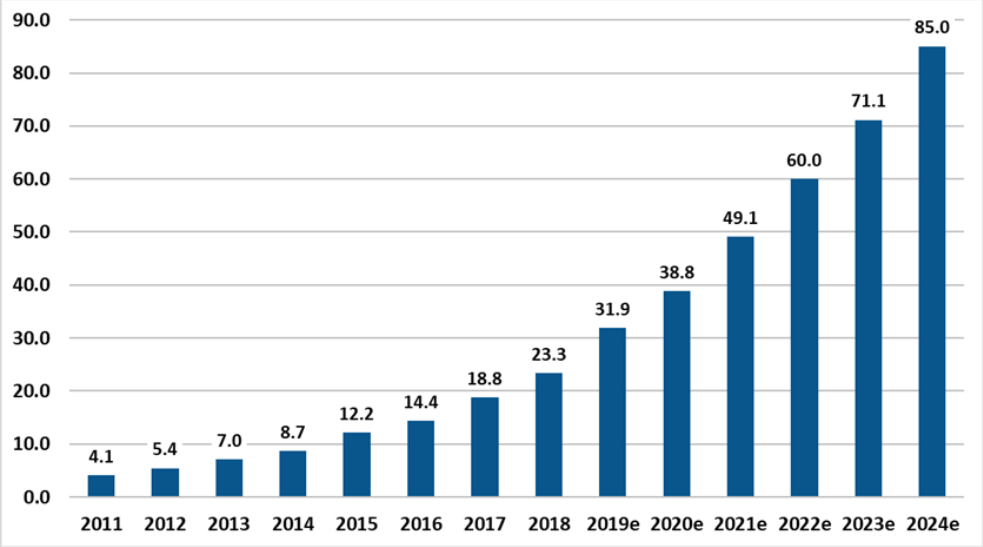


Source: Media & Financial Reports.
Note: The timelines for previous tariffs: UK(2017), USA(2018), China (2018), Taiwan (2018).

In 2018, 51.3 gigawatts (GW) of wind power capacity was installed globally, of which 4.5GW was offshore wind. The installation of global offshore wind power, sitting at 12GW in 2015, reached 23.3GW by the end of 2018, a near doubling in just three years.

The installation of offshore wind power capacity is likely to reach 85GW by 2024 with an annual growth rate of 22% over the next five years, according to a recent report from Norwegian Energy Partners (Norwep). The Global Wind Energy Council (GWEC) predicts similar momentum, noting the emergence of new Asian countries likely to contribute 5-7GW of installations annually.

Figure 2: Medium-term Growth of Offshore Wind Power Capacity Installed (GW)



Source: Global Wind Energy Council, Norwep. Note: Cumulative world total.

Norwep also highlights that yearly capital expenditure in the offshore wind power sector could reach €50 billion (bn) (US$55bn) by 2024, translating into a total global spend of €190bn over the coming five-year period.

In this note we review developments in offshore wind projects in emerging markets in Asia Pacific, including cost trends and policies, against capacity targets in Asia, the United States and Europe.

For instance, China looks set to become one of the world leaders in the offshore wind sector. China took the global lead in annual offshore wind capacity installations in 2018 with 1.8GW installed compared to 1.3GW and 0.9GW from earlier leaders UK and Germany respectively. China has started to build huge internal capacity in manufacturing and technology while creating jobs.

IEEFA notes offshore wind power development is likely to pick up pace as countries phase out nuclear power fleets while progressively reducing dependence on imported coal for electricity generation.

Offshore wind is the new game-changer in the renewable energy transition occurring globally. Governments need to keep up with the pace of development and investment by domestic and international players as emerging countries strive to meet their necessary and ambitious renewable energy targets.

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Rapid Development in Offshore Wind Technologies Causing Rapid Deflationary Trend

Technological advances in the development of offshore wind turbines has been dramatic.

The rotor diameter has doubled from 80 metres to more than 164 metres and average turbine capacity has More than doubled, climbing from 1-2 megawatts (MW) in 2012 to 8-10MW today.

Leading players like MHI Vestas, Siemens Gamesa and Goldwind have already implemented offshore wind turbine upgrades and are betting on reaching 12-14MW by 2024.

These technological improvements and cross-sector learning from other industrial sectors such as maritime, automotive and shipbuilding have pushed offshore wind costs down significantly over the last decade.

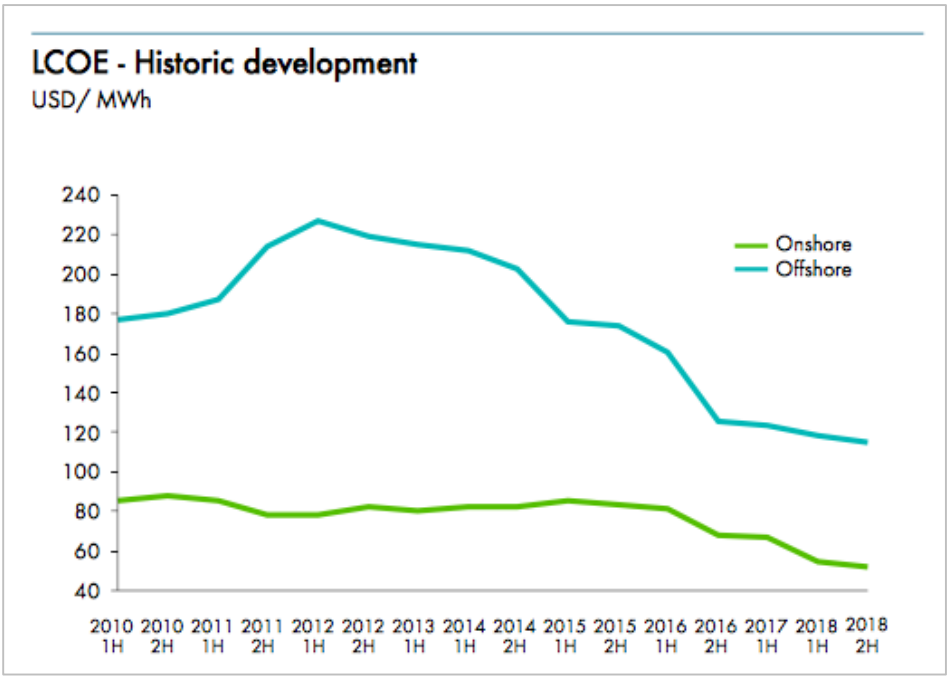
Today, offshore wind power is near matching the value of energy from its onshore counterpart, due to its near-limitless size potential, the grid value of its proximity to coastal city load centres, the exceptional utilisation rates, plus subsea grid technology improvements to carry the energy produced by world leaders like Prysmian Cables.

The offshore wind levelised cost of energy (LCOE)—a common measure to compare costs of different sources of energy—has declined by one-third globally in the last 8 years (Refer to Figure 3), demonstrating a significant, ongoing deflationary trend.

Offshore wind LCOE has declined by one-third globally.

Recent offshore wind energy auctions in Europe resulted in tariffs much below the usual headline tariff (wholesale electricity price) of €100/ megawatt hour (MWh). Europe's industry is now targeting parity with its onshore counterpart with tariffs below €60/MWh, while the United Kingdom set a record low of €44/MWh in September 2019. (details to follow further in the report)

Figure 3: Declining Onshore and Offshore Wind LCOEs



Source: Global Wind Energy Council.

Offshore Wind in Emerging Markets

The World Bank Group has estimated massive offshore wind power potential in the emerging markets of Vietnam, South Africa and Brazil to be 309GW, 356GW and 526GW respectively.

IEEFA previously detailed a cumulative offshore wind power capacity target of 100GW by 2030 amongst the greater Asian countries of China, Japan, Taiwan, India, South Korea, Vietnam, the Philippines and Indonesia.

Asia reaching 100GW of offshore wind capacity by 2035 replaces 35% of the current global seaborne coal market.

Assuming this target is achieved by 2035, it would be replacing the equivalent of 300-350 million tonnes (Mt) of thermal coal annually—35% of the current global seaborne trade.

To increase the uptake of offshore wind in emerging markets, the World Bank launched an initiative called "Energy Sector Management Assistance Programme" (ESMAP) in cooperation with the Global Wind Energy Council's "Offshore Wind Taskforce" in September 2018. The UK government supported the initiative with a £20m grant. Within this initiative, the World Bank aims to convene meetings with developing country governments, commercial developers, development partners

and wind energy experts to raise awareness of offshore wind opportunities in emerging markets.

In this note, we review developments in offshore wind projects, including cost trends and policies, against capacity targets in Asia, the United States (U.S.) and Europe.

Europe

Europe has been home to offshore wind power for several decades.

UK and Germany added 1.3GW and 0.9GW respectively of offshore wind power capacity in 2018. They were overtaken last year for the first time by China which added 1.8GW domestically.

For the first time, China added more domestic offshore wind capacity in 2018 than leaders UK and Germany.

European utilities such as Ørsted of Denmark, RWE of Germany, Vattenfall of Sweden, SSE of UK, Equinor of Norway, and Iberdrola of Spain are the world's top offshore wind developers/owners.

Ørsted, the World's Biggest Offshore Wind Developer

Previously known as DONG Energy, Ørsted is currently the world's biggest offshore wind developer occupying a third of the market outside China. Ørsted's transition was driven by its ailing coal and gas-fired fleet and dwindling profits in its oil business from around 2012.

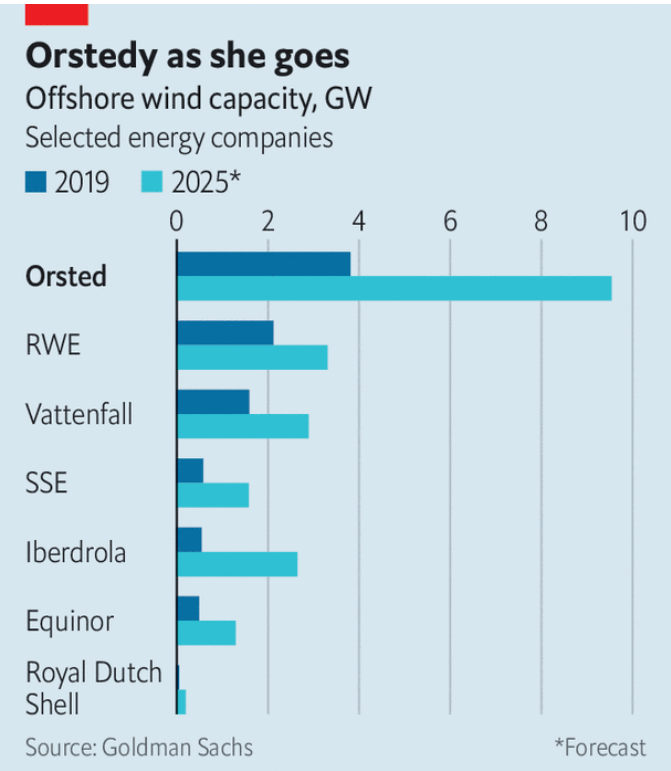
Ørsted's strategic shift from fossil-fuels to renewables paid off well for the company, and for the industry. Ørsted has subsequently contributed to reducing offshore wind tariffs in Europe from more than US$120/MWh in 2012 to US$60-70/MWh currently.

In 2018, offshore wind accounted for about 90% of Ørsted's gross operating profit and 80% of capital employed. Ørsted's operating profits increased 33% to DKK30bn (US$4.4bn) in 2018, of which offshore wind contributed DKK11bn (US$1.6bn). Today, the company operates 5.6GW of offshore wind capacity and has upgraded its target from 11-12GW to 15GW by 2020.

Whilst the world's energy sector has been the worst performing sector during the last decade, Ørsted's return on equity (RoE) has dramatically increased from 3.1% in 2014 to 22.9% in 2018. Since being listed on the Nasdaq Nordic maket, Ørsted's share price rose 146% from DKK252 to DKK622 between June 2016 and September 2019, whilst its benchmark index—OBX Copenhagen 25—gained only 10%.

Ørsted's renewables transformation has created enormous value for its shareholders, while utilities in the fossil fuel industry it exited have remained laggards, unable to keep up with changing global energy sector dynamics.

Figure 4: Top European Offshore Wind Power Developers by Capacity



Source: The Economist.

United States

Offshore wind development is gaining critical mass in the U.S. market with a number of competitive auctions held in the last 12 months.

In January 2019, the state of New York massively upgraded its offshore wind power target from 2.4GW by 2030 to 9GW by 2035. The state of Rhode Island signed a power purchase agreement (PPA) with the Ørsted-acquired Deepwater Wind at a tariff of US$74/MWh in February 2019. And in September 2019, Virginia's utility Dominion Energy announced plans for a 2.6GW-plus offshore wind project to be fully commissioned by 2026.

Offshore wind development is gaining critical mass in the U.S.

French wind power developer Ideol, which specialises in floating offshore wind power technology, recently identified three sites on California's seaboard. Ideol is also developing a "multi-hundred-megawatt" floating offshore wind project with Japanese renewable energy developer Shizen Energy in the East China sea.

The overall size of the U.S. offshore wind energy project development and operational pipeline has reached 25GW. According to the US Department of Energy, this investment has been motivated by reduced turbine costs, accelerated federal offshore wind lease auctions, and state procurement mechanisms.

Asia-Pacific

China

With its world-leading position in most aspects of the current global renewable energy transition including annual capacity installs, investments, technology and supply chain, China looks set to become one of the world leaders in the offshore wind sector.

China had 4.6GW[1] of operational offshore wind power capacity by the end of 2018. It installed 1.8GW of offshore wind capacity in 2018 alone, which is 40% of the total 4.5GW added globally during the year.

According to Bloomberg New Energy Finance (BNEF), China's investment of US$11.7bn was almost half of world's US$25bn investment in offshore wind last year. As a result, China's near-term national target of 5GW of offshore wind power capacity by 2020 was almost achieved two years ahead of schedule.

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While the UK is the current leader in offshore wind capacity, FTI Consulting expects China to continue its momentum, surpassing the UK by 2021 with 10.9GW of offshore wind capacity to be installed. China's annual new installs will reach 2GW from 2019 onwards and will continue to grow to an annual install of 4GW by 2025, according to FTI. Wood Mackenzie forecasts China to add 40GW of offshore wind capacity by 2030.

In January 2019, China approved 24 offshore wind power projects off the coast of Jiangsu Province with a total capacity of 6.7GW and an investment injection worth US$18bn. The projects are expected to be operational by 2020. China's largest utilities including China Energy Group, China General Nuclear Power Corp., China Huaneng Group and the State Power Investment Corp. are backing these offshore wind projects. The involvement of China's state-owned utilities further reinforces the government's ambition to make China an offshore wind powerhouse similar to its onshore counterpart as well as its burgeoning solar industry.

In May 2019 China announced a new competitive tariff policy for offshore wind, departing from its fixed feed-in tariff (FiT) tariff regime. Offshore projects were

[1] Global Wind Energy Council, Annual Report 2018, p. 26.

previously supported by a fixed FIT tariff of ￥850/MWh (US$119/MWh) until 2018. The new competitive tariff is guided by upper tariffs of ￥800/MWh (US$112/MWh) for projects awarded in 2019 and ￥750/MWh (US$105/kWh) for projects awarded in 2020.

Following the announcement of the new competitive tariff policy, the first competitive auction held in August 2019 saw the lowest tariff at ￥620/MWh (US$88/MWh), 21% below the guided upper tariffs. The lowest bid came from China Longyuan, the wind development arm of China Energy Investment Corp (CEI) for a 200MW Fengxian phase 1 project in Hangzhou bay off Shanghai. Six other domestic offshore wind giants bid for the projects including China General Nuclear, China Huaneng, Shanghai Electric Power, a consortium formed by China Datang, China National Offshore Oil Corp (CNOOC), and Shanghai Electric in the range of ￥738-760/MWh (US$103-106/MWh).

In addition to the Chinese utilities, international utilities such as EDF of France are betting big on the Chinese offshore wind market. In March 2019, EDF agreed to deliver two offshore wind power projects with Chinese power utility CEI to deliver a total installed capacity of 500MW.

EDF currently has 5.3GW of offshore wind power capacity either operational or underdevelopment in China, while also providing operations and maintenance (O&M) services to an existing 500MW of offshore capacity.

Another recent partnership was announced between the Norwegian energy company Equinor and China's State Power Investment Corporation's (SPIC) subsidiary—China Power International Holding (CPIH). Equinor and CPIH plan to cooperate in the development of offshore wind projects in both China and Europe.

China's renewable energy transition has been largely domestically orientated using world-leading homegrown technology and supply chains.

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The Chinese wind turbine developer Goldwind is amongst world's top three wind developers. In August 2019, Goldwind introduced its new 8MW turbine with a rotor diameter of 184 meters, which the company states is the most powerful turbine available in China.

Another Chinese company, Shanghai Electric, bought licensing rights to manufacture and install 8MW wind turbines from Siemens Gamesa. U.S. manufacturer GE has also announced plans to build its 12MW Haliade-X turbine in Guangdong, China, and to target China and other regional markets for further installations.

According to BNEF, there is currently roughly 40GW of offshore wind capacity in China's pipeline waiting to receive government subsidy support. IEEFA expects China's offshore wind industry will follow a similar path to that of its solar and onshore wind industries, whereby the Chinese government provided initial subsidy support until the industry reached a point of commercial viability.

Moreover, Chinese domestic turbine manufacturing is supported by China's policy visibility with targets to build 40-50GW of offshore wind power capacity in the coming decade. This certainty encourages manufacturers to innovate and apply economies of scale to improve the technology so that it is competitive with European turbine manufacturing giants, bringing down the costs for both China and the rest of the world in doing so.

Taiwan

In 2017, the Taiwanese government declared its ambition to increase its renewable energy target from 5% at that time to 20% of its generation by 2025. Taiwan also aims to phase out its nuclear power fleet (currently 10% of its generation) by 2025 and progressively reduce dependence on imported coal for electricity generation.

In order to achieve this target Taiwan has planned for 27GW of installed renewable energy capacity by 2025. Roughly 5.5GW has already been awarded for offshore wind power.

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In April 2018, the Ministry of Economic Affairs of Taiwan awarded seven developers 738MW of grid-connected offshore wind capacity to be commissioned by 2020, and another 3,098MW to be commissioned between 2020 and 2025.

In June 2018, the 120MW Formosa 1 offshore wind project developed near Miaoli off the west coast of Taiwan attained financial close following 16-years of project financing to the value of NT$18.7bn (US$603m). This asset is co-owned by Ørsted (35%), Macquarie Capital (50%) and local developer Swancor Renewable (15%).

In July 2018, Taiwan's Ministry of Economic Affairs awarded the remaining 1,664MW of the targeted 5,500MW of offshore wind capacity to be developed by 2025. Ørsted was awarded 920MW for two offshore sites in the Changuha region, which took Ørsted's total offshore wind capacity in Taiwan to 1,820MW. Northland Power of Canada and Yushan Energy of Taiwan (partly owned by Mitsui & Co) won 744MW of offshore wind capacity for the sites knowns as Hai Long 1, 2 & 3 to be located on the west coast of Taiwan, 50km offshore from Changhua.

In May 2019, the 640MW Yunlin offshore wind project, developed off the coast of Yunlin County in Taiwan, reached financial close. With debt financing of NT$85.5bn

(~US$2.75bn), it is by far the largest and most complex offshore wind project in Asia-Pacific to-date.

Yunlin wind farm is 73% owned by wpd AG of Germany, an international wind power developer, and 27% owned by a Japanese investor consortium led by Sojitz Corp. Other members of the consortium include Chugoku Electric Power Co. Inc., Chudenko Corp., Shikoku Electric Power Co. Inc. and JXTG Nippon Oil & Energy Corp.

The financing for the Yunlin project involves 19 banks including 12 international banks, 4 Taiwanese domestic banks, and 3 export credit agencies—Atradius of Netherlands, Euler Hermes of France and Eksport Kredit Fonden (EKF) of Denmark.

The Yunlin project offers its developers an escalated FiT for the first ten years of NT$7,118/MWh (US$230/MWh), and NT$3,568/MWh (US$115/MWh) for the next 10 years of the 20-year PPA. This is a significantly higher FiT compared to current European projects.

Taiwan's first reverse bidding auction conducted to award capacity for Hai Long project 1, 2 & 3 resulted in a much lower tariff range of NT$2,224-2,548/MWh (US$72-82/MWh).

Similarly, Formosa 1 (120MW) has been financed by eleven international banks and four local Taiwanese banks—Cathay United Bank, Taipei Fubon Commercial Bank, EnTie Commercial Bank, and KGI Bank.

The involvement of international banks in both the Formosa 1 and Yunlin project, including BNP Paribas, Crédit Agricole Corporate and Investment Bank, DBS, Deutsche bank, ING, ANZ, KfW, Standard Charted and Sumitomo Mitsui, highlights the willingness of international financial markets to deploy capital in offshore wind infrastructure in Southeast Asia.

In October 2019 Japan's JERA Co (a joint venture of Tepco and Chubu Electric) acquired a 49% stake in the proposed 376MW Formosa 2 offshore wind project from Macquarie Group, highlighting the growing pivot of Japanese utilities from investing in thermal power towards renewable energy infrastructure.

Taiwan's offshore wind developments confirm the country's position as a frontrunner in supporting commercial scale offshore wind in the Asia-Pacific region, driven by consistent government support, a favourable legal and regulatory framework including a fixed 20-year FiT denominated in US$, and abundant wind resources. These conditions have been favourable in attracting experienced international developers, contractors and financiers.

Japan

Offshore wind power development in Japan is picking up pace as the country tries to gradually phase out its still largely idle nuclear power fleet while reducing dependence on coal for electricity.

Absent continued nuclear restarts, Japan might face a power shortfall in the long-term of up to 10GW. Therefore, the Japanese government is keen to expand its reliance on zero emissions renewable energy capacity.

With Japan's long term reliance on fossil fuel imports, large scale offshore wind power projects have been identified as the go-to technology for future domestically-sourced electricity generation.

The Japanese government is keen to expand its reliance on zero emissions renewable energy capacity.

In July 2019, the Japanese government identified 11 areas suitable for offshore wind farm development. Earlier in 2019, an encouraging policy signal was provided by government in passing a bill to promote use of territorial waters for offshore renewable energy generation facilities.

Japan's biggest power utility Tepco, and European wind power giant Ørsted, have agreed to collaborate in developing an offshore wind project off the coast of Choshi in the Chiba prefecture. ORIX, another of Japan's biggest infrastructure developers, have begun surveying the same region for offshore wind capacity.

In August 2019, Japanese oil company Cosmo Oil Co Ltd. submitted an environmental impact statement for a potential 1GW offshore wind farm in Hokkaido. The company is projecting a turbine size of between 8-12MW for the project. According to the report, the company is still conducting marine geological surveys and studying the transmission line route.

Offshore wind in Japan is still in the early stages of development and not yet ready to replace nuclear power. However, the policy momentum and the involvement of top utilities and developers signify that floating offshore wind is increasingly looking commercially viable in Japan and could progressively reduce reliance on nuclear and coal-fired power in the medium to long-term.

South Korea

Similar to Japan, South Korea's ambition to build renewable energy capacity to 20% of its total generation by 2030 is driven by the desire to reduce reliance on its nuclear and imported coal-fired power fleet.

South Korea plans to add 59GW to its renewable capacity by 2030, of which solar power will account for 31GW and wind power 16GW. The renewable target was further stepped up in April 2019 to 30-35% of total generation by 2040.

In June 2019, Australian giant Macquarie Group's Green Investment Group announced deployment of a floating light detection and ranging system (LIDAR)—sensors used to evaluate wind potential—for the group's 1.4GW offshore wind project off the coast of Ulsan city in South Korea. The project is planned to be commissioned in a phased manner between 2022 and 2024.

South Korea plans to add 59GW to its renewable capacity by 2030.

In July 2019, it was reported that the Norwegian powerhouse Equinor has formed a consortium to construct Asia's first floating offshore wind power project worth 200MW also off the coast of Ulsan in South Korea.

Equinor operates the world's first commercial-scale floating offshore wind project in Hywind Scotland. This plant's capacity is 30WM and has been in operation since 2017, generating 0.14 terawatt-hour (TWh) of power annually accounting for an extremely viable utilisation factor of 53%.

Following the commercial success of its first floating offshore wind project, Equinor announced another 88MW offshore wind project—Hywind Tampen—off the southern coast of Norway in August 2018. The project will provide wind power to the oil and gas installations in Snorre and Gullfaks.[2] This reflects Equinor's confidence in the commercial viability of floating offshore wind projects.

Vietnam

In Vietnam, UK-based Enterprize Energy was given approval in June 2019 to start work on a 3.4GW offshore wind project. The project is located off the coast of Vietnam's Binh Thuan and Ba Ria-Vung Tau provinces. The first 600MW of the project is expected to be commissioned by 2022. The power produced from the project will be bought at a FiT of US$98/MWh.

The Philippines

Similarly, the Philippines is also looking at offshore wind development. The electricity giant, Manila Electric Company (Meralco) recently talked about investors encouraging the company to consider offshore wind projects.

Australia

Australia's first offshore wind power project, "the Star of South" off the south coast of Gippsland in the state of Victoria, plans 2.2GW of capacity. The federal government approved an exploration licence for the project in March 2019, and the

[2] Equinor, Annual report 2018, p. 43.

plan is to produce one of Australia's largest electricity projects with reportedly AU$8bn (US$5.4bn) investment.

European offshore wind power giant, Copenhagen Infrastructure Partners (CIP) have supported the project, transmitting electricity through subsea cables into a connection point in the Latrobe Valley for distribution to the Victorian market. CIP also contracted a company to survey Australia's labour market to determine availability of skilled labour and other supply-chain capabilities available to execute the project.

India

In June 2018, India announced an offshore wind target of 5GW by 2022 and 30GW by FY2030. The states of Gujarat and Tamil Nadu, already with 6-9GW of onshore wind capacity, have also been identified by the government and industry as top destinations for the initial deployment of offshore wind capacity.

In February 2018, India's ministry of renewable energy (MNRE) invited an expression of interest for 1GW of offshore wind capacity in the Gulf of Khambhat, located off the coast of Gujarat. The invite garnered immense interest from domestic as well as foreign developers. Prominent participants from India included Sterlite Power Grid, Greenko, Mytrah Energy, Inox Wind, Suzlon Energy, and ReNew Power Ventures. Well-known foreign participants included Ørsted, alfanar, Deep Water Structures, E. ON Climate and Renewables, Terraform Global, Macquarie Group, Shell and Senvion.

The Indian government has committed to subsidise the project via a mechanism of 'viability gap funding' worth US$900m. The funding will be disbursed during the construction phase to help developers in bridging the gap between its required first-of-a-kind price and the tariff of Rs3.5/kwh (US$0.05/kWh) which the Gujarat electricity distribution company will pay for drawing the power.

In July 2018 the National Institute of Wind Energy (NIWE), an autonomous institution under the MNRE, installed a LIDAR to assess offshore wind resources off the Gulf of Khambhat.

Offshore Wind to Displace Imported Thermal Coal

Over the coming decade, IEEFA expects offshore wind technology to get closer to matching the viability of its onshore counterpart due to its near-limitless size potential, 50-60% capacity utilisation rates, the proximity to coastal city load centres, and subsea grid technology improvements.

In IEEFA's opinion, the emerging economies of South Asia and Southeast Asia such as India, Vietnam and the Philippines should let the advanced economies of Europe and Asia take the lead in the offshore wind learning curve and supply chain establishment. In time, costs will continue to decline, and tariffs will become competitive in their domestic markets, fortuitous for a more aggressive scaling up of activity in Asia.

Recent offshore wind transactions in Taiwan exhibited the magnitude of international capital available to be deployed in Asia's relatively advanced economies. International investors see some of these early projects as a 'learning by doing' opportunity. The much higher tariffs compared to the European and U.S. market reflect the first movers' higher risk premium.

China is playing a huge role in driving offshore wind costs down, enabling an investment opportunity of US$150-200bn in Southeast Asia.

Europe, and lately the U.S. market, have gathered critical mass with long-term experience which is further supported by competitive auctions driving tariffs down. IEEFA expects a similar story to unfold in the coming decade with China playing a huge role in driving costs down, enabling an offshore wind investment opportunity of US$150-200bn in Asia itself.

Most offshore wind tenders to date have had domestic content requirements. This means the development of offshore wind could also support the development of related manufacturing industries while creating job opportunities.

Countries across greater Asia cumulatively have a target of 100GW of offshore wind by 2030. Conservatively assuming this is achieved by 2035, this creates an opportunity to replace 300-350 million tonnes (Mt) of polluting thermal coal annually—which is 35% of the current global seaborne trade. Or, it could facilitate the progressive phase-out of much of the region's aging nuclear capacity.

Offshore wind could facilitate the progressive phase-out of much of the region's aging nuclear capacity.

The governments which are aiming to replace expensive and risky nuclear and imported coal-fired power in the medium to long-term require a favourable energy policy environment focussed on improving domestic sourced energy security and a progressive decarbonisation.

Offshore wind is the new game-changer in the renewable energy transition occurring globally. Governments need to keep up with the pace of development and investment by domestic and international players as emerging countries strive to meet their necessary and ambitious renewable energy targets.

About IEEFA

The Institute for Energy Economics and Financial Analysis conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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