Global Offshore Wind Market Overview

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The global renewable power outlook is positive

Renewable energy will account for ~50% of installed capacity by 2030

Investment in renewable energy capacity has outstripped investment in fossil fuel capacity over last

5 years[1]

~$US4 trillion

to be invested in renewable power generation by 2030[2]

85% of renewable infrastructure investment will be wind and solar[2]

Renewable energy will account for

~50%

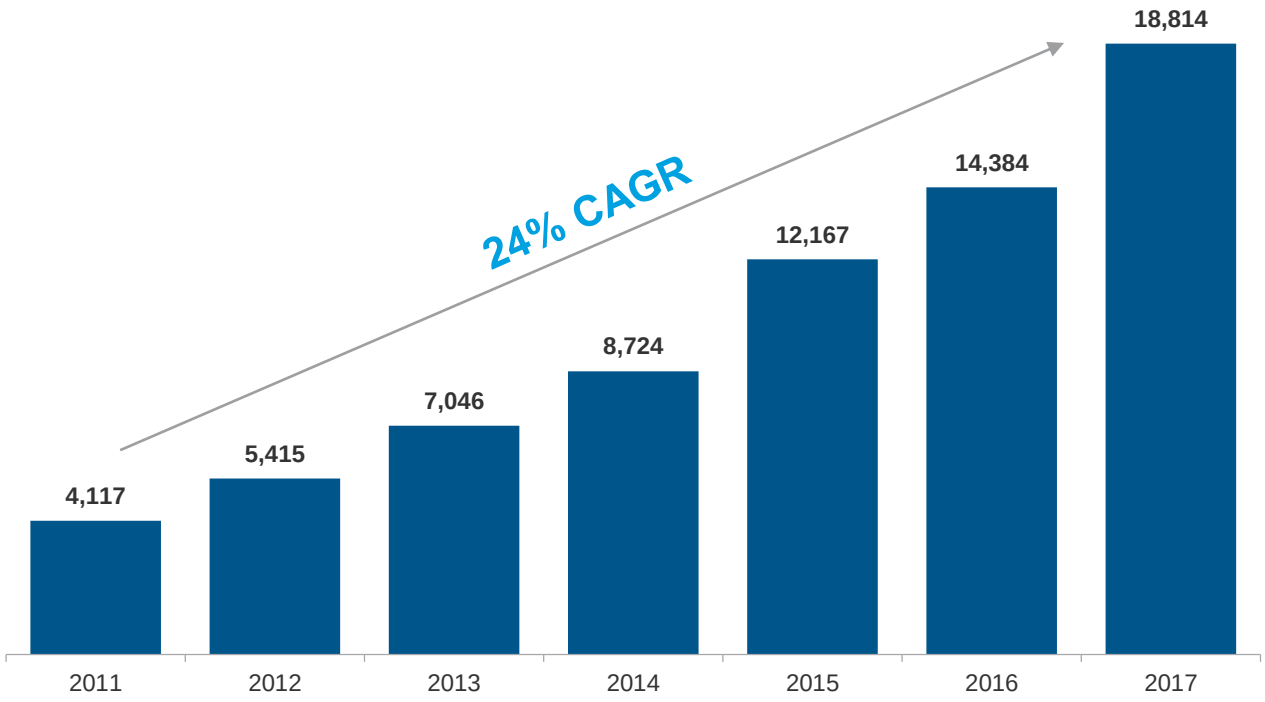
of installed capacity by 2030[1]

1. UN Environment and Bloomberg New Energy Finance, Global Trends in Renewable Energy Investment, 2017 2. Bloomberg New Energy Finance London Summit 2017, Breaking Clean, 2017

Offshore wind is the fastest growing asset class

Even though offshore wind only represents ~2% of installed renewable capacity, it's been growing at 24% CAGR since 2011

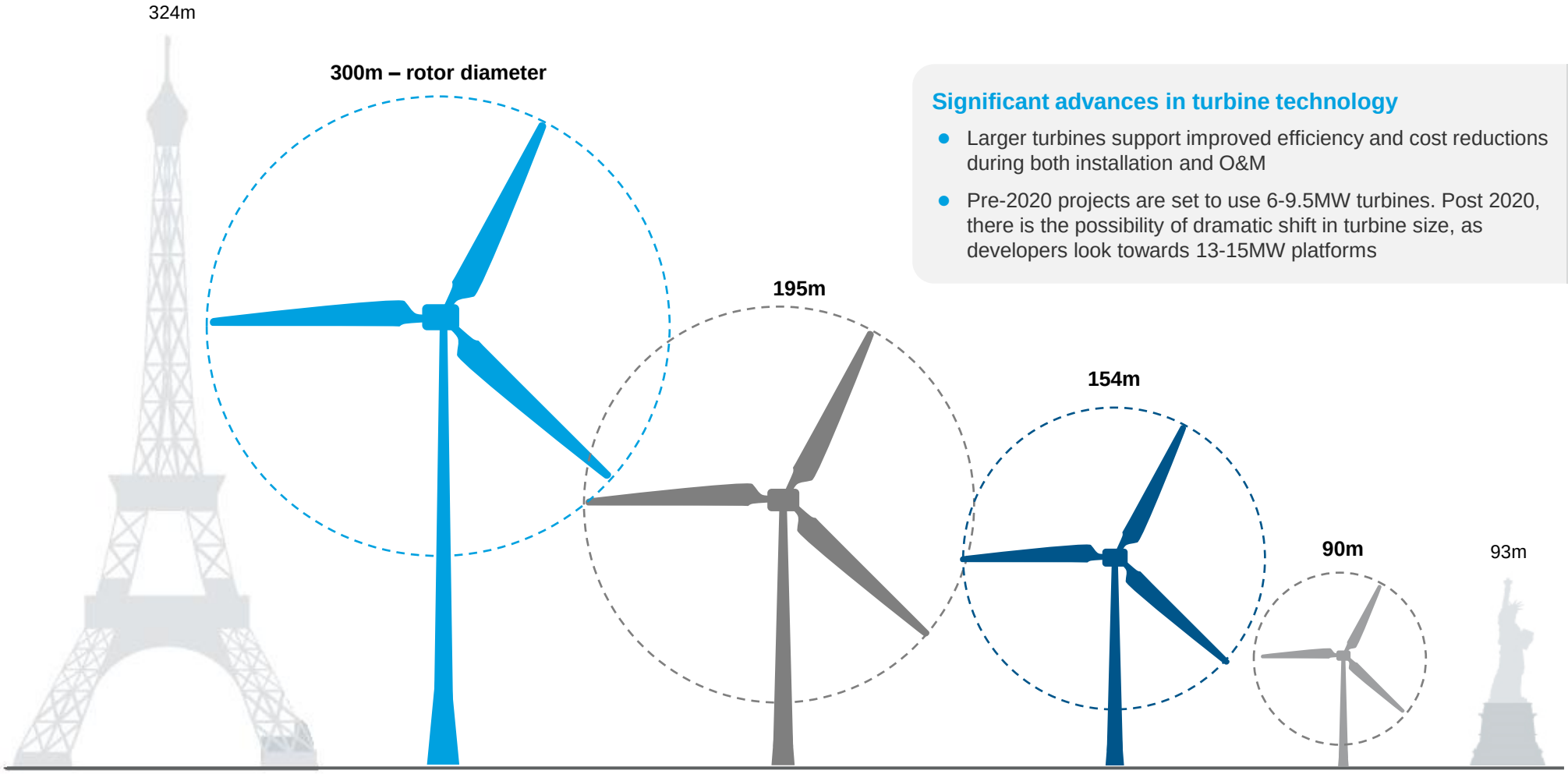
Global cumulative offshore wind capacity (2011 – 2017)



- A historic record of new offshore wind power was installed across nine markets globally in 2017
- At the end of 2017, nearly 84% of all offshore installations were located in the waters off the coast of eleven European countries. The remaining 16% is located largely in China, followed by Vietnam, Japan, South Korea, the US and Taiwan

Source: Global Wind Energy Council

Technology is evolving…



15MW Turbine

Post-2020
In development from MHI Vestas, Siemens

MHI Vestas

8-9.5MW turbines
Installed in Europe - 2016

Siemens

6MW turbines – Installed in Europe 2014-2016 (upgraded to 7MW & 8MW models)

Earlier Models

2-4 MW turbines, Vestas V90, V80, and earlier models

Significant advances in turbine technology

- Larger turbines support improved efficiency and cost reductions during both installation and O&M
- Pre-2020 projects are set to use 6-9.5MW turbines. Post 2020, there is the possibility of dramatic shift in turbine size, as developers look towards 13-15MW platforms

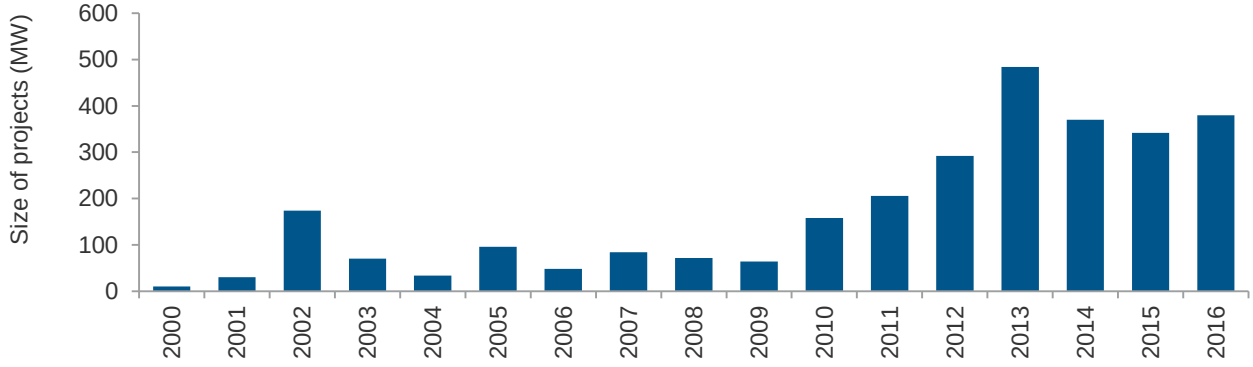
…and capacity and project sizes increasing

Turbine capacity and project size are trending upwards, reflecting market maturity and benefits of scale

Average offshore wind turbine rated capacity

- Continuous development in the sector, with turbine capacity increasing
- Average turbine size in 2016 was 4.8MW, compared to 3.6MW in 2010,
- Gradual introduction of larger turbines (6-9.5MW) is currently taking shape, with expectations of over 10MW turbines in frequent use post 2020

Average size of offshore wind farm projects



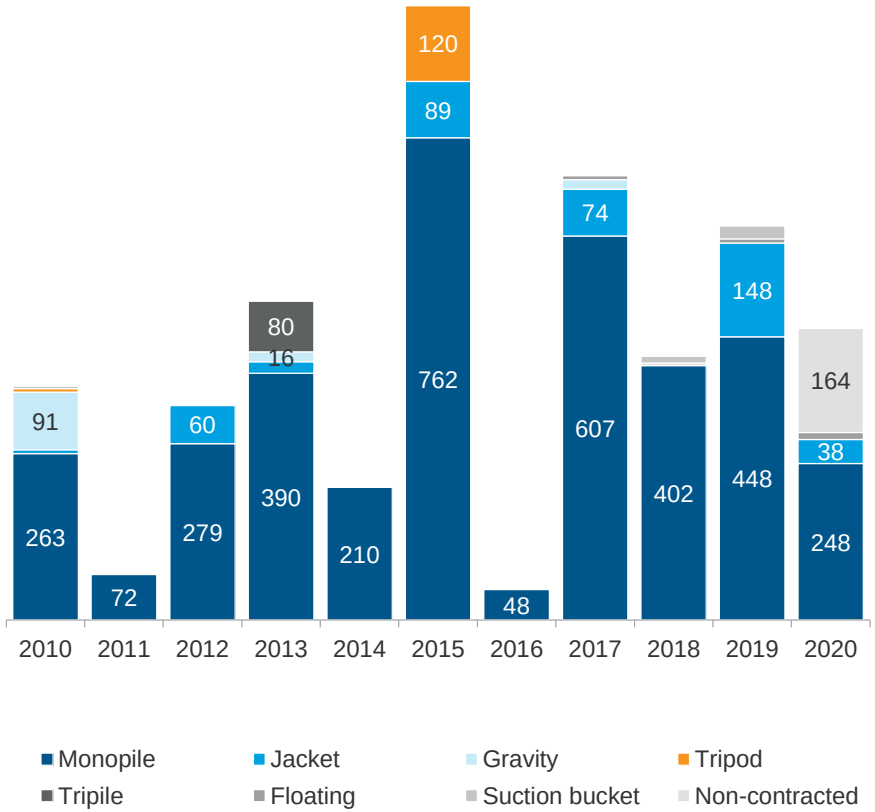
- Average scale of wind farm has been increasing at a significant rate to allow generators to capture cost savings
- Capacity has grown rapidly on a per project basis, with average capacity increasing from 158MW in 2010 to 380MW in 2016
- Rapid growth of offshore wind developments in China will further increase average project size in the near term

Source: WindEurope, Bloomberg New Energy Finance, Global Wind Energy Council

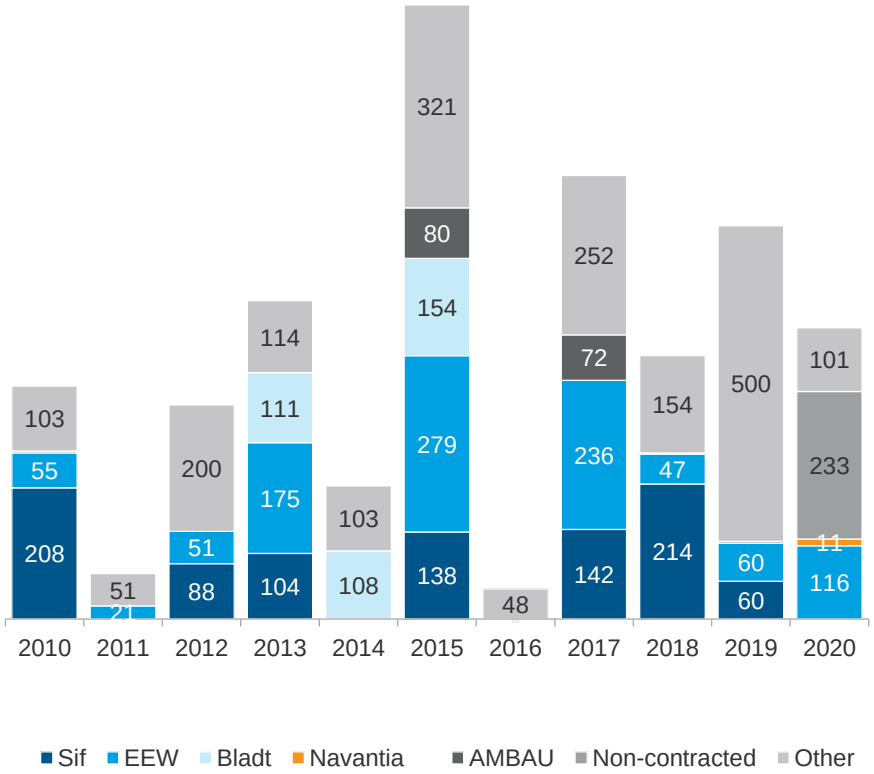
Foundation installation is developing…

Monopile foundations will continue to dominate the market, but there is a growing adoption of new fixed and non-fixed technologies as projects move into deeper waters

By foundation type (European offshore, # of units)



By foundation company (European offshore, # of units)

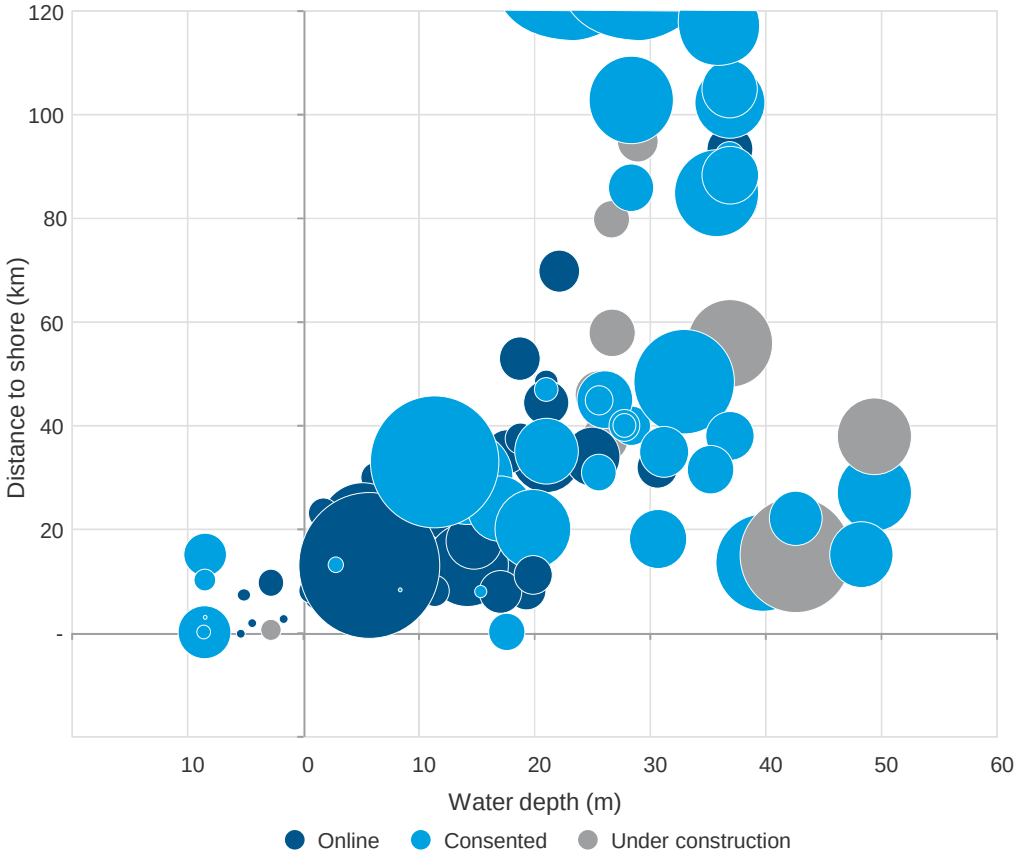


Bloomberg New Energy Finance, 1H 2017 Offshore Wind Market Outlook

…and project locations more flexible

With projects becoming larger, construction is taking place in deeper waters and further from shore to leverage more favourable wind conditions

Average water depth and distance to shore



- Longer distances to shore is driven by the need to capture strong wind resources, and is enabled by improved understanding of key marine construction and operating risks
- This trend is expected to continue with evolution in foundation technologies and the rise of 'non-fixed bottoms' (floating and gravity-based foundations)
- In 2016, installed projects have average water depth of 29.1m and were on average 44.0km from shore, in comparison to 2010 figures of 17.4m and 27.1km, respectively

Summary of growth trends

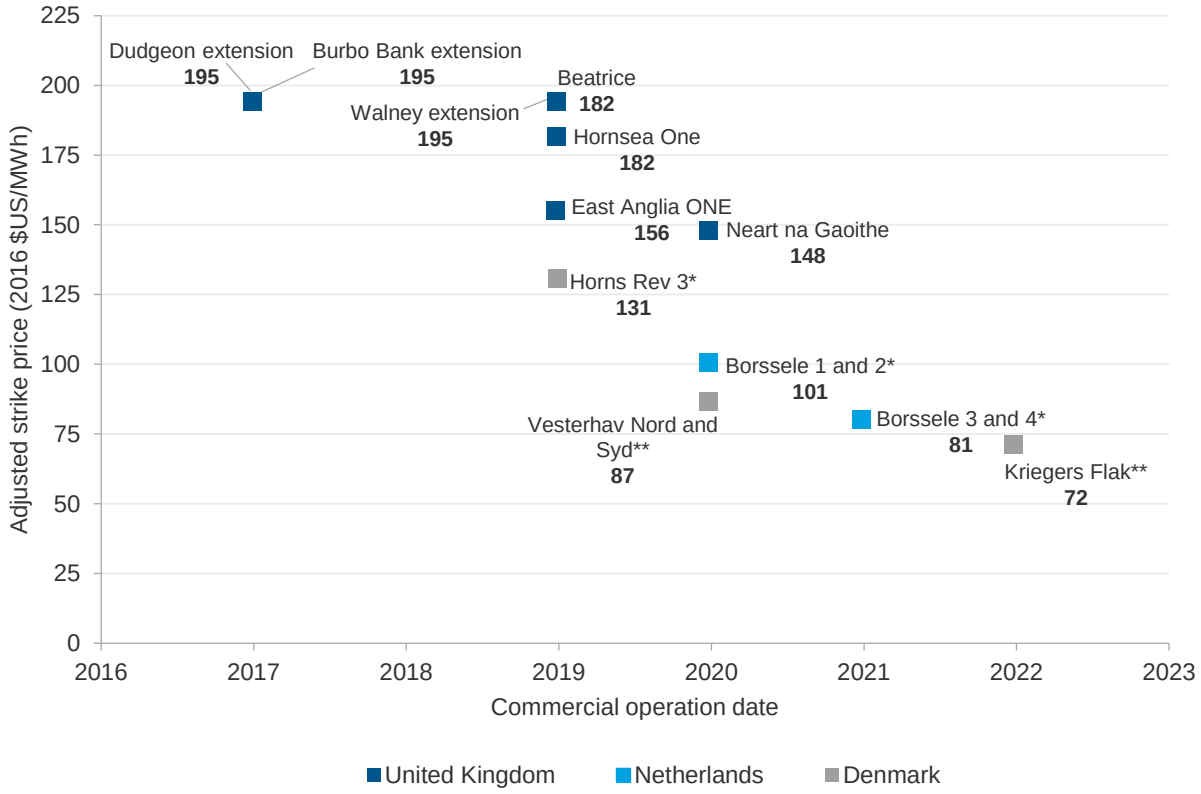
- Strong development experienced over the last 6 years highlights the fast maturation of the technology and the industry

	2010	2016	CAGR
Average water depth	17.4m	29.1m	9.0%
Distance to shore	27.1km	44.0km	8.4%
Average rated capacity of turbine	3.0MW	4.8MW	8.2%
Average project size	158MW	380MW	15.8%

Source: WindEurope, Bloomberg New Energy Finance, Global Wind Energy Council

Costs are reducing…

The Levelised Cost of Energy ("LCoE") has dropped dramatically in the last three years across Europe, and the trend is expected to be replicated in new markets as they develop



- Projects that are currently being built in the UK have a tariff of £150/MWh, whilst recent auctions show projects being awarded at £58.5/MWh (Moray East, Horn Sea 2) and subsidy free in last year's auction in Germany (EnBW's He Dreiht and Orsted's Borkum Riffgrund III)

Summary of cost reduction

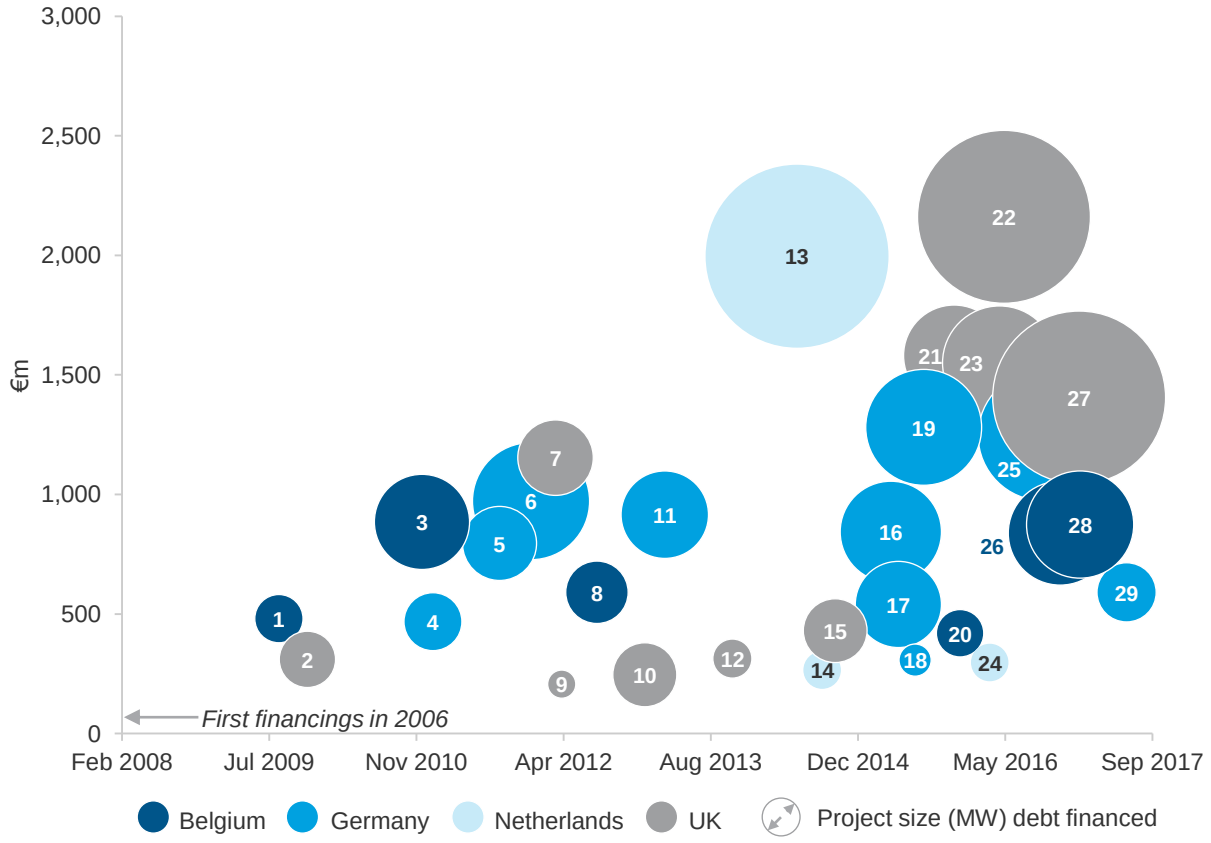
- Increase in competition through auctions and new players
- Technology evolution: constant turbine upscaling
- Upscaling the size of the wind farms
- O&M efficiencies

Source: National Renewable Energy Laboratory (NREL) Date source 4coffshore

…and investment is increasing

Maturity in the European market has led to greater project financings, and $US68b of investment is forecast to be required over the next three years

European project financing precedents for offshore wind farms



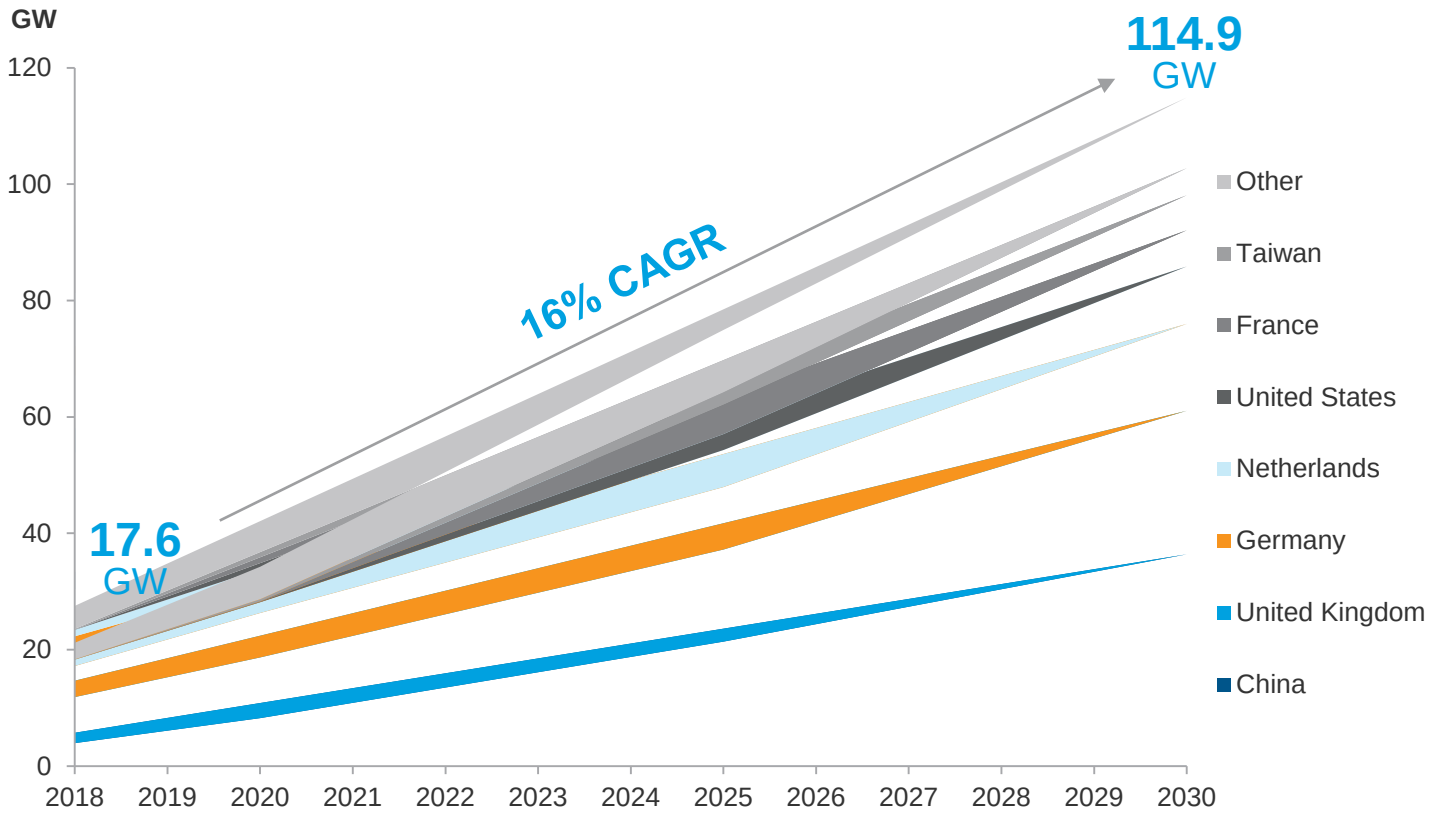
#	Project	Size (MW)
1	Belwind I	165
2	Boreas	194
3	Thornton Bank II	325
4	Borkum West II	200
5	Meerwind	288
6	Global Tech I	400
7	Lincs	270
8	Northwind	216
9	Gunfleet Sands	86
10	Walney	213
11	Butendiek	288
12	London Array	126
13	Germini	600
14	Westermeerwind	144
15	Westemost Rough	210
16	Nordsee I	332
17	Baltic II	288
18	Nordergrunde	111
19	Veja Mate	402
20	Nobelwind	165
21	Galloper	336
22	Beatrice	588
23	Dudgeon	402
24	Luchterduinen	129
25	Merkur	396
26	Rentel	309
27	Race Bank	573
28	Norther	370
29	Trianel	200

Source: BNP Paribas, as at July 2017

The trends are expected to continue

By 2030 forecast cumulative capacity will reach 115GW driven by the core markets of the UK, Germany, Netherlands and China

Global cumulative offshore wind capacity



- In 2028, global offshore wind capacity will exceed 100GW
- By 2030 global capacity is forecast to reach 115GW
- Installations will continue to be driven by the core markets of the UK, Germany, Netherlands and China
- Taiwan and the US are both forecast to become GW markets

Source: Bloomberg New Energy Finance, 2H 2017 Offshore Wind Market Outlook

Macquarie's offshore wind portfolio

Macquarie and GIB have invested in more than 60% of the UK offshore wind market and are currently overseeing more than 1,000 offshore wind turbines globally

Offshore wind transactions

Project	Investment Type	Status on Entry	Commitment Amount[3]	Co-Sponsors / Lending Partners
Taiwan – Formosa 1	Equity	Development	Undisclosed	SWancor, DONG energy
Taiwan – Formosa 3[1]	Equity	Development	Undisclosed	SWancor
Galloper – GIB	Equity	FID	£119m	RWE, innogy, SIEMENS
Galloper – Macquarie	Equity	FID	£119m	
Rampion	Equity	FID	£306m	e·on, ENBRIDGE
Race Bank	Equity	Construction	£400m	DONG energy
Westermost Rough	Equity	Construction	£241m	Marubeni, DONG energy
Gwynt y Môr	Equity	Construction	£220m	RWE, SWM Stadtwerke München, SIEMENS
Baltic 2	Equity	Operations	€240m	EnBW
Lincs	Equity	Operations	£681m	DONG energy
Sheringham Shoal	Equity	Operations	£240m	Statoil, Statkraft
Lynn & Inner Dowsing[2]	Equity	Operations	£242m	EIG Global Energy Partners
Rhyl Flat	Equity	Operations	£57m	RWE, Greencoat UK Wind
London Array	Senior Debt	Operations	£59m	SMBC, kfw, MUFG, SIEMENS
Walney	Senior Debt	Operations	£45m	Lloyds Bank, Santander, SIEMENS, RBS
TOTAL			**£2.9b**	

Successfully funded 14 offshore wind transactions since 2013 1

Unique insight gained from 'live' issues on own assets 2

Unparalleled technical capabilities amongst financial investors 3

Sector leading financing expertise proven through market-first transactions 4

1. Formosa is currently under development and is targeting financial close in 2019; 2. Lynn and Inner Dowsing are two separate offshore wind projects; 3. GBP = 1.15 EUR based on July 2017 FX

Key offshore wind transactions

Macquarie and GIB pioneered financial investors' entry into the European and Taiwanese offshore wind markets and accumulated valuable experience in the sector

FORMOSA 1, TAIWAN

- Acqusition of a **50% stake** in the 128MW Formosa 1 Project, a two phase project (8MW in Phase 1 and 120MW in Phase 2), located off the west cost of Taiwan
- Formosa 1 is being jointly developed with Swancor Renewables and Orsted, and is the **first operational offshore windfarm** in Taiwan

LYNN & INNER DOWSING, UK

- Acquisition of a **61% stake** in the 194 MW Lynn & Inner Dowsing wind farm by the UK Green Investment Bank Offshore Wind Fund
- This asset became the **first UK offshore wind farm without a utility ownership interest**, with O&M contracts being awarded to Siemens

#1

61%

49.9%

25:25

BALTIC 2, GERMANY

- Acquisition of a **49.9% stake** in Baltic 2, funded with Germany's **first offshore wind HoldCo financing**
- EnBW's objective to consolidate the project's earnings without taking on any liabilities meant that debt financing must be raised at the holding company level, a structure that had not been implemented in Germany

GALLOPER, UK

- The Galloper offshore wind farm is a **353 MW offshore wind farm** located in the North Sea, 27km off the coast of Suffolk
- Macquarie and GIB invested alongside Innogy and Siemens Financial Services as four equal **25%** equity investors
- Our **strong technical expertise** allowed us to evaluate and contribute to finalising of a construction strategy that delivers an optimal balance between cost savings and structural robustness