



**EWEA**

THE EUROPEAN WIND ENERGY ASSOCIATION



# The European offshore wind industry - key trends and statistics 2015

February 2016

A report by the European Wind Energy Association

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**Photo:** Courtesy of A2SEA

# Executive summary

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## Offshore wind power market in 2015

- 3,019 MW of net installed, grid-connected capacity was added in 2015, 108% more than in 2014. A net addition of 754 new offshore wind turbines in 15 wind farms were grid-connected from 1 January to 31 December 2015.
  - 419 new turbines were erected in 2015. Seven turbines were decommissioned in the UK and Sweden, resulting in a net addition of 412 turbines.
  - 53 of these turbines equivalent to 277 MW are awaiting grid connection.
  - 14 projects were completed in 2015. Work is on-going on six projects in Germany, the Netherlands and the UK.
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## Cumulative offshore wind power market

- 3,230 turbines are now installed and grid-connected, making a cumulative total of 11,027 MW.
  - Including sites under construction, there are 84 offshore wind farms in 11 European countries.
  - 80% of substructures are monopiles, 9.1% are gravity foundations, jackets account for 5.4%, tripods account for 3.6% and tripiles account for 1.7%.
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## Market outlook

- Once completed, the six offshore projects currently under construction will increase total installed grid-connected capacity by a further 1.9 GW, bringing the cumulative capacity in Europe to 12.9 GW.
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## Trends: turbines, foundations, water depth and distance to shore

- The average offshore wind turbine size was 4.2 MW, a 13% increase over 2014. This was due to the increased deployment of 4-6 MW turbines in 2015.
  - The average size of a grid-connected offshore wind farm in 2015 was 337.9 MW, 8.2% less than the previous year. There were some large offshore wind farms: 576-600 MW sites at Gwynt y Môr and Gemini. However, the majority of German sites were 288 MW.
  - The average water depth of wind farms completed, or partially completed in 2015 was 27.1 m and the average distance to shore was 43.3 km.
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## Financing highlights and developments

- Ten projects, worth €13.3bn, reached final investment decision (FID), a doubling over 2014. In total 3,034 MW of new capacity reached FID during 2015.
  - Total investments for the construction and refinancing of offshore wind farms and transmission assets hit a record level of €18bn.
  - Reduced risk perception for offshore wind projects has led to the emergence of project bonds as a means of financing. For the first time in 2015, €1.5bn was raised through project bonds for the construction and refinancing of offshore wind farms.
-

# Annual market in 2015

## Offshore wind installations

3,018.5 MW of new offshore wind power capacity was connected to the grid during 2015 in Europe, a 108.3% increase over 2014 and the biggest yearly addition to capacity to date.

- During 2015, work was carried out on 22 offshore wind farms in Europe.
- 14 utility-scale wind farms were completed.
- Work continued on two other wind farms where several wind turbines were erected.
- Work has started but no turbines are yet connected in five other wind farms.
- Two sites had decommissioning of turbines, with a full decommissioning at the Yttre Stengrund site in Sweden.

TABLE 1: SUMMARY OF WORK CARRIED OUT AT EUROPEAN OFFSHORE WIND FARMS DURING 2015

Wind farm name	Country	Status
DanTysk	Germany	Fully grid-connected H1 2015
Gwynt y Mor	United Kingdom	Fully grid-connected H1 2015
Humber Gateway	United Kingdom	Fully grid-connected H1 2015
Meerwind Süd Ost <sup>1</sup>	Germany	Fully grid-connected H1 2015
Westermost Rough	United Kingdom	Fully grid-connected H1 2015
Amrumbank West	Germany	Fully grid-connected
Baltic 2	Germany	Fully grid-connected
Borkum Riffgrund I	Germany	Fully grid-connected
Butendiek	Germany	Fully grid-connected
Global Tech 1	Germany	Fully grid-connected
Luchterduinen	Netherlands	Fully grid-connected
Nordsee Ost	Germany	Fully grid-connected
Trianel Windpark Borkum	Germany	Fully grid-connected
Kentish Flats 2 Extension	United Kingdom	Fully grid-connected
Westermeerwind	Netherlands	Partially grid-connected
Gode Wind II	Germany	Turbines installed
Gemini	Netherlands	Foundations installed
GodeWind I	Germany	Foundations installed
Nordsee One	Germany	Foundations installed
Sandbank	Germany	Foundations installed
Robin Rigg	United Kingdom	Turbines decommissioned
Yttre Stengrund	Sweden	Fully Decommissioned

<sup>1</sup> Meerwind Süd Ost was incorrectly cited in 2014 as being fully grid-connected. 15 turbines were grid-connected in 2015. All necessary changes are reflected for both 2014 and 2015 in this report.

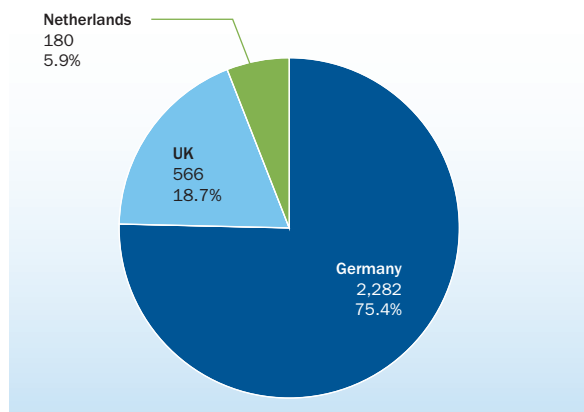


FIG 1: SHARE OF NET ANNUAL OFFSHORE WIND CAPACITY INSTALLATIONS PER COUNTRY (MW)

75.4% of all net capacity brought online was in Germany (2,282.4 MW), a four-fold increase in its grid-connected capacity compared to 2014. This was in large part due to the delay in grid connections finally coming online in 2015 in Germany.

The second largest market was the UK (566.1 MW, or 18.7% share), followed by the Netherlands (180 MW, or 5.9% share).

TABLE 2: NUMBER OF TURBINES AND MW FULLY CONNECTED TO THE GRID DURING 2014 PER COUNTRY (MW)

Country	Germany	Netherlands	Sweden	UK	Total
No. of farms	10	2	-1	4	15
No. of turbines connected	546	60	-5	153	754
MW connected to the grid	2,282.4	180	-10	566.1	3,018.5

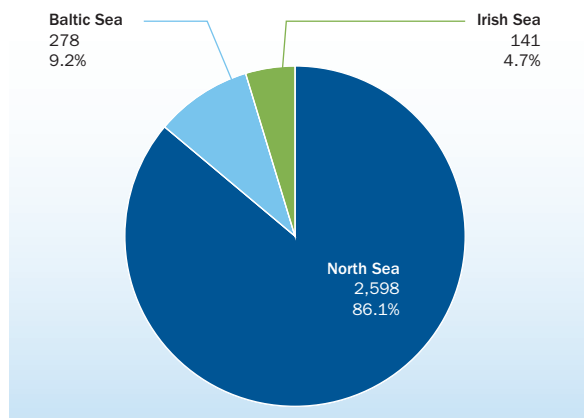


FIG 2: SEA BASIN SHARE OF 2015 NET ANNUAL INSTALLATIONS (MW)

Of the total 3,018.5 MW connected in European waters, 86.1% were in the North Sea, 9.2% in the Baltic Sea, and 4.7% in the Irish Sea.

## Annual market share in 2015 - wind turbine manufacturers

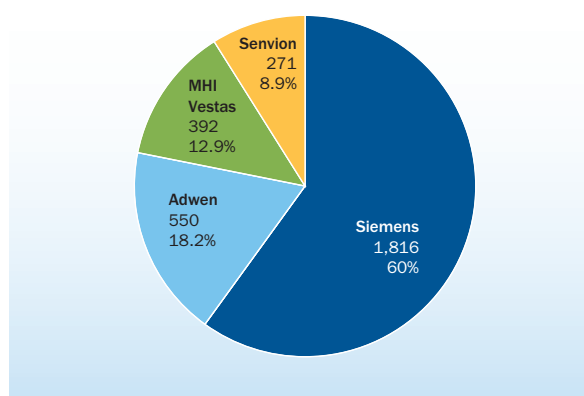


FIG 3: WIND TURBINE MANUFACTURERS' SHARE OF 2015 NET ANNUAL INSTALLATIONS (MW)

Siemens continues to be the top offshore wind turbine supplier in terms of net annual installations. With 1,816.4 MW of new capacity connected, Siemens accounts for 60% of the 2015 market.

Adwen (550 MW, 18.2%), MHI Vestas (391.5 MW, 12.9%) and Senvion (270.6 MW, 8.9%) are the other turbine manufacturers who had turbines grid-connected in full-scale wind farms during 2015.

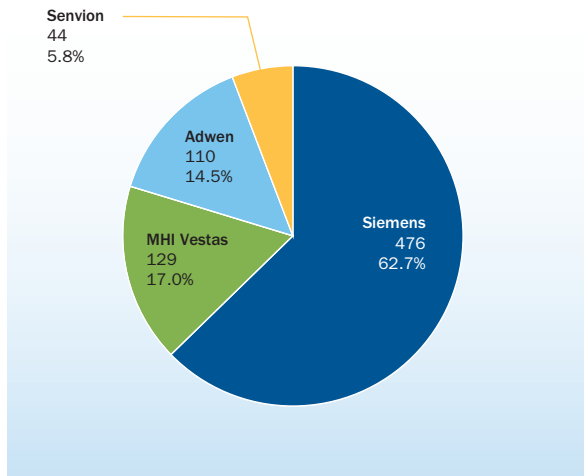


FIG 4: WIND TURBINE MANUFACTURERS' SHARE OF 2015 NET ANNUAL INSTALLATIONS (UNITS CONNECTED)

Similarly, in terms of net grid-connected units, Siemens remains at the top with 476 turbines of various individual turbine capacities (3-6 MW, accounting for 62.7% of connected capacity) connected in European waters during 2015.

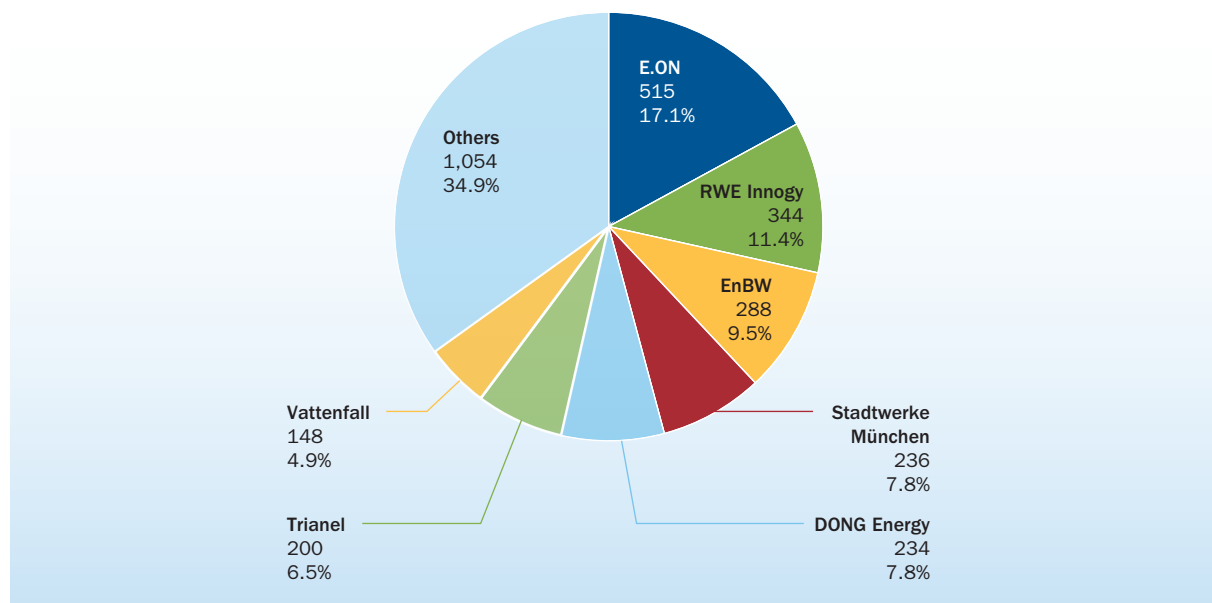
MHI Vestas connected a net total of 129 turbines (ranging from 3-3.3 MW) representing 17%<sup>2</sup>.

Adwen connected 110 turbines to the grid, each rated at 5 MW, representing 14.5% of all turbines connected. Senvion also connected 44 turbines, with an individual turbine rating of 6.15 MW, making up 5.8% of grid-connected turbines in 2015.

### Annual market share in 2015 - wind farm developers/owners<sup>3</sup>

E.ON was the largest developer in the European offshore sector in 2015 with 17.1% of total connections. Combined with RWE Innogy (344.4 MW, 11.4%), EnBW (288 MW, 9.5%), Stadtwerke München (235.5 MW, 9.5%), DONG Energy (234 MW, 7.8%), the top 5 developers added 1.6 GW of installed capacity, representing 53.6% of total installations in 2015.

FIG 5: DEVELOPERS' SHARE OF 2014 ANNUAL INSTALLATIONS (MW)



<sup>2</sup> MHI Vestas numbers factor in two turbines decommissioned at Robin Rigg. Five NEG Micon turbines at Yttre Stengrund are not considered part of the MHI Vestas portfolio and are recorded separately.

<sup>3</sup> Grid-connected market shares are indicative only. Projects owned or developed by several companies have been split according to their respective shares. Where the shares are not known, they have been split in equal parts between the partners.

## Annual market share in 2015 - substructures

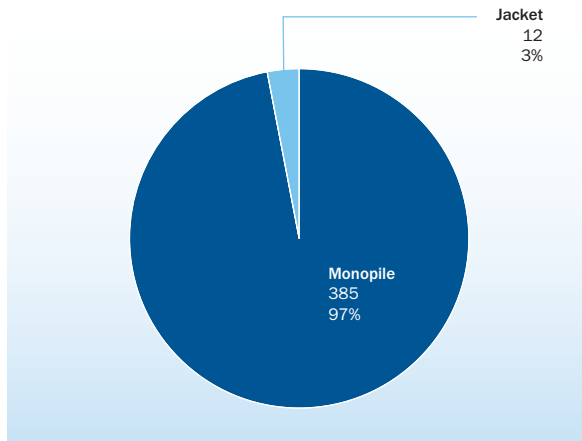


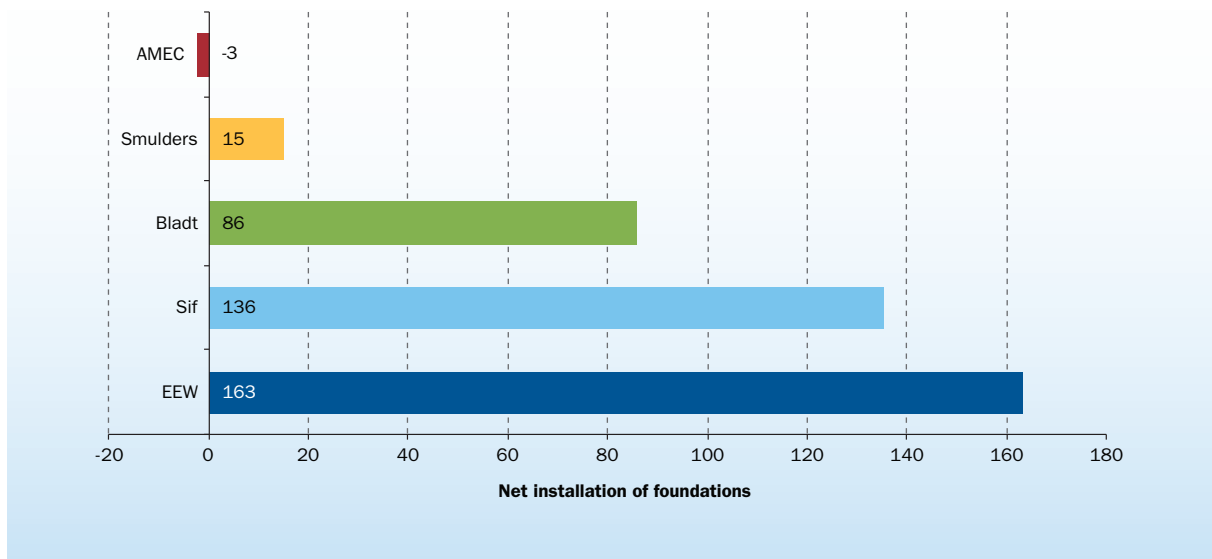
FIG 6: FOUNDATION TYPES' SHARE OF 2015 ANNUAL MARKET

Monopile substructures remained by far the most popular substructure type in 2015 with a net total of 385 installed (97%), taking into account the seven monopiles that were decommissioned in the UK and Sweden.

12 jacket foundations were also installed, representing 3% of all newly installed substructures.

FIG 7: SHARE OF FOUNDATIONS INSTALLED IN 2015 BY MANUFACTURING COMPANY<sup>4</sup>

Foundations installed in 2015 were supplied by EEW (41.1%), Sif (34.1%), Bladt (21.6%), Smulders (3.8%), with decommissioning of AMEC foundations resulting in a decrease in market size by 0.6%



<sup>4</sup> Shares are calculated according to the actual number of individual foundations installed in 2015. When the project developer contracted more than one company to manufacture the foundations, and where the respective shares (in case of consortia/joint venture) were not specified, foundations installed were split in equal parts between the partners. Shares also consider decommissioned infrastructure.

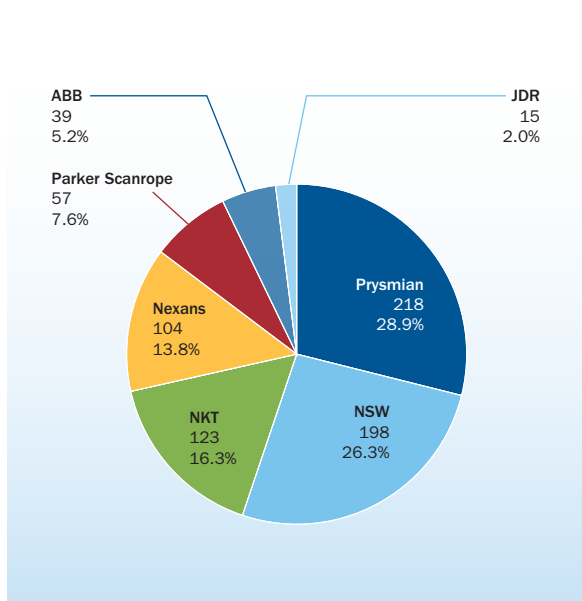
Annual market share in 2015 - cables<sup>5</sup>

FIG 8: SHARE OF INTER-ARRAY CABLE SUPPLIERS TO OFFSHORE WIND FARMS IN 2015 (NO. OF CABLES, PERCENTAGE)

In 2015, 218 inter-array cables manufactured by Prysmian were energised, representing the largest market share at 28.9%.

198 cables connecting wind turbines manufactured by NSW were energised, representing 26.3% of all energised cables.

123 cables manufactured by NKT were also energised (16.3%), together with 104 by Nexans (13.8%), 57 by Parker Scanrope (7.6%) 39 by ABB (5.2%), and 15 by JDR (2%)

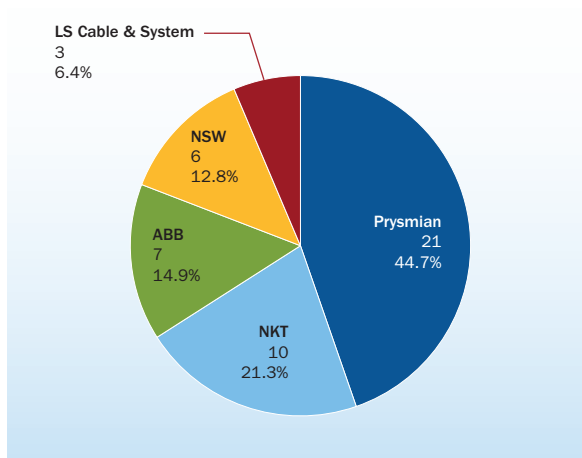


FIG 9: SHARE OF EXPORT CABLE SUPPLIERS IN 2015 (NO. OF CABLES, PERCENTAGE)

In terms of export cables in 2015, 47 export cables manufactured by Prysmian were energised (44.7% of all export cables).

Ten export cables manufactured by NKT (21.3%), along with seven from ABB (14.9%). Six from NSW (12.8%), and three from LS Cable & System (6.4%) completed the market in 2015<sup>6</sup>.

<sup>5</sup> Shares are calculated taking into account the number of grid-connected turbines in each wind farm during 2015 and considers decommissioned infrastructure.

<sup>6</sup> Shares are calculated by taking into account the number of export cables in wind farms fully completed or partially completed.



## Wind turbine capacity and wind farm size

The average capacity rating of the 754 offshore wind farms under construction in 2015 was 4.2 MW, 12.9% larger than in 2014. Larger capacity turbines were deployed by all manufacturers in 2015.

The average size of wind farms in construction in 2015 was 337.9 MW, an 8.2% decrease from 2014.

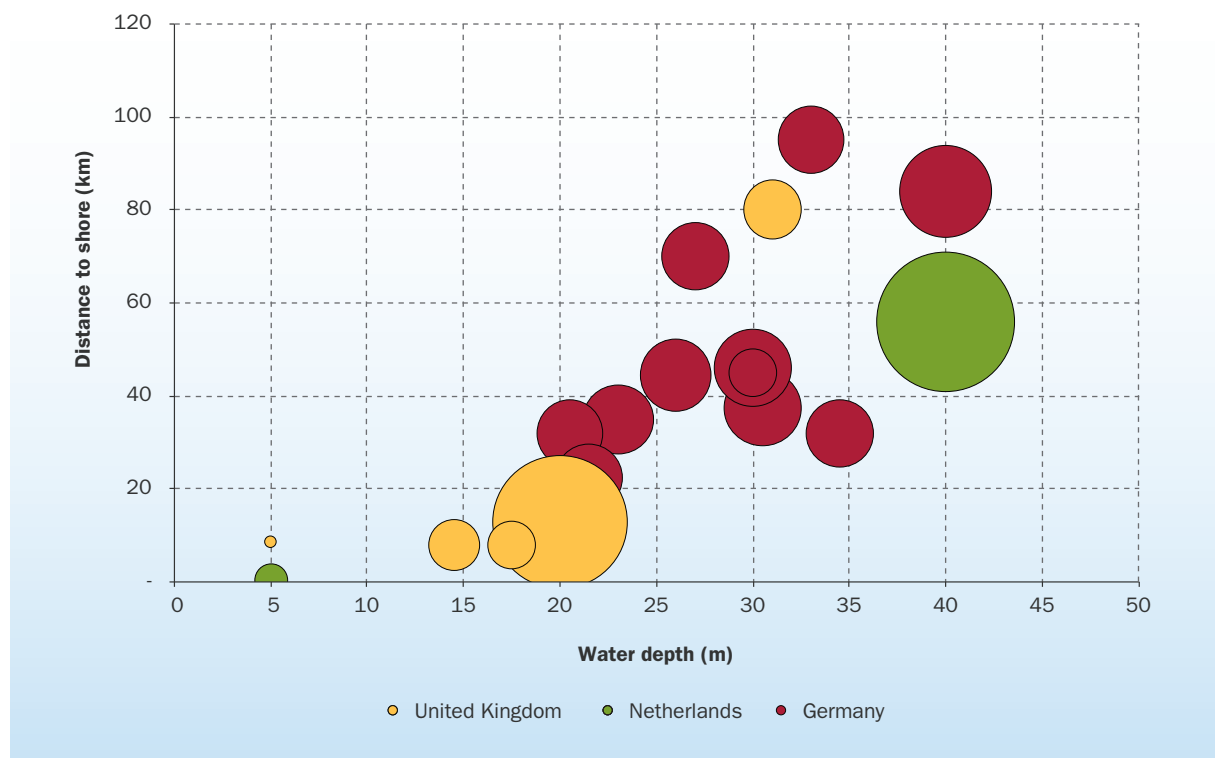
The completion of large numbers of German offshore wind farms designed at 288 MW overall capacity offsets the completion of the large 576 MW Gwynt y Môr site, and construction at the 600 MW Gemini offshore wind farm, affecting the overall average size of sites.

## Water depth and distance to shore

The average water depth of offshore wind farms where work was carried out in 2015 was 27.2 m, slightly more than in 2014 (22.4 m). The average distance to shore for those projects was 43.3 km, significantly more than

in 2014 (32.9 km). This reflects the greater share of projects that were under construction and completed in Germany, which are sited further from shore when compared with other countries.

FIG 10: WATER DEPTH, DISTANCE TO SHORE AND SIZE OF OFFSHORE WIND FARMS UNDER CONSTRUCTION DURING 2015



## Cumulative market

Europe's cumulative installed capacity at the end of 2015 reached 11,027.3 MW, across a total of 3,230 wind turbines. Including sites under construction, there are now 84 offshore wind farms in 11 European countries.

With installed capacity now capable of producing approximately 40.6 TWh in a normal wind year, there is enough electricity from offshore wind to cover 1.5% of the EU's total electricity consumption<sup>7</sup>.

FIG 11: CUMULATIVE AND ANNUAL OFFSHORE WIND INSTALLATIONS (MW)

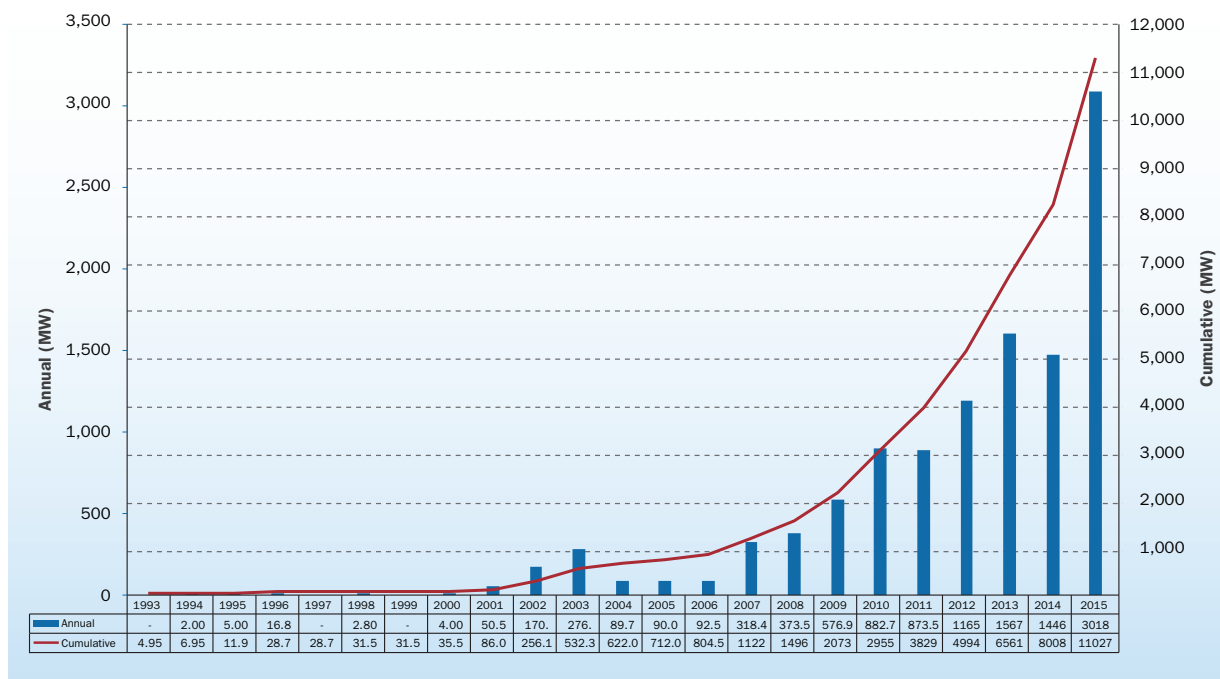


TABLE 3: NUMBER OF WIND FARMS WITH GRID-CONNECTED TURBINES, NO. OF TURBINES CONNECTED AND NO. OF MW FULLY CONNECTED TO THE GRID AT THE END OF 2015 PER COUNTRY.

Country	BE	DE	DK	ES	FI	IE	NL	NO	PT	SE	UK	Total
No. of farms	5	18	13	1	2	1	6	1	1	5	27	80
No. of turbines	182	792	513	1	9	7	184	1	1	86	1,454	3,230
Capacity installed (MW)	712	3,295	1,271	5	26	25	427	2	2	202	5,061	11,027

The UK has the largest amount of installed offshore wind capacity in Europe (5,060.5 MW) representing 45.9% of all installations. Germany follows with 3,294.6 MW (29.9%). With 1,271.3 MW (11.5% of total European installations), Denmark is third, followed by Belgium (712.2 MW, 6.5%), the Netherlands (426.5 MW, 3.9%), Sweden (201.7 MW, 1.8%), Finland (26 MW), Ireland (25.2 MW), Spain (5 MW), Norway (2 MW) and Portugal (2 MW).

<sup>7</sup> The most recent data (2013) for EU 28 final energy consumption of electricity from Eurostat is 2,770 TWh. Source: Eurostat [nrg\_105a], extracted on 17 January 2016.

FIG. 12: INSTALLED CAPACITY - CUMULATIVE SHARE BY COUNTRY

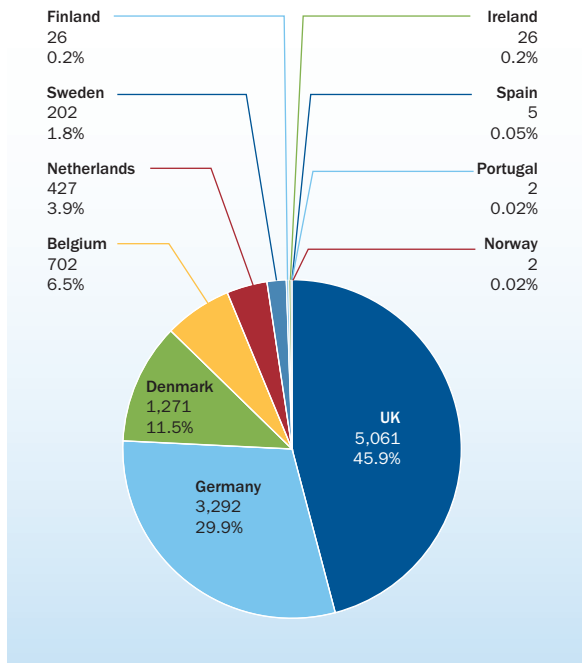


FIG. 13: INSTALLED WIND TURBINES - CUMULATIVE SHARE BY COUNTRY

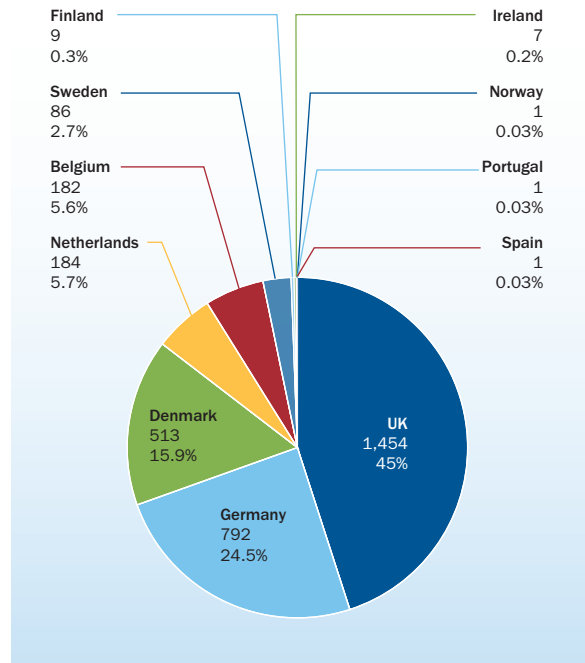
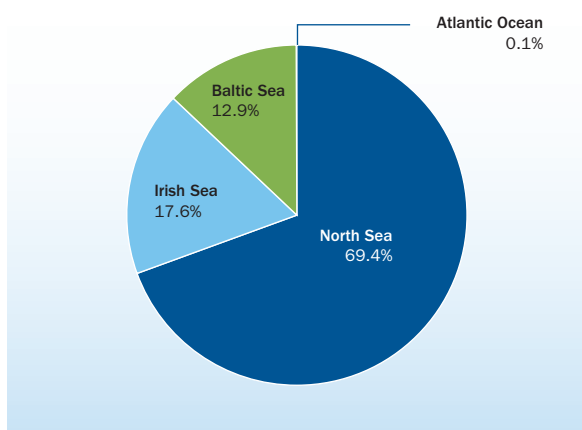


FIG. 14: INSTALLED CAPACITY, CUMULATIVE SHARE BY SEA BASIN



In terms of the number of grid-connected wind turbines in Europe, the UK leads the market with 1,454 turbines (45%), followed by Germany (792 wind turbines, 24.5%), Denmark (513 turbines, 15.9%), Belgium (182 turbines, 5.6%), the Netherlands (184 turbines, 5.7%), Sweden (86 turbines, 2.7%), Finland (nine turbines, 0.3%) and Ireland (seven turbines). Norway, Portugal, and Spain all have one wind turbine each.

The 11,027.1 MW of offshore wind capacity are mainly installed in the North Sea (7,656.4 MW, 69.4%).

1,943.2 MW or 17.6% are installed in the Irish Sea, and 1,420.5 MW (12.9%) in the Baltic Sea, and 7 MW in the Atlantic Ocean.

## Cumulative market share: wind turbine manufacturers

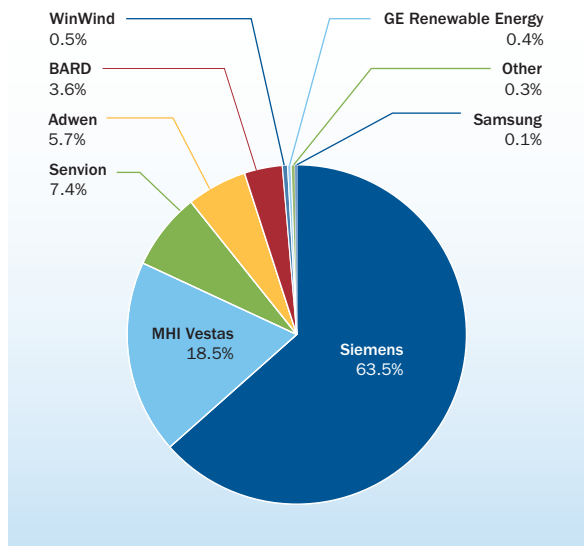


FIG. 15: WIND TURBINE MANUFACTURERS' SHARE AT THE END OF 2015 (PERCENTAGE)

Siemens is the lead offshore wind turbine supplier in Europe with 63.5% of total installed capacity. MHI Vestas (18.5%) is the second biggest turbine supplier, followed by Senvion (7.4%), Adwen (5.7%), and BARD (3.6%).

Turbine portfolios for GE and Alstom are consolidated into GE Renewable Energy following the acquisition of Alstom's power unit in 2015. Areva and Gamesa turbines are also consolidated into Adwen.

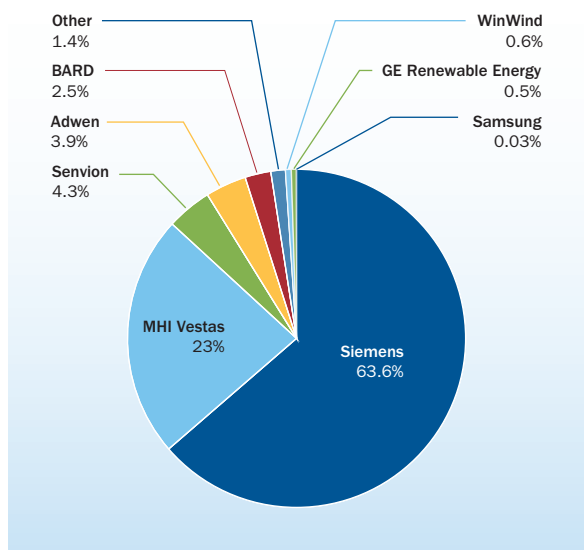


FIG. 16: WIND TURBINE MANUFACTURERS' SHARE AT THE END OF 2015 (PERCENTAGE)

In terms of the total number of wind turbines connected to the grid at the end of 2015, Siemens remains the top supplier with 2,059 turbines, accounting for 63.6% of the market.

MHI Vestas has 750 grid-connected turbines representing 23.2% of total turbines, followed by Senvion (140 turbines, 4.3%), Adwen (127 turbines, 3.9%), BARD (80 turbines, 2.5%), WinWind (18 turbines, 0.6%), and GE Renewable Energy with 15 turbines (0.5%).

## Cumulative market share: wind turbine developers/owners

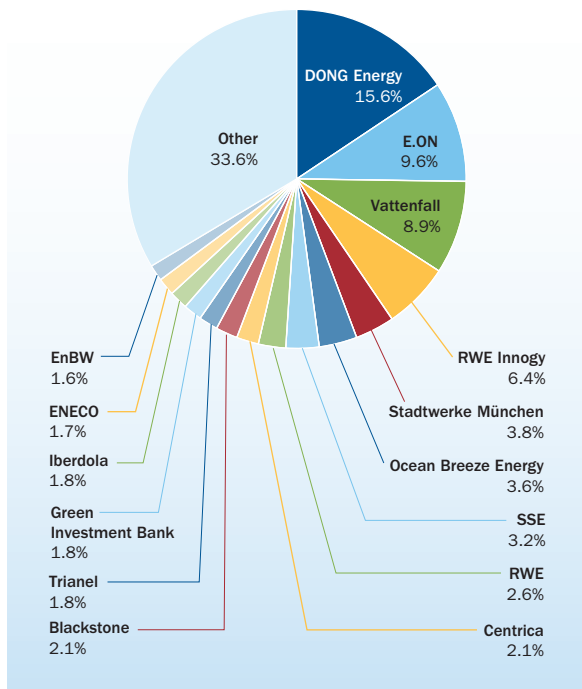


FIG. 17: OWNERS' SHARE OF INSTALLED CAPACITY (PERCENTAGE)

DONG Energy maintains its position as the biggest owner of offshore wind power in Europe with 15.6% of cumulative installations at the end of 2015.

E.ON (9.6%), Vattenfall (8.9%), RWE Innogy (6.4%) and Stadtwerke München (3.8%) complete the top five developers and owners.

## Substructures

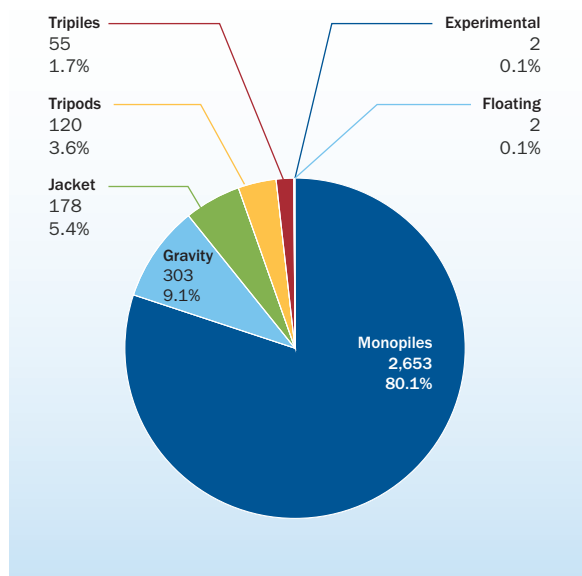


FIG. 18: SHARE OF SUBSTRUCTURE TYPES FOR ONLINE WIND TURBINES END 2015

Share of monopiles increased to 80.1%, as did jackets, which now account for 5.4% of the 3,313 foundations installed in Europe, a figure which includes those awaiting turbine installations or grid connections.

# Market outlook for 2016 and 2017

The volume of new grid-connected installations will be lower in 2016 than it was in 2015. This is due in part to the high volume of turbines installed in 2014 that were only grid-connected in 2015 in Germany; and in part to the reduced number of project starts in 2015 compared to 2014.

However, turbine orders in 2015 were stronger than in 2014, presenting an early indication of good momentum for offshore wind after 2016. Year-on-year orders grew by 74.5% to 5.1 GW of firm and conditional orders placed.

Offshore construction work is expected to start at sites larger than those worked on in 2015, such as

Iberdrola's Wikingen wind farm in Germany and E.ON's Rampion in the UK, meaning that overall average wind farm sizes will increase in 2016. Average turbine size will also increase as the industry develops larger models.

Once completed, the six offshore projects currently under construction will increase installed capacity by a further 1.9 GW, bringing the cumulative capacity in Europe to 12.9 GW. EWEA has identified 26.4 GW of consented offshore wind farms in Europe that could be constructed over the next decade. A total of 63.5 GW of projects are understood to be in the planning phase.

FIG. 19: QUARTERLY OFFSHORE WIND TURBINE ORDERS 2014-2015 (MW)

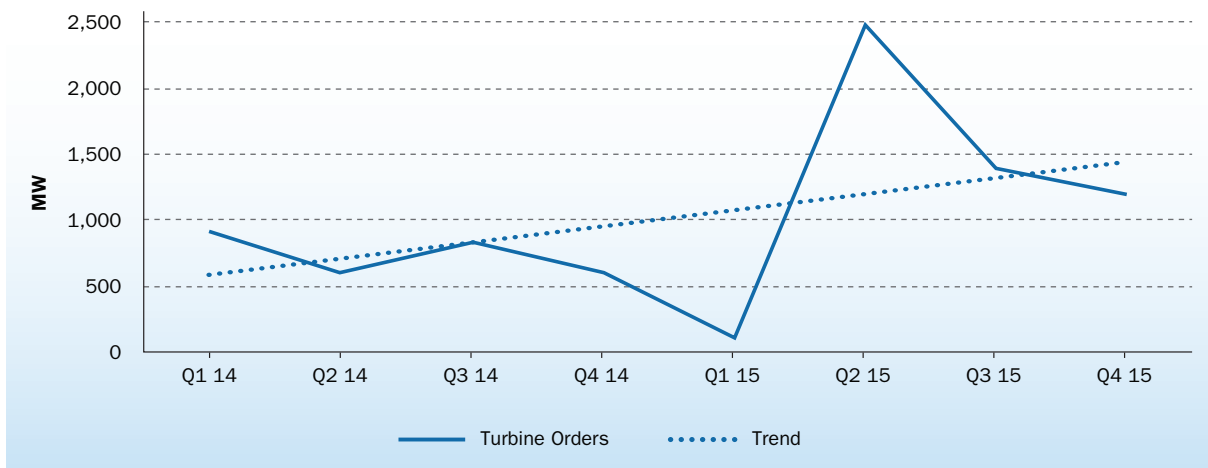
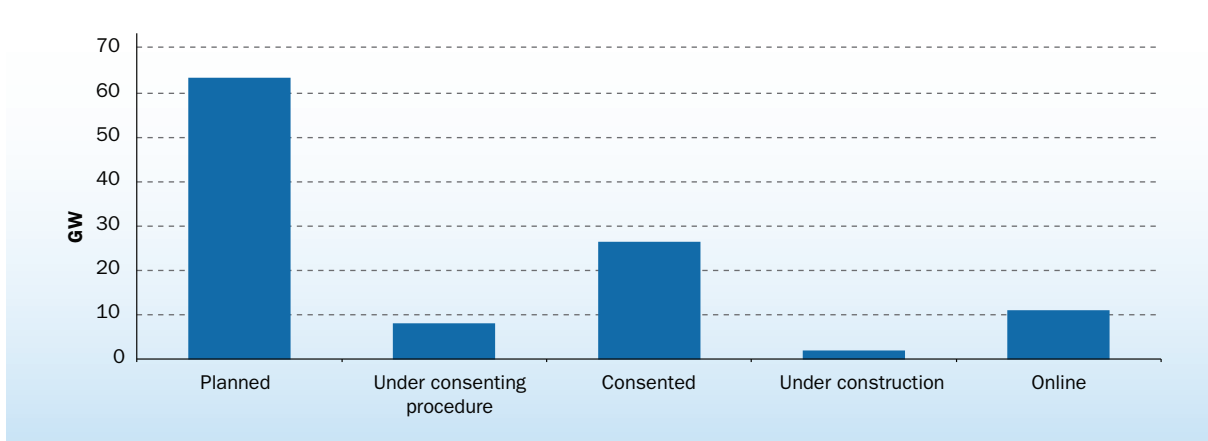


FIG. 20: OFFSHORE MARKET: PROJECTS ONLINE, UNDER CONSTRUCTION AND CONSENTED (GW)



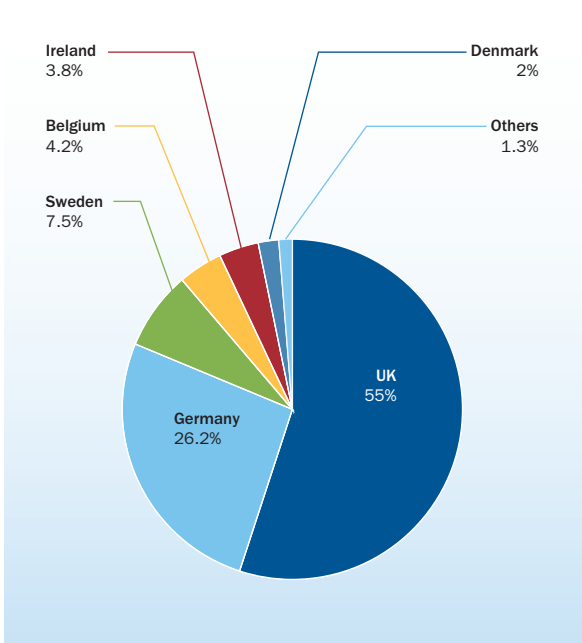


FIG. 21: SHARE OF CONSENTED OFFSHORE CAPACITY PER COUNTRY (PERCENTAGE OF MW)

The UK has the highest share of consented offshore wind capacity (55%), followed by Germany (26.2%).

Sweden (7.5%), Belgium (4.2%), Ireland (3.8%) and Denmark (2%) have the remaining share of consented sites.

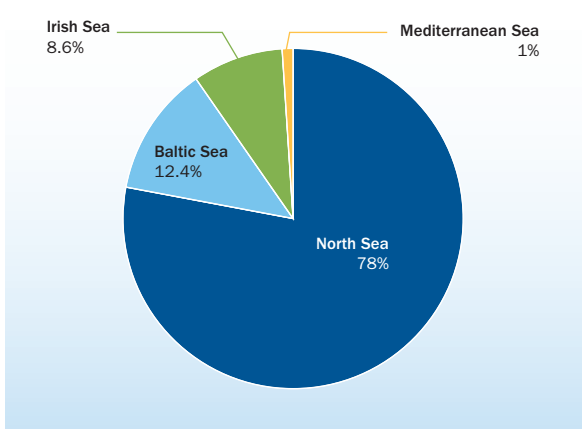


FIG. 22: SHARE OF CONSENTED OFFSHORE WIND FARMS BY SEA BASIN (PERCENTAGE OF MW)

In the medium term, an analysis of consented wind farms confirms that the North Sea will remain the main region for offshore deployment (78% of total consented capacity) with significant developments also foreseen in the Irish Sea (8.6% of consented capacity) and in the Baltic Sea (12.4%). Whilst consented projects exist in the Mediterranean, there is no immediate outlook for deployment.

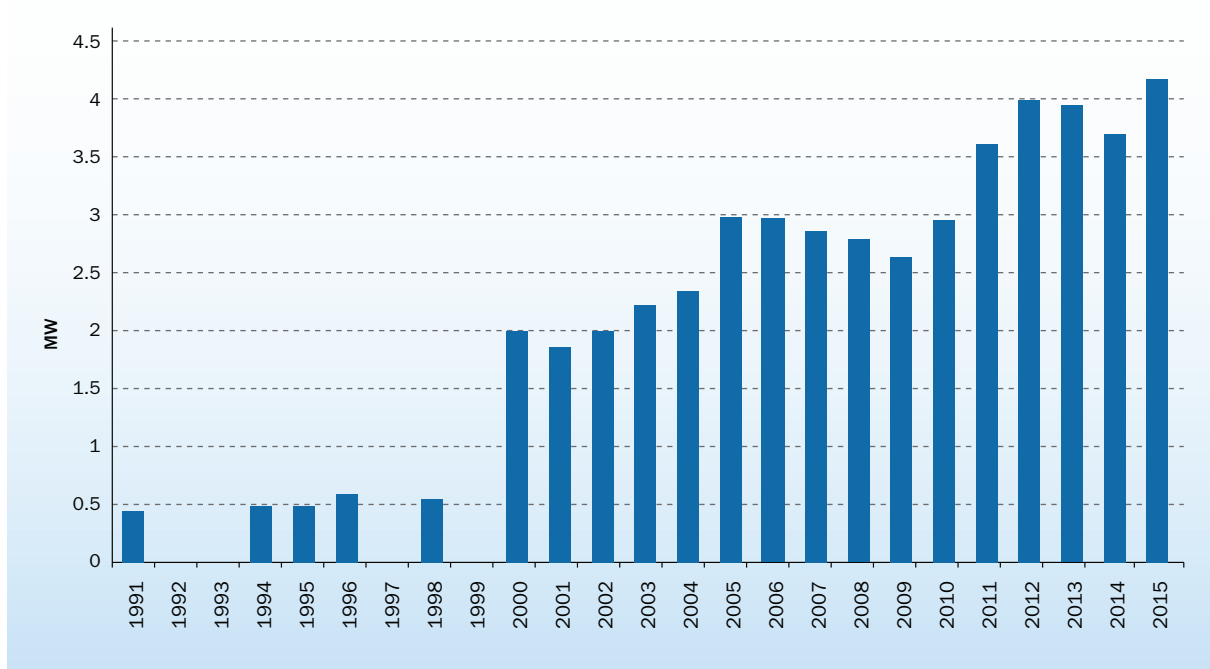
# Trends: turbines, water depth and distance to shore

## Wind turbine capacity

Wind turbine capacity has grown 41.1% from 2010 to 2015. In 2015, the average capacity of new wind turbines installed was 4.2 MW, a significant increase from 3.0 MW in 2010, reflecting a period of continuous development in turbine technology to increase energy yields at sea.

The deployment of 4-6 MW turbines seen in 2015 will be followed by the gradual introduction of 6-8 MW turbines closer towards 2018.

FIG. 23: AVERAGE OFFSHORE WIND TURBINE RATED CAPACITY

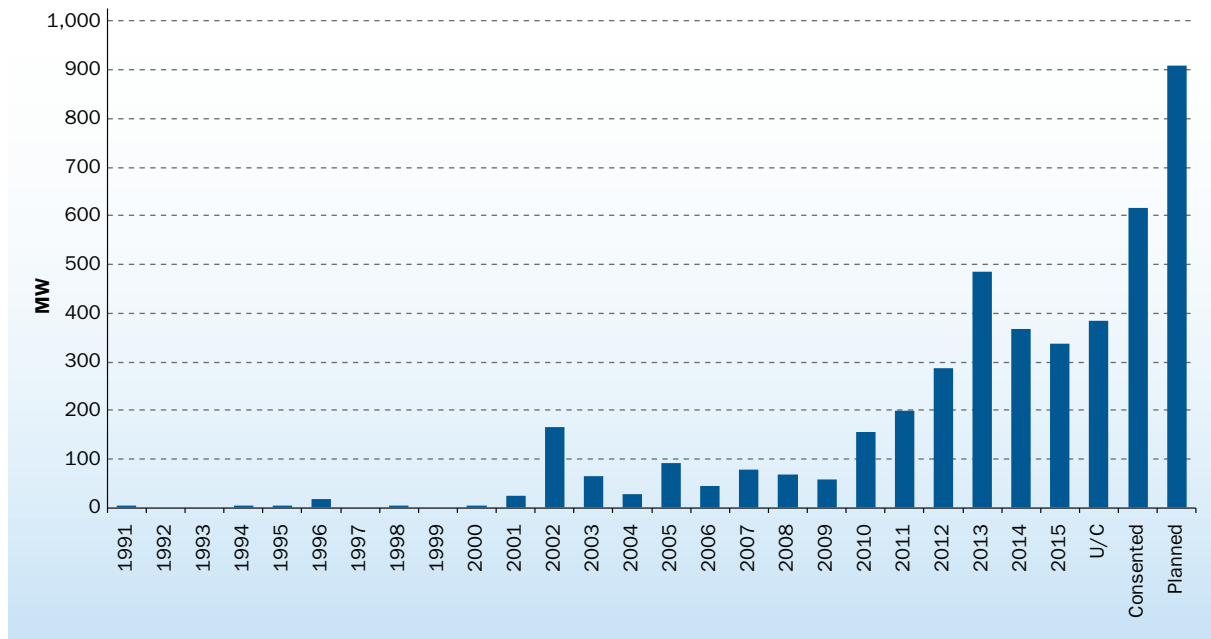




## Wind farm size

In the last five years, the average wind farm size has more than doubled, from 155.3 MW in 2010 to 337.9 MW in 2015. Multiple consents granted last year in the UK for 1.2 GW sites in the Dogger Bank provide indications for the scale of offshore wind farms in the longer term.

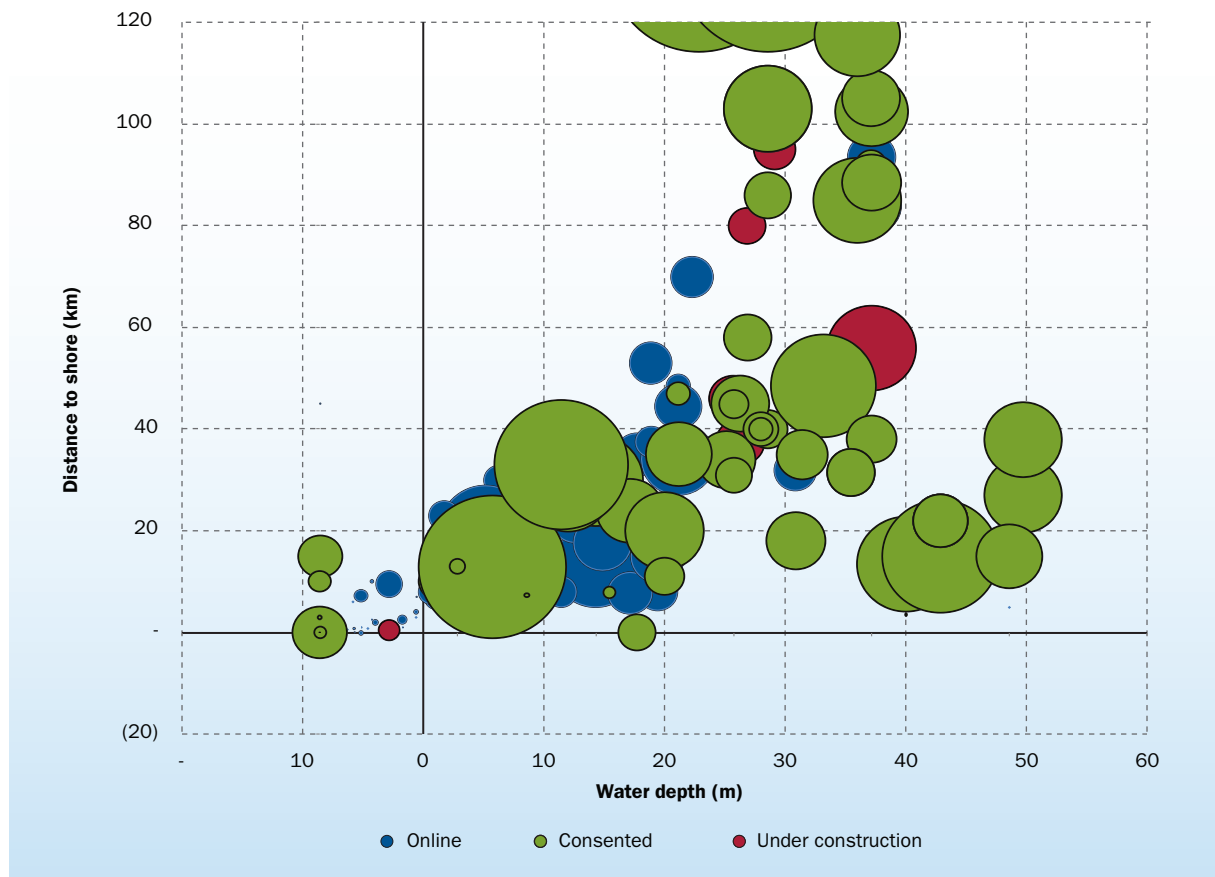
FIG. 24: AVERAGE SIZE OF OFFSHORE WIND FARM PROJECTS



## Water depth and distance to shore

Offshore wind farms have moved further from shore and into deeper waters. At the end of 2015, the average water depth of grid-connected wind farms was 27.1 m and the average distance to shore was 43.3 km. This is primarily the result of increased deployment in Germany during 2015, where sites are an average of 52.6 km from shore. By comparison, UK projects were on average 9.4 km from the shoreline. Dutch projects were sited at an average of 31.4 km away from shore.

FIG. 25: AVERAGE WATER DEPTH AND DISTANCE TO SHORE OF ONLINE, UNDER CONSTRUCTION AND CONSENTED WIND FARMS



# Finance

## Highlights and developments in 2015

The financial markets in 2015 continued to support the offshore wind sector across a variety of instruments and actors. The record level of commercial debt that was raised in 2015 through project finance, green and/or non-recourse bonds indicates that financial markets are willing to back well-structured projects.

Ten projects worth €13.3bn in total reached final investment decision in 2015, compared to €6.5bn, a doubling from 2014. In total, 3 GW of new gross capacity were financed across four countries, 66% of which was in the United Kingdom.

FIG. 27: NON-RECOURSE DEBT FINANCINGS AND RESPECTIVE GROSS CAPACITY FINANCED

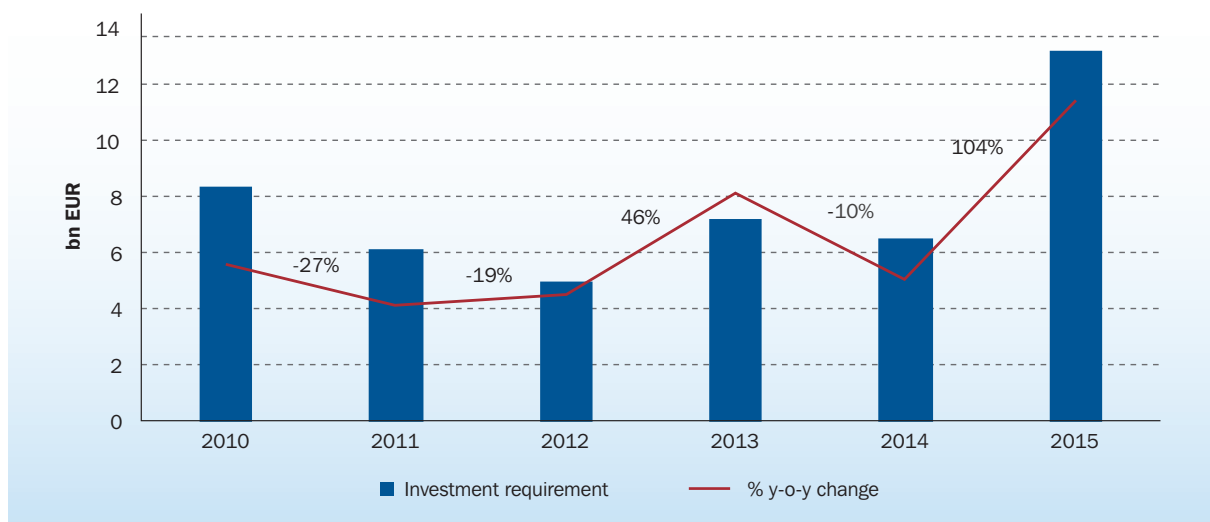
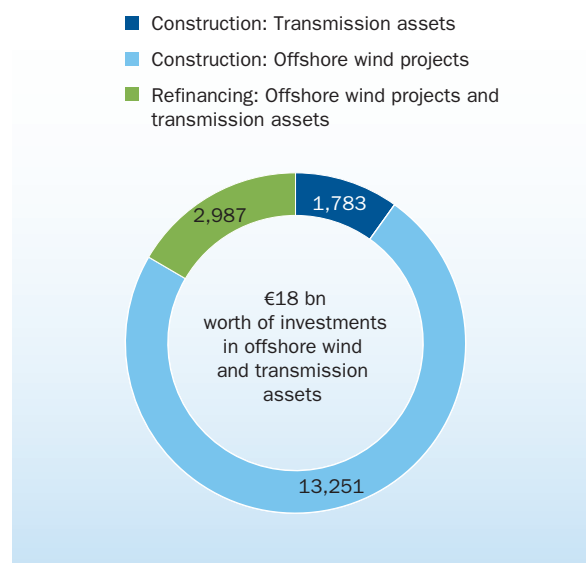


FIG. 28: INVESTMENTS IN THE OFFSHORE WIND SECTOR IN 2015

Total investments in offshore wind in 2015 were more than €18bn; this includes investments in construction of offshore wind projects, transmission assets and refinancing.

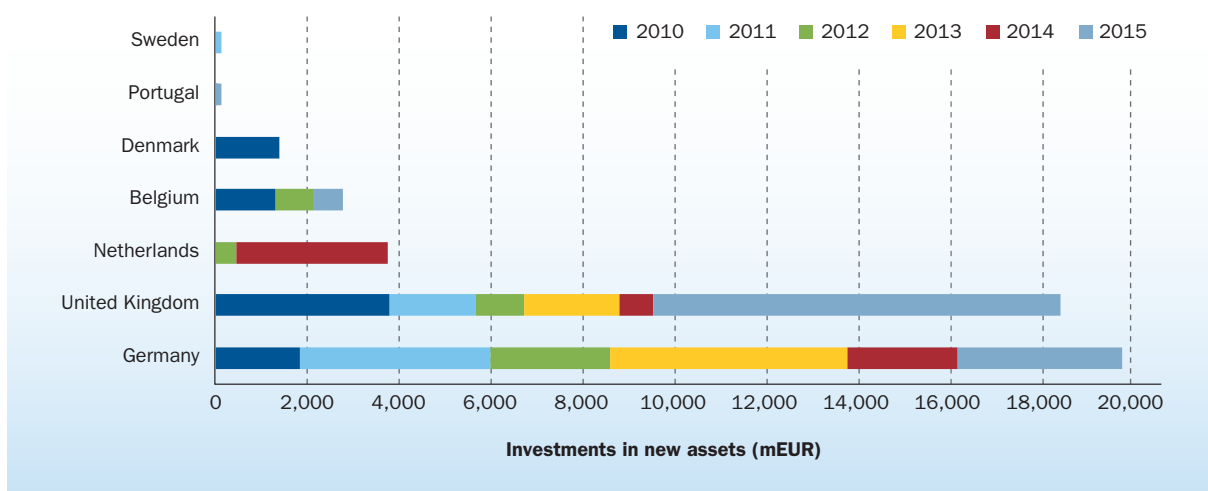
This makes 2015 a record year in terms of total committed funds.



In 2015 the UK had the largest level of investment in new offshore wind farms, at €8.9bn. Cumulatively, over the last 5 years, Germany has received the most

investment, attracting €19.8bn for the construction of new offshore wind projects, or 43% of the total funds committed to the sector for the same period.

FIG. 29: INVESTMENTS IN NEW OFFSHORE WIND FARMS 2010-2015



## Non-recourse debt

Given the scale of the offshore wind sector in 2015, project finance remained an important tool in the market.

€5bn, equivalent to 44% (1.3 GW) of the new gross

capacity was financed on a non-recourse basis. This is a significant increase from the previous year. As a trend, offshore wind farms in Germany are completed utilising project finance. On the corporate finance side, the UK generally favours on-balance sheet financing.

FIG. 30: CORPORATE FINANCE AND NON-RECOURSE DEBT LEVELS 2010-2015

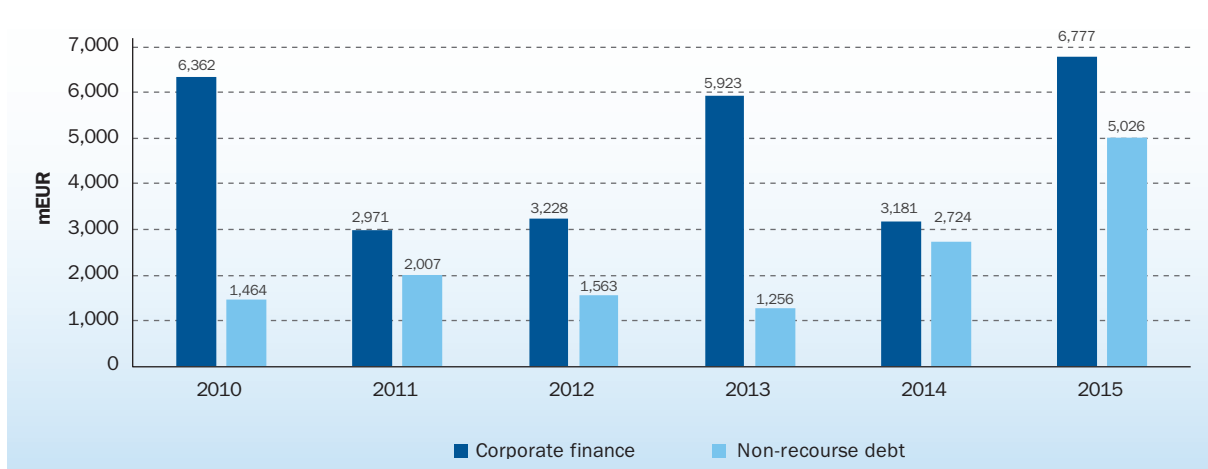
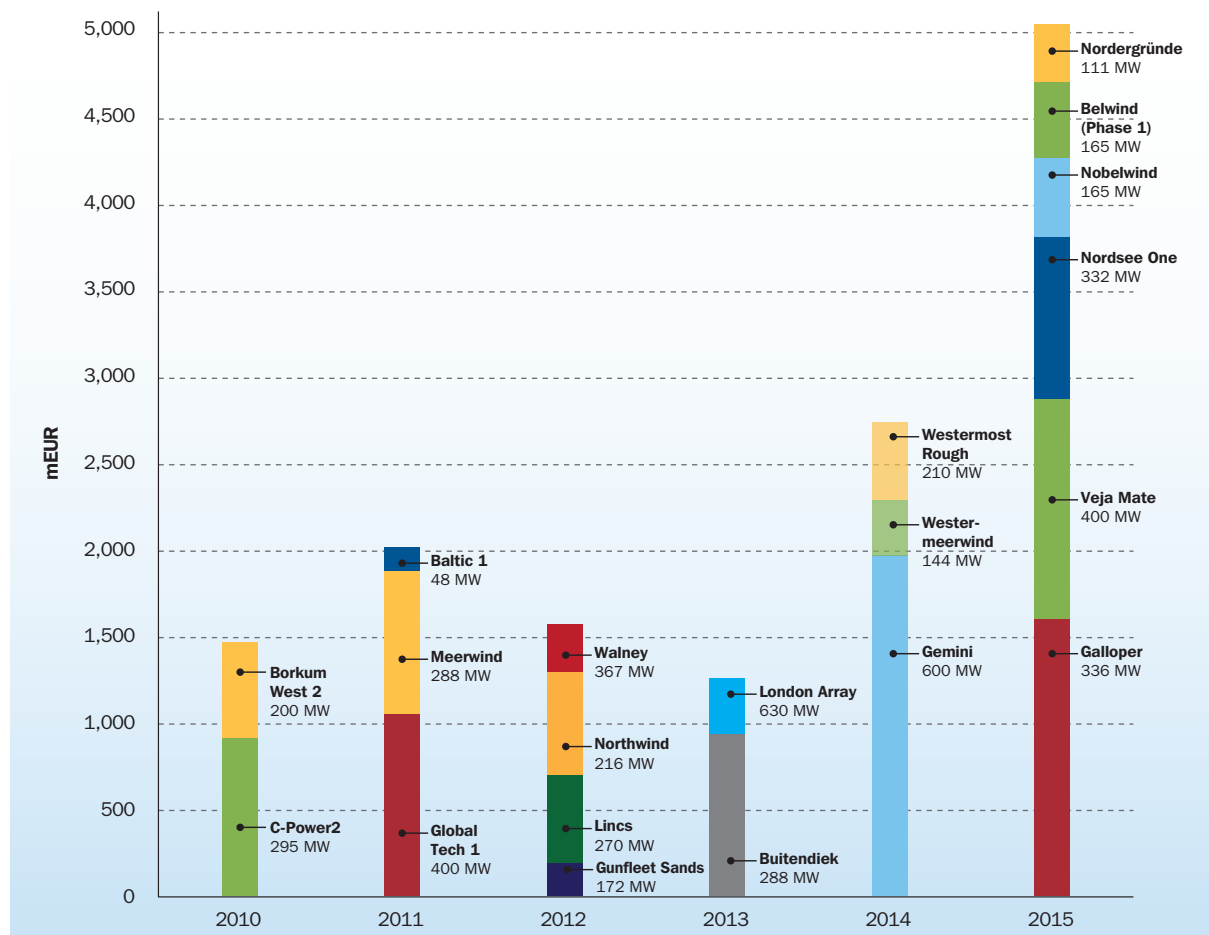


FIG. 31: PROJECT FINANCE TRANSACTIONS 2010-2015



Five new projects and one re-financing (Belwind) were recorded in 2015. The general trend of easing loan terms continued in 2015, with three factors at play. The liquidity in the financial markets, the low interest rate environment, and the considerable experience gained throughout a decade have all contributed to the competitiveness of offshore wind in the infrastructure sector.

Commercial banks are willing to take a larger share of financing. Debt-to-equity ratios remain largely in the margins of 70:30. However, there is sufficient appetite from the financial sector to push the margins further on the debt side, with many international names.

The larger capacity size of projects has increased financing needs. As a result, multilateral backing remains important as a form of risk sharing on projects. Notably in 2015, the European Investment Bank (EIB) directly committed €817m for offshore wind projects under the European Fund for Strategic Investments (EFSI). The EIB has been involved this year in the financing of Galloper (336 MW), Nobelwind (165 MW), and Nordergruende (111 MW) offshore wind farms.

However, certain projects have progressed without multilateral backing as risks are better understood. Nordsee One became the first project to be completed without the presence of any multilateral financial institution.

## Equity finance

The equity markets have remained active, in particular during the pre-construction phase. In total, 2.8 GW have been divested in 2015, compared to 1.8 GW divested in 2014. The current trend of increasing project size, cost, and distance from the shore are all factors that have

contributed to this peak volume of capacity divested as part of recycling capital. Partnerships are turning into a key strategy to free up capital from the balance sheets through the sale of project stakes.

FIG. 32: DIVESTMENTS IN THE OFFSHORE WIND SECTOR

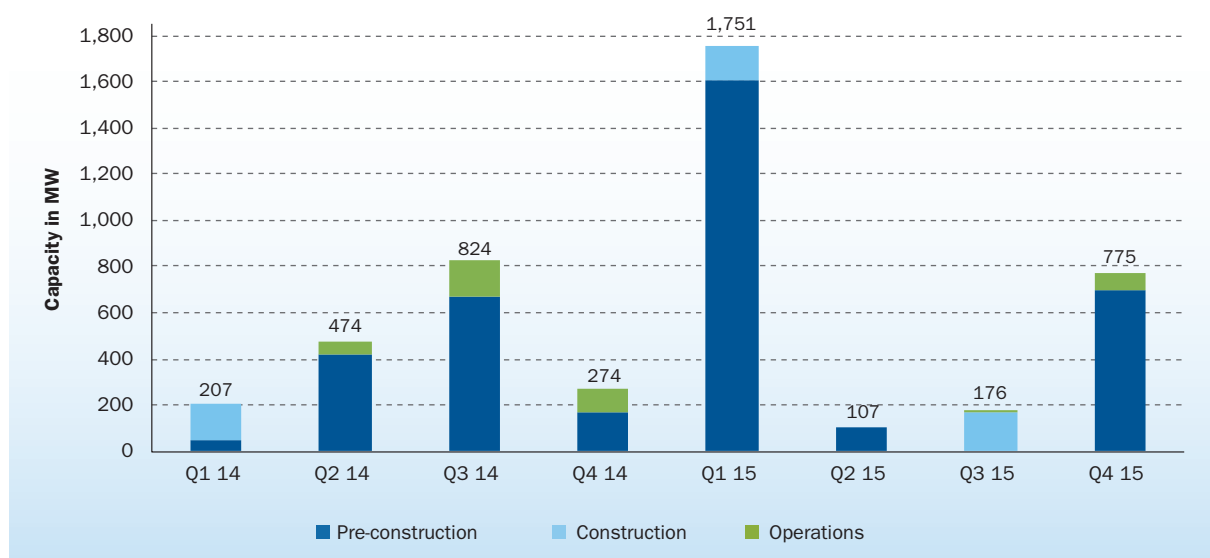
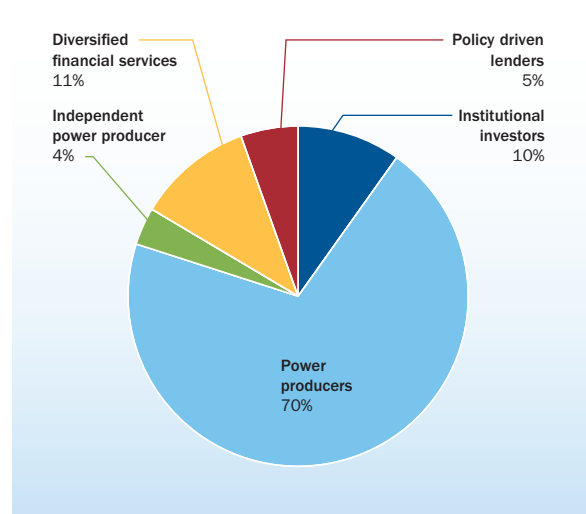


FIG. 33: MARKET SEGMENTATION OF MAJOR EQUITY INVESTORS IN 2015

Power producers continue to lift the majority of equity capital in the offshore wind sector. However, due to the large scale investment and stable income returns, there is greater interest from the financial services industry.

The involvement of financial services in equity financing so far has been mainly limited to assets under construction.



## Transaction highlights: project bond issuance

One of the main developments in 2015 was the diversification of the financial structures employed during construction and operation project stages. Project bonds are emerging as a competitive lending tool compared to the more established sources of corporate debt or project finance.

The Gode Wind 1 (330 MW) project bond became the first of its kind issued within the offshore wind sector. The bond was issued by Global Infrastructure Partners (GIP) to finance their 50% stake acquisition from DONG Energy in

the currently under-construction project. The €780m deal was supported by GIP, an infrastructure fund, with €230m in equity finance. A group of institutional investors, with Talanx as cornerstone lender, subscribed to the project bond.

Later in the year came the refinancing of Meerwind Süd Ost (288 MW) offshore wind farm. Having previously reached financial close in 2011, Meerwind Süd Ost is now in the operational stage. The transaction of €960m provided windows of opportunity for new investors to emerge.

## Transmission assets

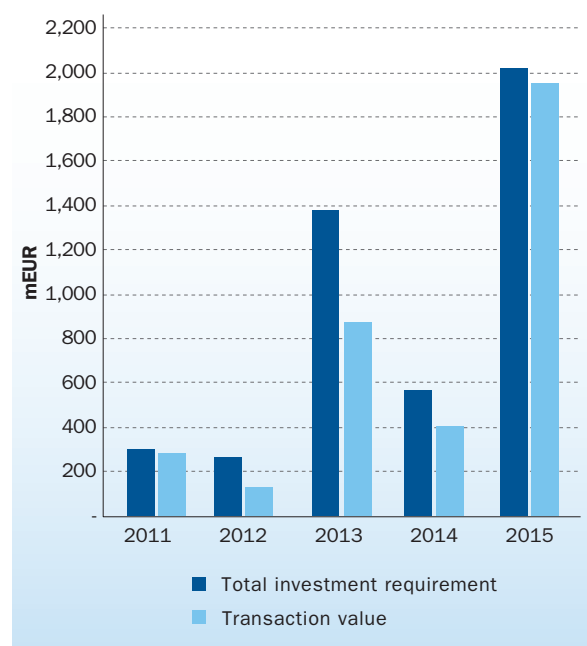


FIG. 34: INVESTMENTS IN TRANSMISSION ASSETS 2011-2015

Total investment requirements for transmission assets in 2015 reached €2bn, including refinancing. €1.9bn was raised through commercial debt, out of which €1.5bn was through bond issuances. In Germany alone, Dutch grid operator TenneT raised €1bn for DoWin 1 transmission line through a green bond issuance that was twice oversubscribed.

With the offshore wind sector, transmission lines have also evolved into a strategic asset class due to their inflation linked, stable revenue streams. Capitalising on this low risk exposure and solid credit quality, transmission asset sponsors have been able to utilise the liquidity in the capital markets to finance their transactions.

## Outlook for 2016

€11bn of estimated financing will be required for 3,052 MW of new capacity in 2016. Several transactions are already under appraisal or expected to go through final investment decision in 2016. Projects under appraisal include Otary Rentel (294 MW) wind farm, Hornsea

Phase 1 (1,200 MW), Hohe See (492 MW), Dudgeon (402 MW), Beatrice (664 MW), and the refinancing of Luchterduinen (129 MW).



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