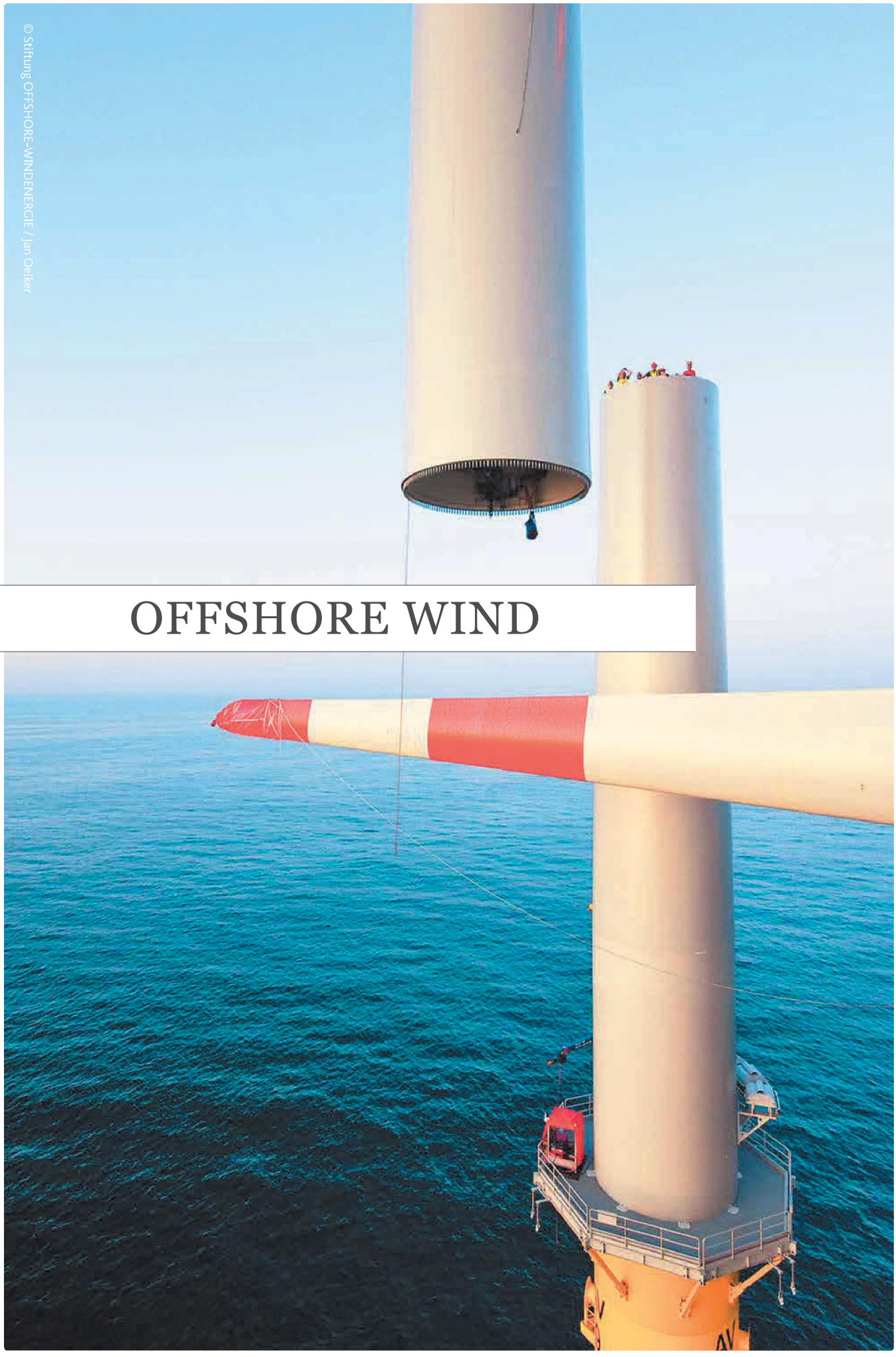


OFFSHORE WIND

A total of 2,219 MW of new offshore wind power was installed across seven markets globally in 2016, and although numbers were down 31% from last year's record, the future looks promising. Overall, there is now 14,384 MW of installed offshore wind power capacity in 14 markets around the world.

At the end of 2016, nearly 88% (12,631 MW) of all offshore wind installations were located in waters off the coast of ten European countries. The remaining 12% is located largely in China, followed by Japan, South Korea and the United States.

The UK is the world's largest offshore wind market and accounts for just under 36% of installed capacity, followed by Germany in the second spot with 29%. China passed Denmark in 2016 to achieve 3rd place in the global offshore rankings with 11%. Denmark now accounts for 8.8%, the Netherlands 7.8%, Belgium 5% and Sweden 1.4%. Other markets including Finland, Ireland, Spain, Japan, South Korea, the USA and Norway make up the balance of the market.

The spread of the offshore industry beyond its northern European home to North America, East Asia, India and elsewhere has begun. The first US offshore wind farm came on line last year, there is a renewed push in China, and an ambitious programme in Taiwan; we can hope to see global growth start to take off in earnest in the next few years, although Europe will continue to dominate for the foreseeable future.

However, the big story in 2016 was the dramatic reduction in offshore wind prices. It started with the Dutch tender for Borssele 1 & 2 in June coming in at EUR 72/MWh, well below expectations; followed by a Danish nearshore tender in September at EUR 64/MWh. This was followed in November with the winning bid for the Danish Krieger's Flak project coming in at an astonishing EUR 49.90/MWh; and then Borssele 3 & 4 in the Netherlands coming in at EUR 54.50/MWh in December. We now have the strange situation where at least at the moment, in some circumstances, *offshore is cheaper than onshore!*

The reasons are many: the maturing of the industry, the improvement and maturation of the technology and management thereof, growing investor confidence, and the introduction and deployment of a new generation of 6-8 MW (and now 9 MW with the up-rating of the Vestas V-164) machines, with enormous swept area and tremendous output.

Summary of work carried out at European offshore wind farms during 2016

Wind farm name	Country	Status
Gode Wind I	Germany	Fully grid-connected
Gode Wind II	Germany	Fully grid-connected
Gemini	Netherlands	Fully grid-connected
Westermeerwind	Netherlands	Fully grid-connected
Sandbank	Germany	Partially grid-connected
Burbo Bank Extension	United Kingdom	Partially grid-connected
Nobelwind	Belgium	Turbines installed
Nordergründe	Germany	Turbines installed
Nordsee One	Germany	Foundations installed
Veja Mate	Germany	Foundations installed
Wikinger	Germany	Foundations installed
Dudgeon East	United Kingdom	Foundations installed
Galloper	United Kingdom	Foundations installed
Race Bank	United Kingdom	Foundations installed
Rampion	United Kingdom	Foundations installed
Hooksiel	Germany	Decommissioned
Lely	Netherlands	Decommissioned
WindFloat phase 1	Portugal	Decommissioned

Source: WindEurope

EUROPEAN OFFSHORE WIND INVESTMENT UP 40% IN 2016

The European offshore wind industry added 1,558 MW of new capacity - 338 turbines in six wind farms in 2016, representing a decrease of 48% compared to 2015. However, eleven projects accounting for 4,948 MW reached Final Investment Decision (FID) and are expected to become operational by 2018 or 2019 depending on the project. Europe invested a total of EUR 18.2bn (USD 19.6 bn) in offshore wind in 2016, up 39% from 2015.

Overall, there are now 12,631 MW of installed offshore wind power capacity in the waters of the EU. Including sites with partial grid-connected turbines, there are now 81 offshore wind farms in ten European countries.

The UK has the largest offshore wind capacity in Europe, with 5,156 MW, followed by Germany (4,108 MW) and Denmark (1,271 MW). The Netherlands took over fourth place in 2016 with 1,118 MW, with Belgium fifth (712 MW). Combined, the top five EU countries represent 97% of all grid-connected offshore wind installations in Europe.

Installations in the North Sea account for 72% of all offshore wind capacity in Europe, a slight increase from the previous year. The Irish Sea has 16.4% of installed capacity, followed by the Baltic Sea with 11.5%.

Siemens Wind Power is the leading offshore wind turbine supplier in Europe with 67.8% of total installed capacity. MHI Vestas Offshore Wind (16.4%) is second, followed by Senvion (6.2%), Adwen (5.2%) and BARD (3.2%).

In terms of ownership, Northland Power connected the most MW in 2016, representing 23% of ownership, followed by DONG Energy with 20.4%. Global Infrastructure Partners (10.5%), Siemens (7.7%) and Vattenfall (7.6%) complete the top five owners in new additional capacity, accounting for 69.2% of the 2016 market.

The average installed offshore wind turbine size was 4.8 MW, a 15% increase over 2015, and the first 8 MW turbines were grid-connected in 2016. The average size of a grid-connected offshore wind farm in 2016 was 380 MW, 12% larger than the previous year. The average water depth of offshore wind farms where work was carried out in 2016 was 29.2 m, slightly more than in 2015 (27.2 m). The average distance to shore for those projects was 43.5 km, a small increase on the previous year (43.3 km).

Looking ahead, a strong pipeline of projects ensures over 3 GW of installed capacity in 2017. Projects expected to go through FID in 2017 are estimated at a combined capacity of 2.8 GW. These include Borssele I & 2 (700 MW) and Borssele 3 & 4 (700 MW), Global Tech II (553 MW), Kriegers Flak (600 MW), and the financial close of Deutsche Bucht (252 MW). The refinancing of Butendiek (288 MW) and the minority stake in London Array (630 MW) are also scheduled for financial close in 2017. Financing needs could top EUR 7bn based on disclosed transaction costs.

Number of wind farms with grid-connected turbines, no. of turbines connected and no. of MW grid-connected at the end of 2016 per country

Country	Belgium	Germany	Denmark	Spain	Finland	Ireland	Netherlands	Norway	Sweden	UK	Total
No. of farms	6	18	13	1	2	1	6	1	5	28	81
No. of turbines connected	182	947	517	1	11	7	365	1	86	1,472	3,589
Capacity Installed (MW)	712	4,108	1,271	5	32	25	1,118	2	202	5,156	12,631

Source: WindEurope

A slight decrease is expected for annual installations between 2018 and 2020. Nevertheless, European offshore wind is on track to reach at least 24 GW of cumulative installed capacity by 2020.

UK continues global leadership

The UK remains the world leader in terms of cumulative offshore wind installations with 27 wind farms and a total capacity of over 5.1 GW. The largest wind farm is the London Array (630 MW), followed by the largest Welsh wind farm Gwynt-y-Mor (576 MW) and Greater Gabbard (504 MW). While no new offshore wind farms came into full operation in 2016, three windfarms gained consent (Triton Knoll, Hornsea P1 and Blyth).

The new Government elected in 2016 seems supportive of offshore wind, and a second contract for difference allocation round has been announced with results expected in summer 2017. The UK has confirmed its next carbon budget and remains committed to the *Climate Change Act,* placing the focus more on low carbon than renewables specifically, but there is an indication that offshore wind will play a major role in this.

The Offshore Renewable Catapult[1] delivered the third annual *Cost Reduction Monitoring Framework* in January. It showed that industry has met the target of £100/MWh by 2020 four years early in 2016, with offshore wind energy prices falling by 32% since 2012.

Scottish offshore wind projects are being challenged under judicial review. Closure of the renewables obligation is rapidly approaching in 2017, and beyond this allocation round there is a lack of clarity on future allocation rounds and long term visibility. Offshore wind investors are also watching the outcome of negotiations to leave the European Union.

The pipeline of projects is strong with about 12 GW of consented offshore wind farms. The current government sees offshore wind as a key sector for decarbonisation. With an industrial strategy and clean growth plan scheduled for this year offshore wind is likely to take a key role.

Stable growth until 2019 in Germany

In 2016, the German offshore wind industry installed 156 new offshore wind turbines with a total capacity of 818 MW. Overall, 947 offshore wind turbines are grid connected with a total capacity of 4,108 MW, enough to produce 13 TWh of electricity and to power 3 million homes in Germany. This represents an increase of nearly 57% compared to the 8.3 TWh generated in 2015, consolidating offshore wind power's position in the German power mix. The offshore wind expansion is expected to continue with about 1,400 MW in 2017 followed by a steady average of around 1,000 MW per year until 2019.

However, after 2020 the federal government has reduced the target for offshore wind to 500 MW per year. This places a strain on the value chain for the offshore wind industry and overshadows some positive changes brought by the revised *EEG 2017*, such as an extension of the permissible service life of turbines beyond the EEG funding period of 25 years.

A reliable political framework and sufficient expansion volumes are needed for the offshore industry to be able to achieve further cost reductions. This includes swifter grid reinforcement both off and onshore.

The Offshore Wind Act was also adopted as part of the EEG 2017 and includes the introduction of auctioning for offshore wind. The aim of this act is to ensure dovetailing between site planning, regional planning, approval of installations, funding and grid connection. The target for offshore wind has been set at 15 GW by 2030.

Denmark plans to double offshore capacity by 2021

While no new offshore wind was installed in 2016, the Danish offshore wind industry has grand plans for the sector in the near future. At present, Denmark has a total installed offshore capacity of 1,271 MW from 947 grid-connected turbines.

The Danish ambition to cover 50% the country's electricity consumption by wind by 2020 entails an offshore wind target of 1,500 MW. This includes the two tenders which were carried out in 2016 for the 600 MW Krieger's Flak offshore wind farm located in the Baltic Sea and the near shore tenders of 350 MW, which are split up into Vesterhav Syd and Vesterhav Nord, located in the North Sea. Additionally, the installation of the 400 MW Horns Rev 3 also located in the North Sea, will begin in 2017. Overall, Denmark is planning to install nearly 1,400 MW of offshore wind by 2021, more than doubling its current capacity.

The impressive news in 2016 in Denmark was the dramatic reduction of offshore wind prices: the winning bid for the Danish Near Shore tender came in at DKK 475/EUR 64/USD 69 MWh, followed by the world's record low offshore price for the Krieger's Flak project at DKK 372 /EUR 49.90/USD 53 MWh.

In 2017, the world's first offshore wind farm, Vindeby (5 MW) will be decommissioned. The Vindeby wind farm played a crucial role in proving the case for offshore wind after it was installed in 1991.

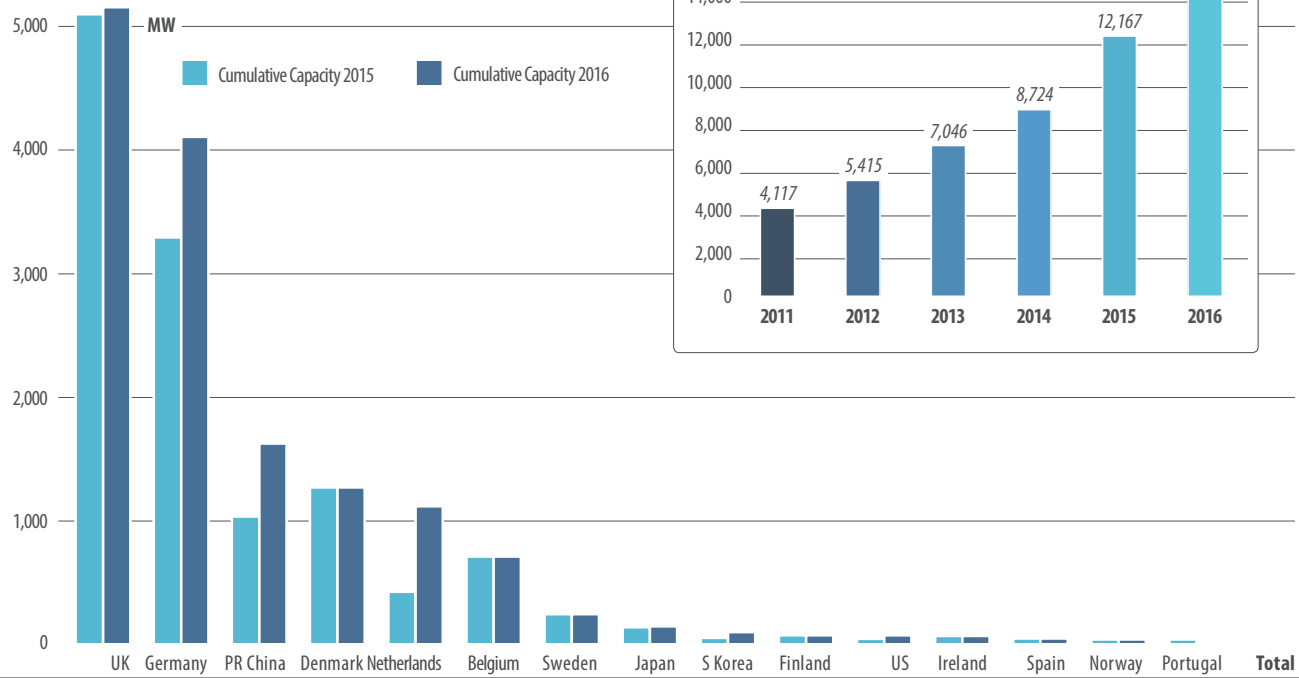
Offshore wind development in Denmark is expected to continue running smoothly with the target to install nearly 1,400 MW by 2021.

Netherlands scores record in 2016

The offshore wind industry in the Netherlands had a record year in 2016. A total of 177 offshore wind turbines with a capacity of 691 MW came online making the Netherlands the 2nd largest market in 2016.

1 https://ore.catapult.org.uk/

GLOBAL CUMULATIVE OFFSHORE WIND CAPACITY IN 2016



ANNUAL CUMULATIVE CAPACITY (2011-2016)

	UK	Germany	PR China	Denmark	Netherlands	Belgium	Sweden	Japan	S Korea	Finland	US	Ireland	Spain	Norway	Portugal	Total
Total 2015	5,100	3,295	1,035	1,271	427	712	202	53	5	32	0.02	25	5	2	2	**12,167**
New 2016	56	813	592	0	691	0	0	7	30	0	30	0	0	0	-2	**2,219**
Total 2016	5,156	4,108	1,627	1,271	1,118	712	202	60	35	32	30	25	5	2	0	**14,384**

Source: GWEC

In cumulative terms, there are 1,118 MW of offshore wind power installed in Dutch waters, the fifth largest market globally, consisting of three relatively small wind farms in the North Sea and the 600 MW Gemini project, located north of the Wadden Islands. The Dutch wind industry expects to reach a total of 4,500 MW of offshore wind power by 2023.

A key challenge for the sector is to ensure the smooth implementation of the planned tenders for offshore wind energy. The first two tenders were successfully held in 2016, encompassing a total of 1,400 MW in the Borssele area off the coast of Zeeland in the southwest.

The industry is well on the way to achieve the objective to reduce costs by 40% over the next five years. Already the first tender was well below the price cap with a winning bid by Dong at EUR 72.7/MWh (USD 76.9/MWh), excluding grid costs. The second tender was awarded to a consortium made up of Shell, Van Oord, Eneco and Diamond Generating Europe Limited at a new record low cost of EUR 54.5/MWh (USD 57.6/MWh), excluding grid costs. The Dutch North Sea has a huge potential to further develop large scale wind after the 2023 targets have been achieved, beginning with the already designated area of *IJmuiden-Ver* which could accommodate 6,000 MW of offshore wind power, after it's been cleared of its current spatial claims.

The government's *Energy Agenda*, published at the end of 2016, includes a solid plan for offshore wind development showing an upscaling of the current 700 MW/year to 1 GW per year. The first tender of this new round will be carried out right after the last tender of the current scheme, ensuring a smooth continuation of the roll-out of offshore wind energy in the Netherlands providing clear visibility for project developers and investors.

CHINA PASSES DENMARK TAKING 3rd PLACE

In 2016, 592.2 MW of new offshore capacity was added in China, up 64% from 2015, bringing the total to 1,627 MW. Shanghai Electric led installations with 82.5% of total installed capacity, followed by Envision (8.5%), Goldwind (8.1%) and CSIC (0.8%).

New offshore wind installations in 2016

Manufacture	Turbine Size (kW)	Units Installed	Total Capacity (MW)
Shanghai Electric	3,600	28	100.8
	4,000	97	388
Envision	4,200	12	50.4
Goldwind	3,000	16	48
CSIC	5,000	1	5
Total		**154**	**592.2**

Limited potential for new onshore wind development in the Northern and Western regions of China helps push developers to move offshore, while the technology has steadily improved in the past few years, with some of the domestic manufacturers now developing bigger turbines to harness the wind offshore.

Additionally, all new installations in 2016 were near shore projects, not the inter-tidal projects that have previously dominated offshore development in China. This is a significant development showing the industry's readiness for take-off. The

Offshore wind power in Japan at the end of 2016

Type	Location	Distance (km)	Depth (m)	Rated (MW)	No. of WTG	Total (MW)	Start operation	
Fixed	Hokkaido	Setana Port	0.7	13	0.6	2	1.2	Dec.2003
	Akita	Akita Port	0.1	-	3.0	1	3.0	Feb.2015
	Yamagata	Sakata port	0.05	4	2.0	5	10.0	Jan.2004
	Ibaraki	Kamisu	0.04	4	2.0	7	14.0	Feb.2010
		Kamisu	~0.05	4	2.0	8	16.0	Feb.2013
	Chiba	Choshi*	3.1	12	2.4	1	2.4	Mar.2013
	Fukuoka	KitaKyushu*	1.4	14	2.0	1	2.0	Jun.2013
Floating	Nagasaki	Fukuejima	5.0	100	2.0	1	2.0	Apr.2016
	Fukushima	Iwaki city	20	120	2.0	1	2.0	Dec.2013
		Naraha			7.0	1	(+5.0)	Mar.2016
					5.0	(1)		2017
Total						**28**	**59.6**	

** projects under commissioning/construction*

Offshore wind projects in the pipeline in Japan

Type	Location	Area	WTG (MW)	No.of WTGs	Total (MW)	Start Operation	EIA Status	
Fixed	Hokkaido	Wakkanai port	Port			10		Pre EIA
		Ishikari new port	Port	4.0MW	26	104	2020	Draft EIA
	Aomori	Mutsuogawara port	Port	2.0MW	40	80	2018~	Draft EIA
	Akita	Noshiro port	Port	3.3-6.0	20	100	2021	Scoping
		Akita port	Port	3.3-6.0	14	70	2022	Scoping
		Akita North	Gen.	3.3-5.0	120	455	2023	Scoping
		Yurihonjo	Gen.			560		Pre EIA
	Yamagata	Sakata port	Port			15		Pre EIA
	Ibaraki	Kashima port1,1st	Port	5.0MW	20	100		No EIA needed as project started before 2012
		Kashima port1,2nd	Port	5.0MW	5	25		No EIA needed
		Kashima port2	Port	5.0MW	25	125		No EIA needed
	Fukuoka	Kitakyushu port	Port			228.8		Pre EIA
		Kitakyushu	Gen.			300**		Pre EIA
	Niigata	Iwafune, Murakami	Gen.	5.0MW	44	220	2025	Pre EIA
	Yamaguchi	Yasuoka, Shimonoseki	Gen.	4.0MW	15	60		Draft EIA
Floating	Fukushima	Iwaki city Naraha*	Gen.	5.0MW	1	5	2017	No EIA needed as total project size smaller than 10MW
	Fukuoka	Kitakyushu*	Gen.		2	7.5	2018	No EIA needed
	Nagasaki	Fukuejima	Gen.	2.0-5.0	10	21		Consulting
Test Field	Niigata	Awashima	Gen.					No EIA needed
	Nagasaki	Kabashima	Gen.					No EIA needed
Total						**2,486.3**		

**National projects **Estimated by JWPA*

13th Five-Year Plan sets a feed-in tariff of RMB 0.85/EUR 0.11/ USD 0.12 kWh for offshore/nearshore and RMB 0.75/EUR 0.10/ USD 0.11 kWh for intertidal projects, which are expected to provide the major driving force for the sector for the next five years.

Ten manufacturers dominate the Chinese offshore market, with the leading four - Shanghai Electric, Envision, Sinovel and Goldwind - taking 90% of the market share. Shanghai Electric, which started its offshore business as a joint-venture with Siemens that came to an end in 2015, leads with 58% of the total share.

On the legislative side, China's National Energy Administration (NEA) issued a new regulation *Offshore Wind Construction and Management Rules* to replace the *Interim Rules on Offshore Wind Construction and Management,* which was issued in 2010. This new rule is a big step forward, clarifying and simplifying issues such as the project approval process, offshore planning and environmental protection. Moreover, provincial governments have been given more autonomy, and are now the key government bodies for project approval.

The 13th Five-Year Plan sets a target of 5 GW by 2020 for the Chinese offshore wind industry.

JAPAN HAS A STRONG PROJECT PIPELINE

By the end of 2016, Japan had 59.6 MW of offshore wind power, with a total of 28 turbines in Japanese waters, including three (two 2 MW and one 7 MW) floating wind turbines. The 7 MW MHI floating turbine was installed as a part of the Fukushima FORWARD project. A further 5 MW Hitachi floating turbine is under commissioning and due to start operation in March 2017.

In 2016, a 2 MW floating turbine situated about 1km off the coast of the Goto islands in Kabashima was moved 10km southwest next to the neighbouring, larger island of Fukuejima and re-connected to the grid starting operation in April 2017. This is the first and only offshore wind project which could enjoy Japan's feed-in tariff for offshore wind at JPY 36/ EUR 0.30/USD 0.32 kWh.

A further 2,486 MW of offshore wind power projects are currently under various stages of development. The 60 MW Yasuoka project is likely to start construction in 2018, and several other projects are expected to start construction within the next couple of years.

Japanese construction company Penta Ocean Company has announced that they will build their own jack-up ship in 2016.

Marine areas in Japan are categorised either as a *Port associated area or as a General common sea area.* The Japanese Ministry of Land, Infrastructure, Transport and Tourism (MILT) amended the *Port and Harbor Law* in May 2016, to promote offshore wind power development in port associated areas. The amended law allows the use of the designated water zone in the port area for developers for 20 years which reduces project risk. Port areas have good infrastructure facilities for construction and grid connection, and most offshore wind power projects are planned in port areas in Japan today.

The City of Kitakyushu held an offshore wind tender in February 2017 according to this new rule in August 2016, which was won by a local consortium which includes J Power, a subsidiary of Kyushu Electric Power Company.

When it comes to the *General common sea area,* there is no law or regulation for offshore wind power. It is governed by Thomas Hobbes' so-called *the war of all against all,* and therefore, it is a huge business risk to undertake projects in the *General common sea area.* The Japanese Cabinet in charge of ocean policy together with MILT are trying to improve the situation but it will take some time.

Offshore wind power has developed at a slow pace in recent years in Japan, despite the huge resource in the country. According to a new study[2] by the Institute for Energy Economics and Financial Analysis (IEEFA) Japanese offshore wind is hugely underestimated. The study found that Japan's move away from nuclear and fossil fuel power could be helped by 10 GW of offshore wind by 2030.

However, this would require a major lowering of regulatory and grid barriers to renewable energy projects, changes that will allow Japan to tap capital markets to support national renewable energy programmes. At the moment the industry is faced with long lead times for environmental permits and local agreements, slowing down wind development in the country.

The Japan Wind Power Association's roadmap for development calls for 700 MW of offshore capacity by 2020, including 100 MW of floating capacity. By 2030 it envisages 10 GW of offshore capacity in total, including 4 GW of floating capacity.

2 http://ieefa.org/wp-content/uploads/2017/03/Japan-Greater-Energy-Security-Through-Renewables-March-2017.pdf

KOREA OFFSHORE MOVES FORWARD

2016 was a significant year for the South Korean offshore wind industry, which was stalled for a few years, but is now moving forward with the installation of the 30 MW Tamra project. Along with two demonstration turbines (5 MW) installed in 2011, the country's total installed offshore capacity now stands at 35 MW. All projects are located off Jeju Island.

The Tamra project, with 3 MW Doosan turbines located 0.5-1km from the shore, is the first utility scale offshore wind project in South Korea. The Tamra project is part of first phase of the 2.5 GW Southwestern Offshore wind project, developed by a state-owned company, Korean Offshore Wind Power (KOWP). Doosan, and potentially Hyosung, will supply turbines for the first phase of the project. Another 60-80 MW are planned to be installed by 2019.

The second phase with about 400 MW is planned to start operation by 2022. The remaining 2 GW doesn't have a timeline for installation, but is expected to come online before 2030, when experience from the first phase can be applied to accelerate the rest of the work.

Driven by the *Carbon Free Island Jeju by 2030* plan, another +400 MW of offshore wind is expected to come online by 2022, contributing to the 100% clean energy goal of the local government.

TAIWAN IS SET FOR A NEW BOOM

The first two turbines of the 128 MW Formosa 1 project came online in March 2017, a significant step forward for a promising new Asian offshore market. The first two turbines are Siemens 4 MW machines and the remaining 120 MW is scheduled to be installed by 2019.

With the new president's reiteration of the target to source 20% of electricity from renewables by 2025, combined with good offshore wind and seabed conditions, the offshore wind industry is looking at another GW size market in Asia. Offshore wind is the backbone for delivering the government's objective of phasing out nuclear power by 2025. The target for offshore wind is set at 3 GW by 2025, five years earlier than in the previous plan. 36 offshore locations have been identified for future planning.

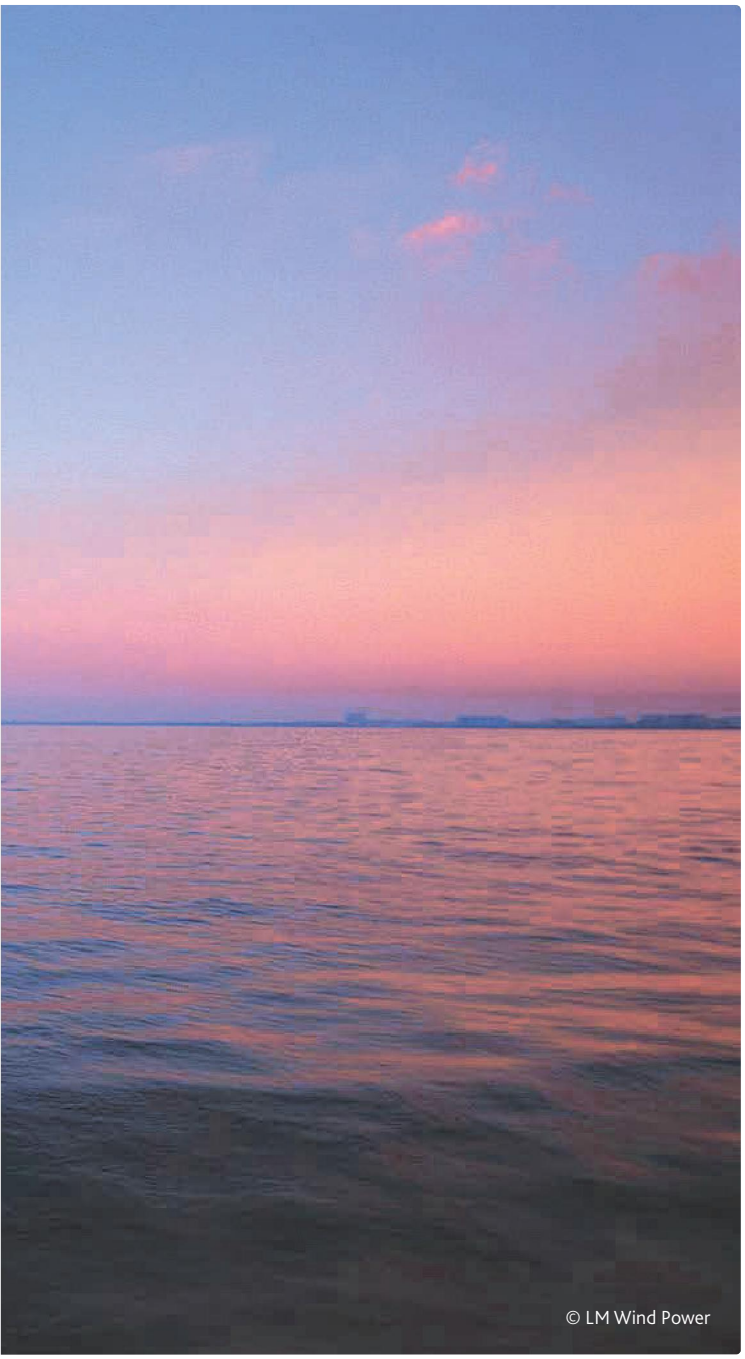
The offshore wind market in Taiwan is easy for international players to enter. Dong Energy is now looking at another 4 projects, totalling 2 GW, located in the Taiwan Strait, while other international players, both developers and manufacturers, see Taiwan as a strategic location for developing their offshore business in Asia.

Developers can choose between two options for a feed-in tariff in Taiwan. The first is set at TWD 5.740 EUR 0.176/ USD 0.189 per kWh for 20 years, and the second option at TWD 7.108/ EUR 0.218/USD 0.235 kWh for the first ten years, and at TWD 3.459/EUR 0.106/USD 0.114 kWh for the following ten years. Further incentives are provided for demonstration projects, such as government-supplied wind masts, Environmental Impact Assessments (EIA) and interest-free loans.

US OFFSHORE WIND ENERGY AT LAST A REALITY

American offshore wind energy is at last a reality, bringing an energy source familiar in Europe to the US for the first time. The US commissioned its first offshore wind project in December 2016, the 30 MW, five turbine Block Island project off the coast of Rhode Island. Additional projects are proposed in both state and federal waters off the Atlantic and Pacific coasts, as well as in the Great Lakes.

In March 2017, Statoil and the US Bureau of Ocean Energy Management (BOEM) formally executed the lease of 321sq km offshore New York, paving the way for the Norwegian giant to explore the potential development of an offshore wind farm. The lease comprises an area that could potentially accommodate more than 1 GW of offshore wind, with a phased development


© LM Wind Power

expected to start with 400-600 MW. The New York Wind Energy Area is located 30-60km offshore, spans 321sq km, and covers water depths between 20-40 meters.

The wind farm would provide New York with a significant, long-term source of clean and renewable electricity.

In addition to the recent offshore wind developments in Massachusetts, Rhode Island and New York, the latest news comes out of North Carolina: Avangrid Renewables has won a Department of Interior auction to develop a project off the state's coast. North Carolina's first land-based wind farm recently became operational, and now offshore wind is on its way. Situated near Kitty Hawk, the site of the Wright Brothers' first flight, the ocean parcel could soon power thousands if not millions of American homes. Millions of dollars in private investment drawn to this new ocean energy resource will help boost North Carolina's economy, creating new demand for skilled jobs, factories and US flagged vessels.

In all, 13 offshore wind projects on both coasts and in the Great Lakes remain under various stages of development. The US Department of Energy's roadmap for wind power, *Wind Vision*[3] envisages offshore wind providing 2% of US electricity demand in 2030 and 7% in 2050.

UPCOMING MARKETS

India takes steps forward

The Indian Ministry of New and Renewable Energy announced *India's Offshore Wind Policy* in 2015. India's National Institute for Wind Energy (NIWE) was designated as the nodal agency for implementing the policy and creating the necessary ecosystem for the sector.

The first comprehensive assessment of offshore wind potential in two key coastal states is being undertaken by the FOWIND project[4], a GWEC led consortium. This is a four-year European Union co-financed project. NIWE is the knowledge partner to FOWIND.

FOWIND is undertaking the first offshore wind resource measurement in the Gulf of Khambhat, off the coast of Gujarat. India's first offshore wind research platform is being installed under this project. FOWIND, the Indian Ministry of New and Renewable Energy (MNRE), and the National Institute of Wind Energy (NIWE) have developed the platform jointly. The National Institute of Ocean Technology (NIOT) provided technical support during the platform design phase. FOWIND will install India's first offshore LiDAR in 2017.

Also, NIWE is in the process of finalising the first geo-physical surveys along the Gujarat coast. Another offshore platform is in the works for the Tamil Nadu coast.

The Offshore Wind Policy outlines an international competitive bidding mechanism for the sector. The first tender is likely to be announced in 2019.

Vietnam's abundant offshore wind resources

Vietnam's first near-shore/intertidal wind project, the 99.2 MW Bac Lieu wind farm, is Asia's first offshore wind farm in the Mekong Delta region, and came online in stages from 2013-2015. Another nearshore wind project, the 800 MW Phu Cuong wind farm, also located in Mekong Delta, is now gearing up. The first phase, the Phu Cuong 1 Wind Farm (170 MW), is expected to reach financial close in 2018.

In 2016, new projects, both onshore and offshore, were being developed in Soc Trang Province, which is emerging as the next hot spot for wind development in Vietnam.

Despite slow progress to date, the Vietnamese wind market has started attracting world leading turbine manufacturers and investors. Vietnam may become the next gigawatt sized wind market in Asia, once the regulatory and financial conditions are corrected, which may come during the course of 2017.

With input from AWEA, BWE, CWEA, DWIA, JWPA/JWEA, KWEIA, NWEA, RenewableUK, VDMA, WindEurope

3 https://energy.gov/eere/wind/maps/wind-vision
4 Facilitating Offshore Wind in India (FOWIND). For more info visit www.fowind.in