



# Offshore Wind in Europe

Key trends and statistics 2017

**Wind**<sup>•</sup>  
EUROPE



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Published February 2018

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[windeurope.org](http://windeurope.org)

This report summarises construction and financing activity in European offshore wind farms from 1 January to 31 December 2017.

WindEurope regularly surveys the industry to determine the level of installations of foundations and turbines, and the subsequent dispatch of first power to the grid. The data includes demonstration sites and factors in decommissioning where it has occurred, representing net installations per site and country unless otherwise stated. Rounding of figures is at the discretion of the author.

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#### TEXT AND ANALYSIS:

*WindEurope Business Intelligence*  
Tom Remy (Construction highlights)  
Ariola Mbistrova (Financing highlights)

#### EDITORS:

Iván Pineda, WindEurope

#### DESIGN:

Laia Miró, WindEurope

#### FINANCE DATA:

Clean Energy Pipeline  
All currency conversions made at EUR/GBP 0.8774 and EUR/USD 1.1330  
Figures include estimates for undisclosed values

#### PHOTO COVER:

Courtesy of Øyvind Gravås  
Statoil - Floating Offshore Wind Farm: Hywind Scotland

#### MORE INFORMATION:

[policy@windeurope.org](mailto:policy@windeurope.org)  
+32 2 213 18 68

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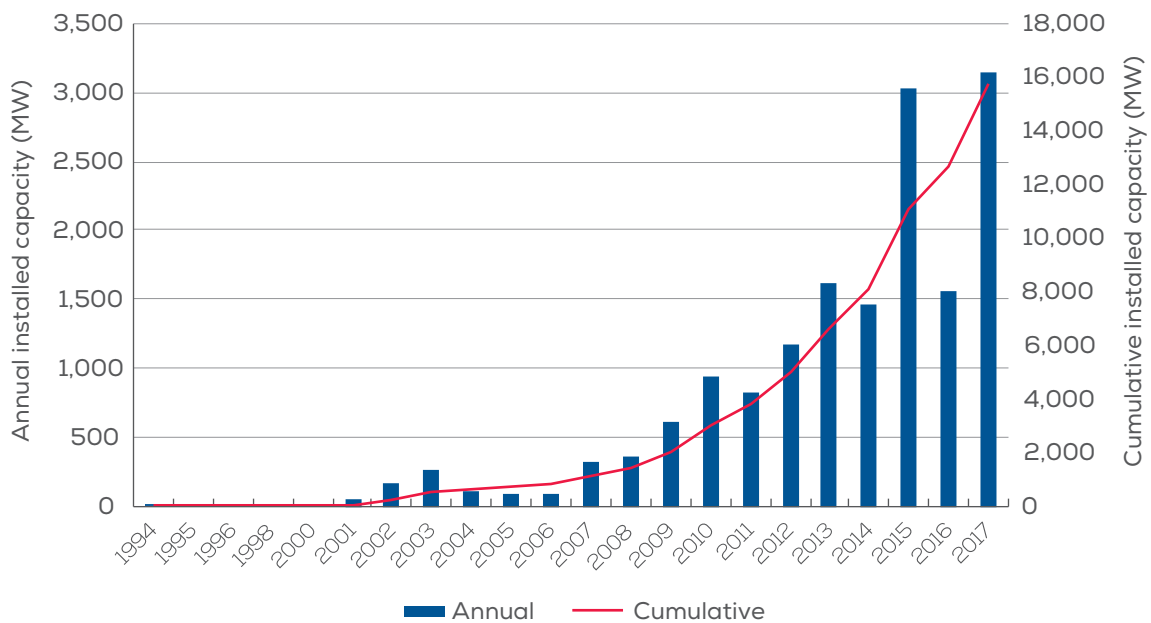
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# EXECUTIVE SUMMARY

Offshore wind in Europe saw a record 3,148 MW of net additional installed capacity in 2017. This corresponds to 560 new offshore wind turbines across 17 wind farms.

Europe now has a total installed offshore wind capacity of 15,780 MW. This corresponds to 4,149 grid-connected wind turbines across 11 countries.

**FIGURE 1**  
Cumulative and annual offshore wind energy installation



Source: WindEurope

2017 also saw Final Investment Decision (FID) on 6 new offshore wind projects to be installed in the coming years.

The new investments total €7.5bn and cover 2.5 GW of capacity.

## New installations in 2017

- 2017 saw 3,148 MW additional net installed (and grid-connected). This was a record: twice as much as 2016 and 4% higher than the previous record in 2015.
- Europe added (net) 560 new offshore wind turbines across 17 different offshore wind farms.
- 2017 saw 623 new turbines erected in total, but 11 turbines decommissioned in Denmark, resulting in a net addition of 612 turbines.
- 82 turbines equivalent to 1,927 MW are awaiting grid connection.
- 14 projects completed, including the first floating offshore wind farm. Work is ongoing on a further 11 projects in Germany and the UK.

## Cumulative installations

- 4,149 turbines are now installed and grid-connected, making a cumulative total of 15,780 MW.
- Including sites that are partially grid-connected, there are now 92 offshore wind farms in 11 European countries.
- The annual load factors of all the offshore wind farms in Europe range from 29%-48%.
- Monopiles are the dominant substructure with 87% of the market share. Jackets and gravity base respectively account for 9% and 2% of the total installed substructures. 2017 saw the installation of the first floating wind farm, allowing floating spar buoy substructures to make their entry to the market.

## Market outlook

- Once completed the 11 offshore projects under construction will increase the total installed grid-connected capacity by a further 2.9 GW, bringing the cumulative capacity in Europe to 18.7 GW.
- By 2020, offshore wind is projected to grow to a total installed capacity of 25 GW.

## Trends: turbine size, depth, distance from shore

- The average size of installed offshore wind turbine was 5.9 MW, a 23% increase on 2016.
- The average size of the grid-connected offshore wind farms in 2017 was 493 MW, 34% higher than the previous year.
- The average water depth of the wind farms completed or partially completed in 2017 was 27.5 m and the average distance to shore was 41 km.

## Financing highlights and developments

- In total 2.5 GW of new capacity reached FID during 2017. Six projects worth €7.5bn reached FID. This is a 60% decrease from 2016 and the first decrease in investments since 2012.
- Refinancing activities hit a record level of €4.6bn, bringing total investments for the sector to €12.1bn.
- 2017 saw 2.9 GW of project acquisition activity, with the financial services sector owning 35% of the acquired capacity this year, up from 27% in 2016.
- Investments in the offshore wind sector are expected to top €9bn by the end of 2018.

# 1.

# 2017 DATA

## 1.1 OFFSHORE WIND INSTALLATIONS

A record 3,148 MW of new offshore wind power capacity was connected to the grid during 2017 in Europe. This is two times more than in 2016 and 13% higher than in 2015, the previous record year for new installed capacity. The level of activity in 2017 is similar to that seen in 2015.

- 2017 saw 17 sites with partial or full grid connection.
- 13 utility-scale wind farms were completed.
- A further four sites saw turbine installations and partial grid connection.
- Work has started but no turbines have yet been erected in six other wind farms.
- One site was fully decommissioned.

**TABLE 1**

Summary of work carried out at European offshore wind farms during 2017

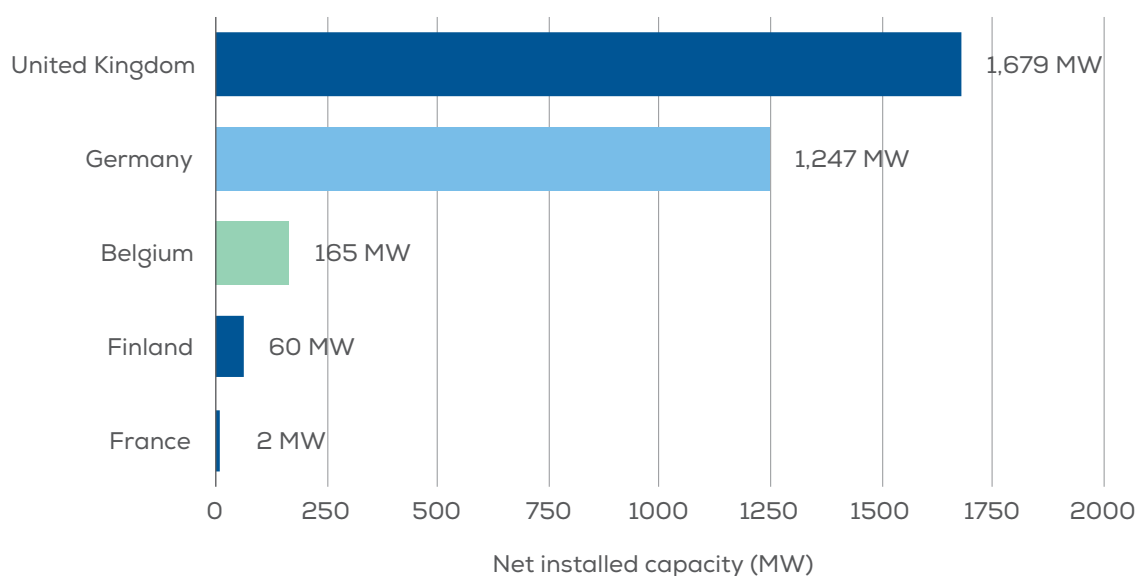
WIND FARM	CAPACITY CONNECTED IN 2017 (MW)	COUNTRY	STATUS
Race Bank	498	UK	Partially grid-connected
Dudgeon East	402	UK	Fully grid-connected



WIND FARM	CAPACITY CONNECTED IN 2017 (MW)	COUNTRY	STATUS
Walney 3 (Extension Phase 1 – West)	256	UK	Partially grid-connected
Burbo Bank Extension	200	UK	Fully grid-connected
Rampion	179	UK	Partially grid-connected
Galloper	72	UK	Partially grid-connected
Blyth	42	UK	Fully grid-connected
Hywind Scotland	30	UK	Fully grid-connected
Veja Mate	402	GERMANY	Fully grid-connected
Wikinger	350	GERMANY	Fully grid-connected
Nordsee One	332	GERMANY	Fully grid-connected
Nordergründe	111	GERMANY	Fully grid-connected
Sandbank	52	GERMANY	Fully grid-connected
Nobelwind (Belwind II)	165	BELGIUM	Fully grid-connected
Pori Tahkoluoto 2	36	FINLAND	Fully grid-connected
Kemi Ajos 1+2	24	FINLAND	Fully grid-connected
Floatgen	2	FRANCE	Fully grid-connected

Source: WindEurope

**FIGURE 2**  
Annual offshore wind capacity installations per country (MW)



Source: WindEurope

53% of all net capacity brought online was in the United Kingdom, including the commissioning of the first floating offshore wind farm: Hywind, in Scotland. The second largest country was Germany with 40% of total European capacity, largely realised through the commissioning of Veja Mate and Wikinger. Belgium represented 5% of the total share. Finland also witnessed the commissioning of the first offshore wind farm specifically designed for icy conditions, Pori Tahkuoloto 2.

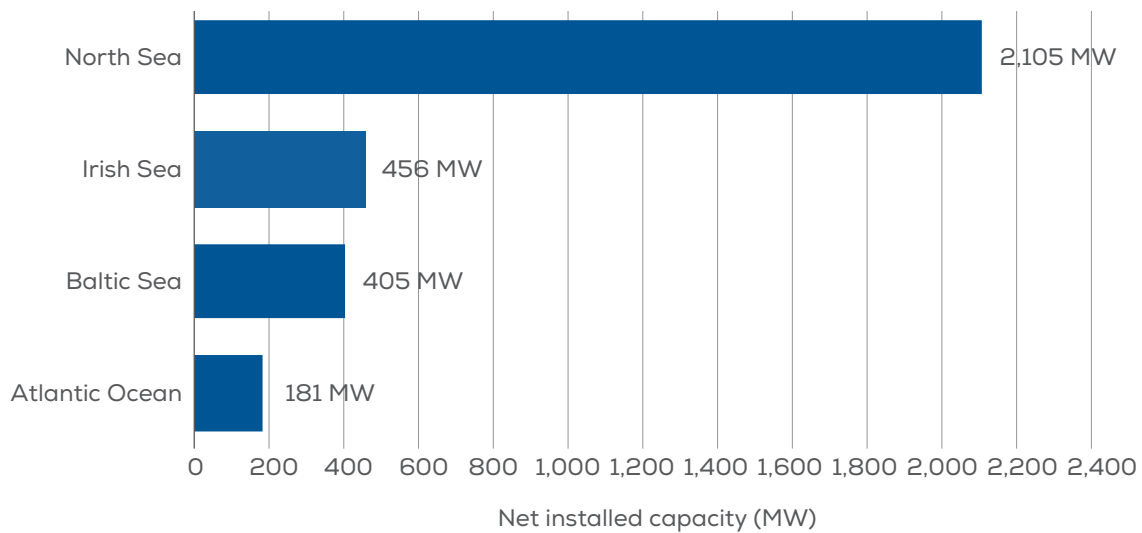
The 2 MW Floatgen demonstrator was commissioned too. This was the first offshore wind turbine in France. 5 MW were also decommissioned at Vindeby in Denmark. In 2017 there work was carried out across 26 wind farms including grid connections, wind turbine erections and foundations installed.

**TABLE 2**  
Sites with grid-connected turbines and MW fully connected to the grid during 2017 per country

COUNTRY	UK	GERMANY	DENMARK	FINLAND	BELGIUM	FRANCE
No. of Farms	10	8	3	2	2	1
No. of turbines connected	281	222	-11	17	50	1
Net MW connected to the grid	1,679 MW	1,247 MW	-5 MW	60 MW	165 MW	2 MW

Source: WindEurope

**FIGURE 3**  
Net annual installations by sea basin (MW)



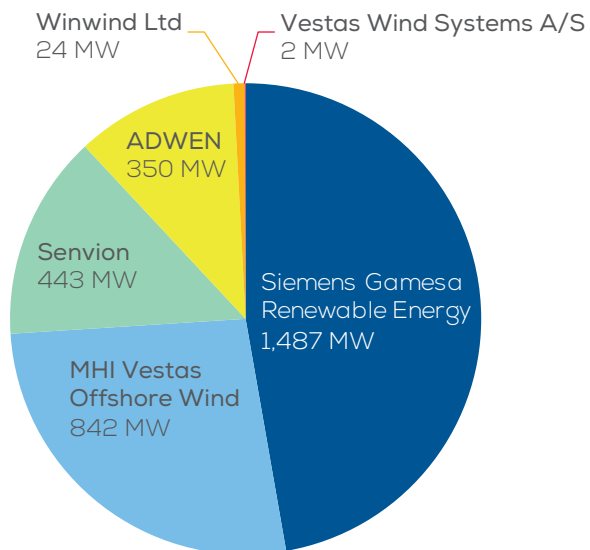
Source: WindEurope

67% of all net capacity installations occurred in the North Sea, with 15% in the Irish Sea. 13% of the capacity was added in the Baltic Sea from the Wikinger and the Pori Tahkuoloto 2 offshore wind farms.

The commissioning of Floatgen and the partial connection of Rampion resulted in an additional 181 MW in the Atlantic Ocean.

## 1.2 ANNUAL MARKET SHARE IN 2017 – WIND TURBINE MANUFACTURERS

**FIGURE 4**  
Wind turbine manufacturers' share of 2017 annual installations (MW)



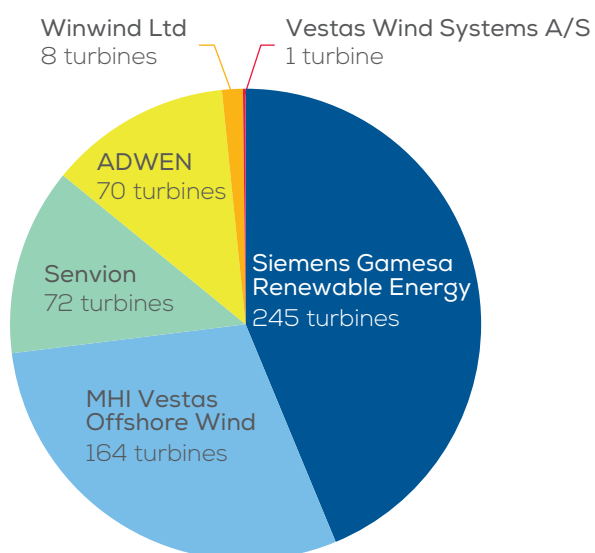
Source: WindEurope

3,148 MW of net capacity was connected to the grid in 2017. Siemens Gamesa Renewable Energy accounted for 51.3% of new capacity, and MHI Vestas Offshore Wind for 24.7%. In 2017, more manufacturers installed new wind turbines than in 2016. But Siemens Gamesa Renewable Energy and MHI Vestas Offshore still accounted for more than 75% of the total installed capacity.

Turbines ranging from 2 to 8 MW were grid-connected.

A total of 5 MW was decommissioned, giving a net capacity addition of a gross capacity of 3,153 MW in 2017.

**FIGURE 5**  
Wind turbine manufacturers' share of 2017 annual installations (Units connected)



Source: WindEurope

560 turbines were connected to the grid, and 11 turbines were decommissioned.

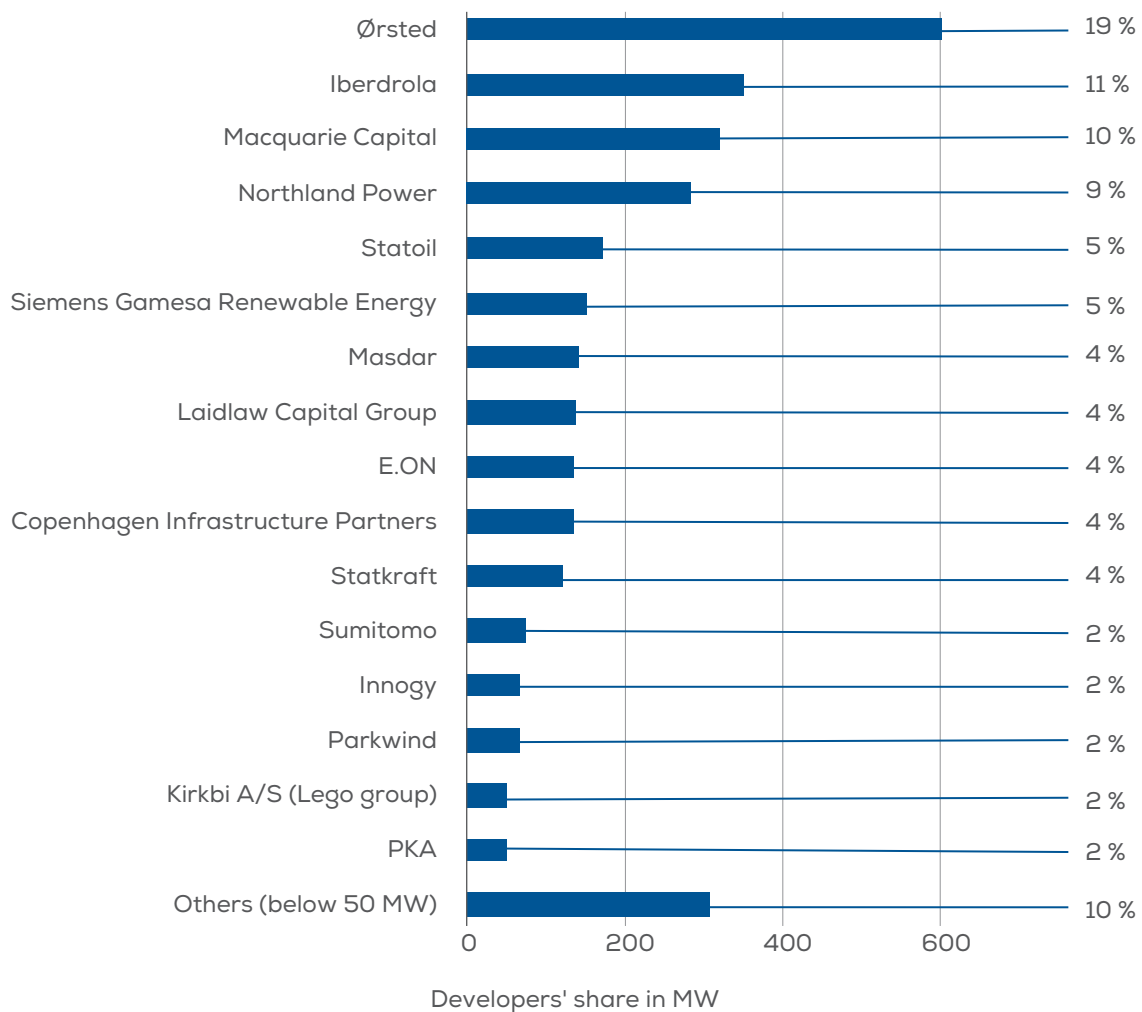
44% of turbines connected were from Siemens Gamesa Renewable Energy, and 29% from MHI Vestas Offshore Wind. Together, this represented 73% of the total number of turbines installed.

### 1.3 ANNUAL MARKET SHARE IN 2017 – WIND FARM OWNERS<sup>1</sup>

Ørsted<sup>2</sup> connected the most megawatts in 2017, representing 19% of ownership, followed by Iberdrola with 11%. Macquarie Capital (10%), Northland Power (9%), and Statoil (5%) complete the top five owners in new additional capacity.

The top five developers account for 54% of all new capacity in 2017.

**FIGURE 6**  
Developers' share of 2017 annual installations (MW)



Source: WindEurope

1. 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.  
2. DONG energy rebranded to Ørsted as of November 2017.

## 1.4 ANNUAL MARKET SHARE IN 2017 – SUBSTRUCTURES

Monopiles remained the most popular substructure type in 2017, representing 87% of all installed foundations.

Five floating spar buoys were installed at Hywind Scotland and one floating barge was commissioned for the Floatgen project.

40 jackets were installed, representing 9.4% of all foundations installed. Nine gravity bases were commissioned at Pori Tahkuoloto 2 (1.2%).

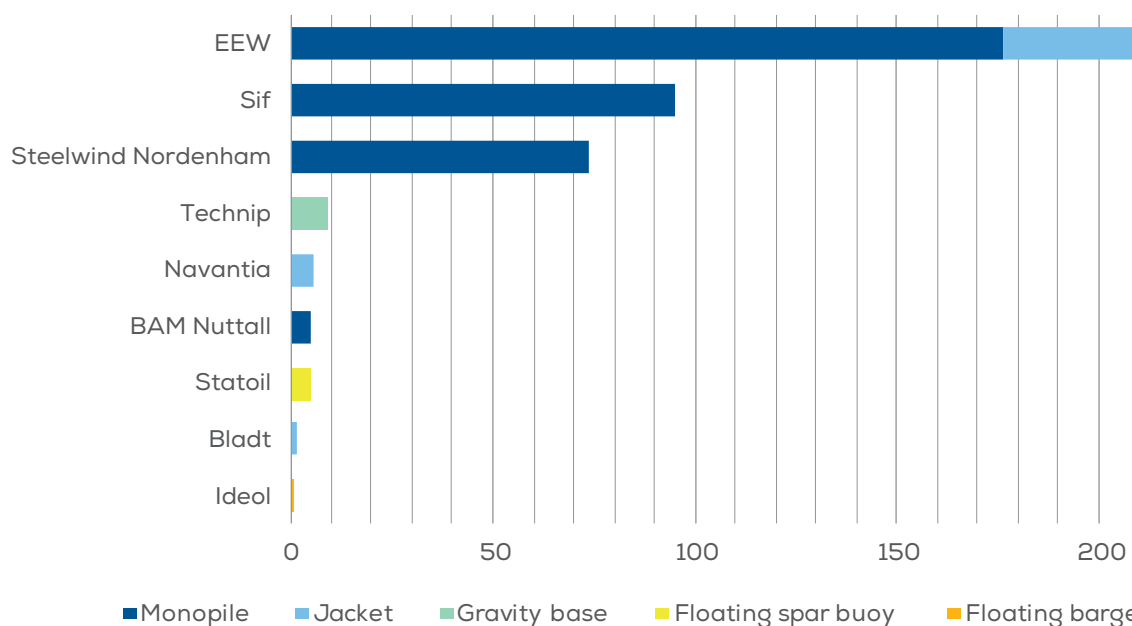
EEW installed 53% of all foundations in 2017 followed by Sif (24.1%), Steelwind Nordenham (18.8%), Technip (2.3%). Statoil, which installed the five floating spar buoys

for Hywind Scotland, accounted for 1.3% of all foundations installed.

Ørsted's Vindeby project was decommissioned, as was the eleven MT Højgaard A/S gravity bases and turbine.

N.B: This includes substructures installed in wind farms under construction, with or without partial grid-connection.

**FIGURE 7**  
Net foundations installed in 2017 by manufacturing company<sup>3</sup>

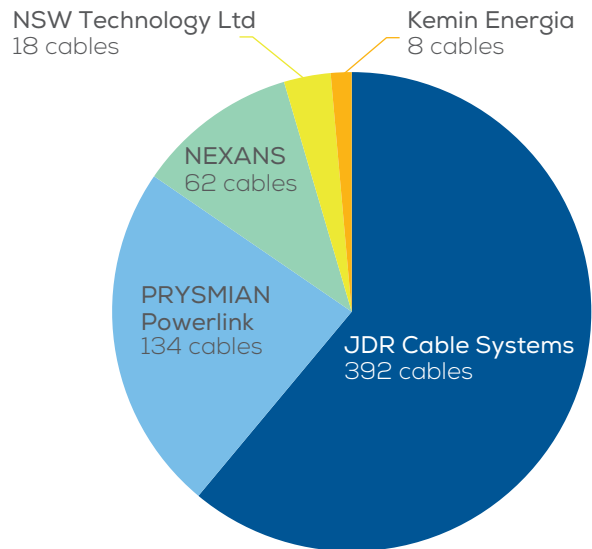


Source: WindEurope

3. Shares are calculated according to the actual number of individual foundations installed in 2017. Where 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 and figures also consider decommissioned infrastructure.

## 1.5 ANNUAL MARKET SHARE IN 2017 – CABLES<sup>4</sup>

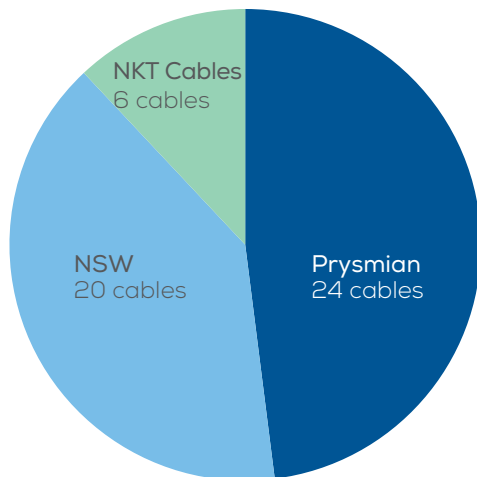
**FIGURE 8**  
Share of inter-array cable suppliers by energised cables



63.7% of inter-array cables energised in 2017 were from JDR Cable Systems. Prysmian (21.8%), Nexans (10.1%) NSW technology (2.9%) and Kemin Energia (1.3%) were the other suppliers with energised inter-array cables.

Source: WindEurope

**FIGURE 9**  
Share of export cable suppliers in 2017 by cables energised<sup>5</sup>



In terms of export cables in 2017, 24 export cables manufactured by Prysmian were energised, representing 48% of the annual market.

NSW had a 40% share, and NKT Cables represented 12%.

Source: WindEurope

4. Shares are calculated taking into account the number of grid-connected turbines in each wind farm during 2017 and considers decommissioned infrastructures.
5. Shares are calculated by taking into account the number of export cables in wind farms fully completed or partially completed.

## 1.6 WIND TURBINE CAPACITY AND WIND FARM SIZE

The average capacity rating of the 560 offshore wind turbines grid-connected in 2017 was 5.9 MW, 23% larger than in 2016.

The average size of wind farms in construction in 2017 was 493 MW, a 34% increase on 2016.

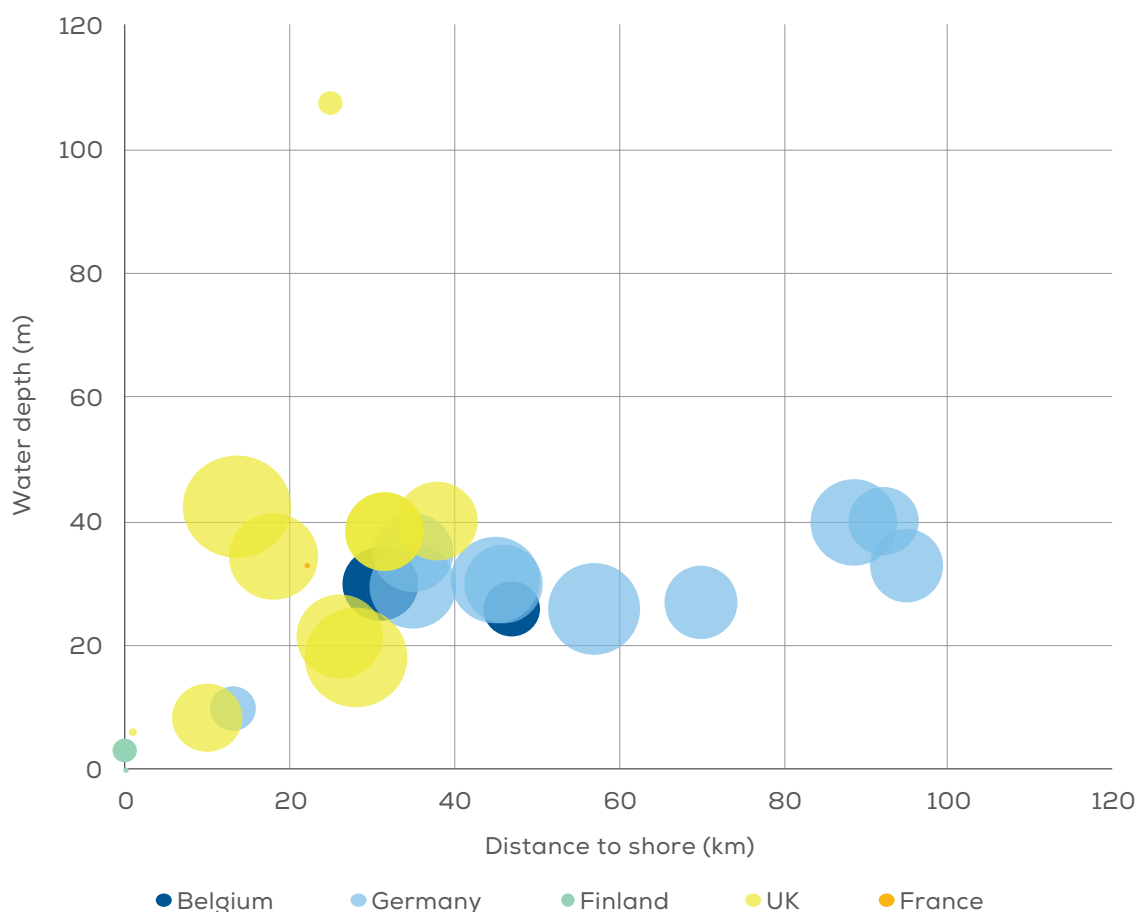
## 1.7 WATER DEPTH AND DISTANCE TO SHORE

The average water depth of offshore wind farms where work was carried out in 2017 was 27.5 m, slightly less than in 2016 (29.2 m). The average distance to shore for those projects was 41 km, a small decrease on the previous year (43.5 km).

Hywind Scotland, the first floating offshore wind farm in the world, has an average water depth twice as deep as that of other bottom-fixed offshore wind farms where work was carried out in 2017.

**FIGURE 10**

Average water depth and distance to shore of offshore wind farms under construction during 2017. The size of the bubble indicates the overall capacity of the site.



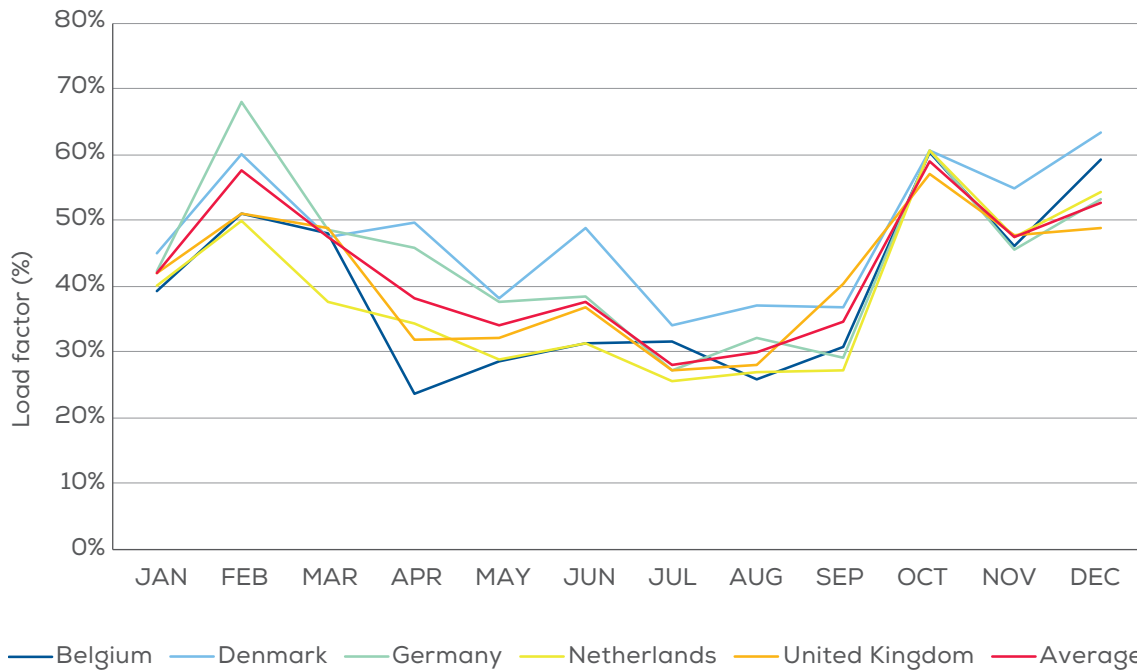
Source: WindEurope

## 1.8 GENERATION AND CAPACITY FACTORS

Below is WindEurope’s analysis of offshore wind capacity factors in the five largest offshore wind markets in 2017. The annual capacity factors of offshore wind in these countries range from 29%-48%, depending on methodology.<sup>6</sup>

The highest monthly capacity factor was in Germany in February 2017, with a capacity factor of 67.9%.

**FIGURE 11**  
Monthly national capacity factors of offshore wind in 2017 (percent)<sup>7</sup>



Source: WindEurope

6. Annual load factors based on BEIS DUKES methodology and WindEurope’s in-house methodology (see below).  
 7. Load factors are modelled by WindEurope from reported TSO generation data and installed capacity tracked in-house. Modelled generation is applied to capacity which sits on DSO networks. Additional installed capacity during the year is accounted for via linear interpolation between reporting periods.



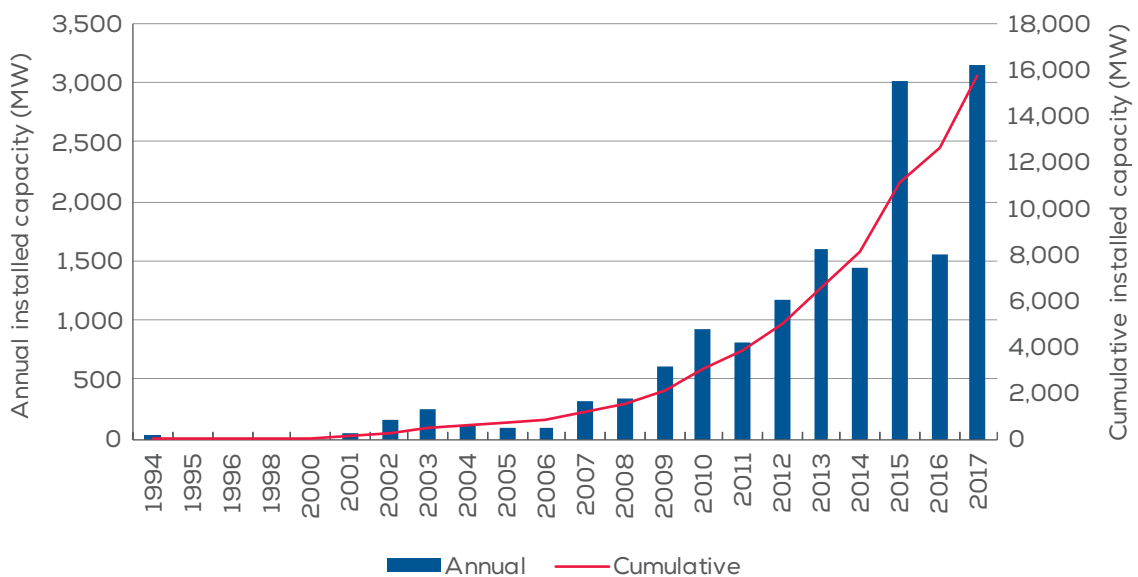
# 2.

## CUMULATIVE DATA

Europe's cumulative installed offshore wind capacity reached 15,780 MW at the end of 2017. Including sites with partial grid connection, there are now 92 offshore

wind farms in 11 European countries and 4,149 wind grid-connected turbines.

**FIGURE 12**  
Cumulative and annual offshore wind installations (MW)



Source: WindEurope

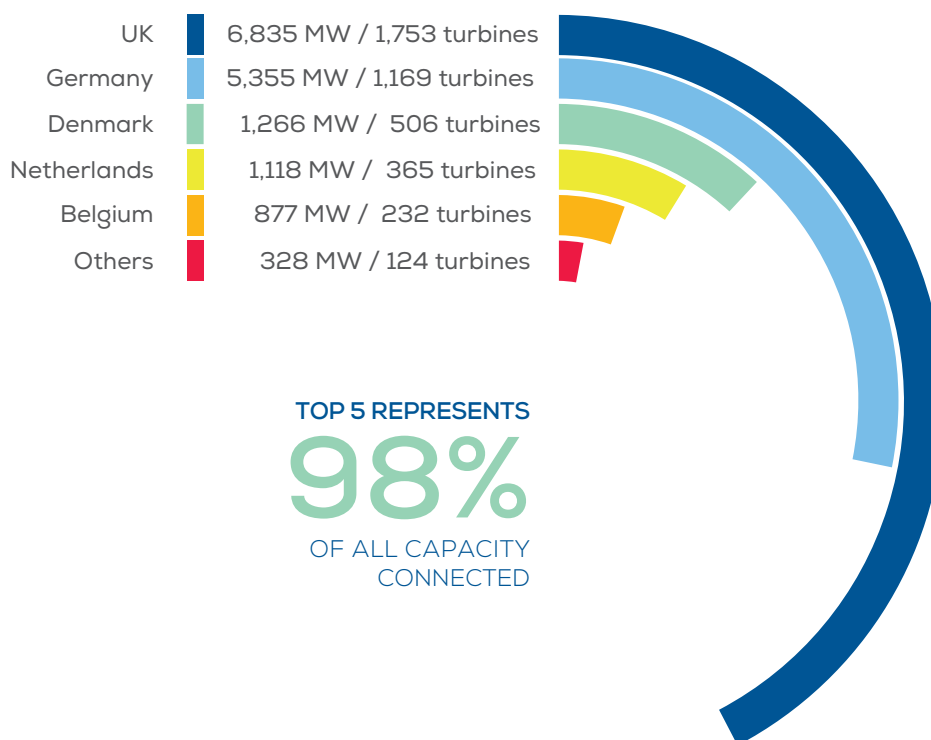
## 2.1 GEOGRAPHICAL BREAKDOWN

TABLE 3

Number of wind farms with grid-connected turbines, number of turbines connected and number of MW grid-connected at the end of 2017 per country

COUNTRY	NO. OF FARMS	NO. OF TURBINES CONNECTED	CAPACITY INSTALLED (MW)	CAPACITY INSTALLED/ DECOMMISSIONED IN 2017 (MW)
UK	31	1,753	6,835	1,679
GERMANY	23	1,169	5,355	1,247
DENMARK	12	506	1,266	-5
NETHERLANDS	7	365	1,118	0
BELGIUM	6	232	877	165
SWEDEN	5	86	202	0
FINLAND	3	28	92	60
IRELAND	2	7	25	0
SPAIN	1	1	5	0
NORWAY	1	1	2	0
FRANCE	1	1	2	2
<b>Total</b>	<b>92</b>	<b>4,149</b>	<b>15,780</b>	<b>3,148</b>

Source: WindEurope

**FIGURE 13****Installed capacity – Cumulative share by country**

Source: WindEurope

The UK has the largest amount of installed offshore wind capacity in Europe, representing 43% of all installations.

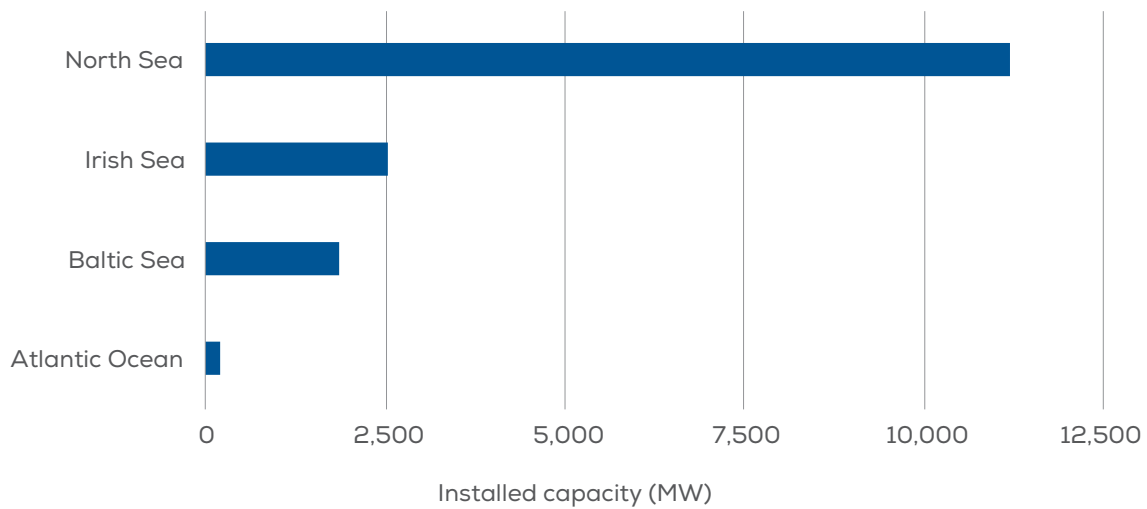
Germany follows with 34%. Denmark remains the third largest market with 8%, despite no additional capacity in 2017. The Netherlands (7%) and Belgium (6%) remain at the third and fourth largest share respectively in Europe.

France has installed its first offshore wind turbine, a floating turbine representing a total of 2 MW of net installed capacity.

In terms of the number of grid-connected wind turbines in Europe, the UK leads the market with 43% of all grid-connected turbines, followed by Germany (28%), Denmark (12%), the Netherlands (9%) and Belgium (6%), representing the top five markets.

Combined, the top five countries represent 98% of all grid-connected turbines in Europe.

**FIGURE 14**  
**Installed capacity – Cumulative share by sea basin (MW)**



Source: WindEurope

Installations in the North Sea account for 71% of all off-shore wind capacity in Europe. The Irish Sea has 16% of

installed capacity, followed by the Baltic Sea with 12% and the Atlantic Ocean (1.2%).

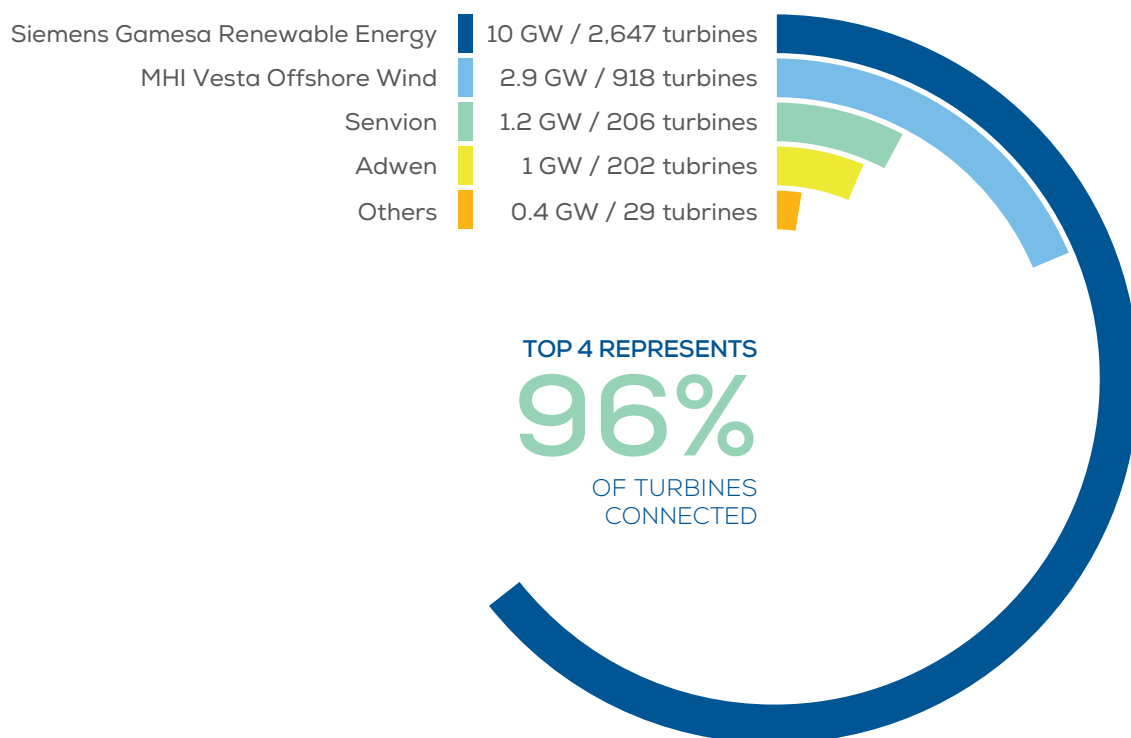
## 2.2 CUMULATIVE MARKET SHARE: WIND TURBINE MANUFACTURERS

Siemens Gamesa Renewable Energy has the most offshore wind turbines in Europe with 64% of the total installed capacity. MHI Vestas Offshore Wind (18%) is the second biggest turbine supplier, followed by Senvion (8%) and Adwen (6%).

Wind follows with a share of 22%, with Senvion (5%) and Adwen (5%) making up the remaining top 4. The top 4 represents 96% of the total number of turbines connected.

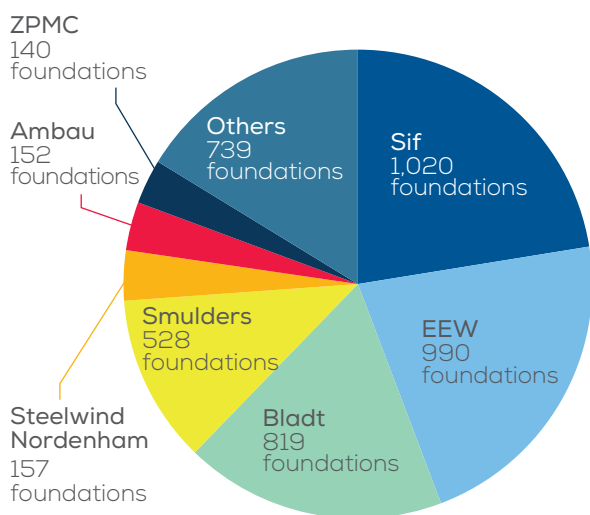
Siemens Gamesa Renewable Energy has a share of 64% of grid-connected turbines in Europe. MHI Vestas Offshore

**FIGURE 15**  
Wind turbine manufacturers' share at the end of 2017



Source: WindEurope

**FIGURE 16**  
Foundation manufacturers' share at the end of 2017 (installed foundations)



Sif has the largest overall share of installed foundations, representing 22.4% of all substructures installed in Europe.

EEW (21.8%), Bladt (18%), Smulders (11.6%) and Steelwind Nordenham (3.5%) make up the remaining top 5 foundation manufacturers.

Source: WindEurope

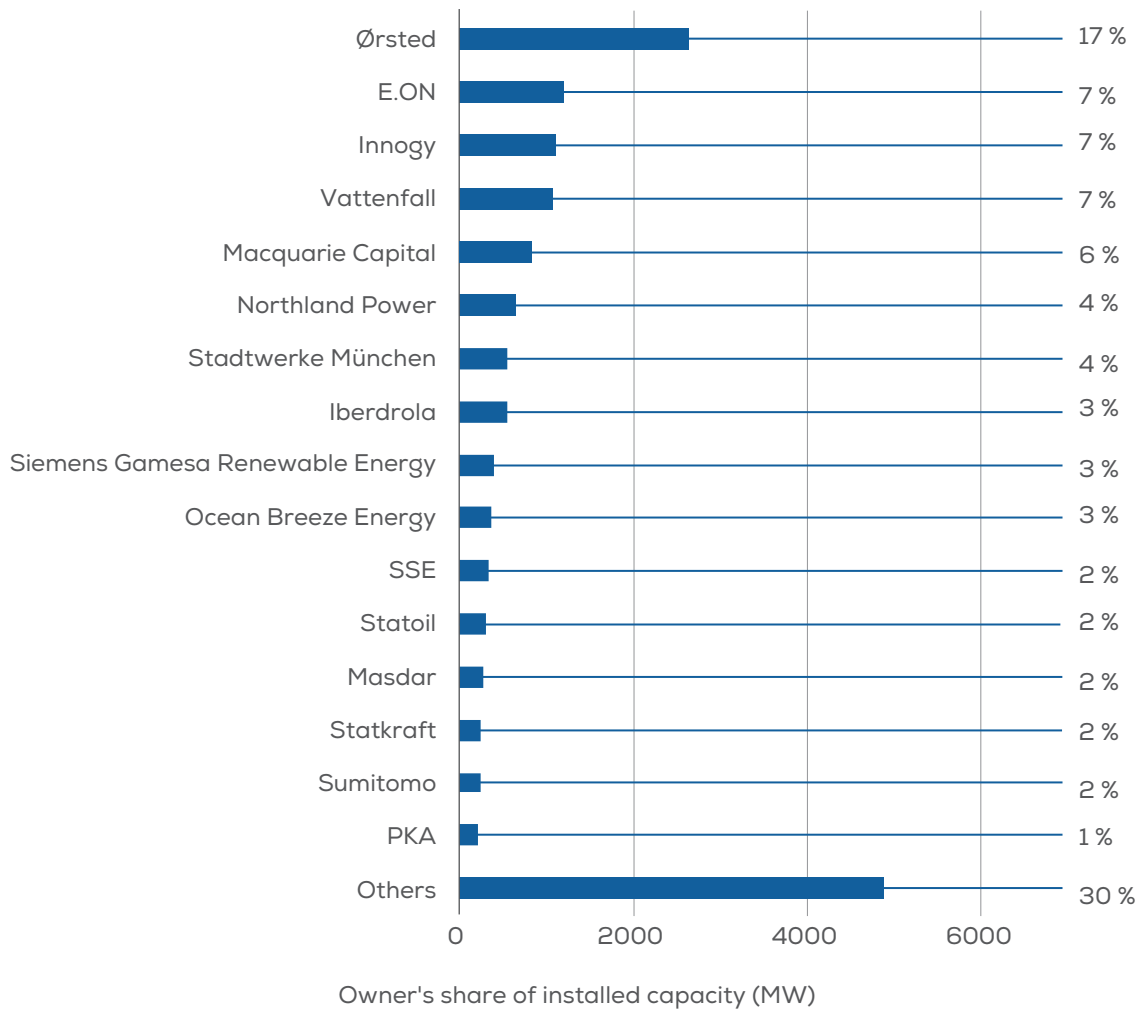
## 2.3 CUMULATIVE MARKET SHARE: WIND FARM OWNERS

Ørsted is the largest owner of offshore wind power in Europe with 17% of cumulative installations at the end of 2017, over a slight increase from last year.

and Northland Power (4%). The top five owners represent 42% of all installed capacity in Europe, a slight decrease compared to the end of 2016.

E.ON is the second largest owner with 8% of installed capacity owned, followed by Innogy (7%), Vattenfall (7%),

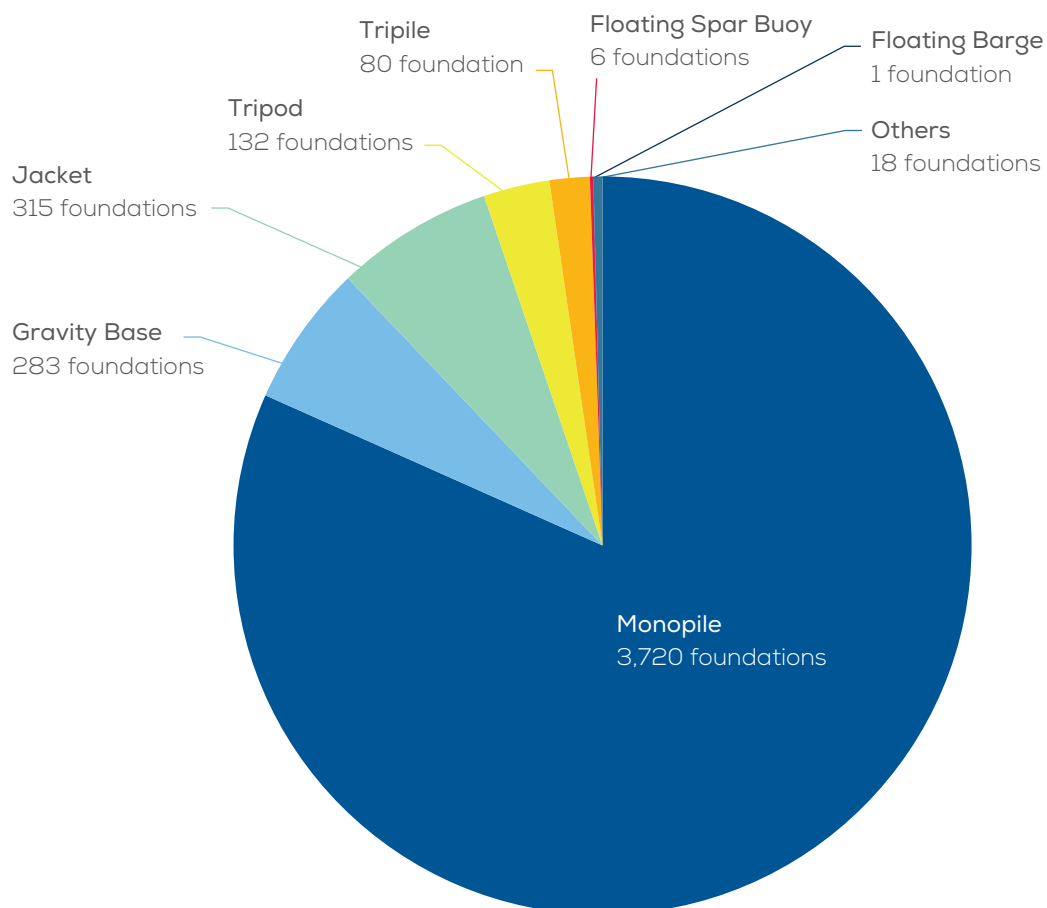
**FIGURE 17**  
Owners' share of installed capacity (MW)



Source: WindEurope

## 2.4 CUMULATIVE MARKET SHARE: SUBSTRUCTURES

**FIGURE 18**  
Share of substructure types for grid-connected wind turbines (units)



Source: WindEurope

Monopiles represent 81.7% of all installed substructures in Europe.

construction at Beatrice 2. Two new types of foundation were introduced: floating spar buoys and floating barges.

Tripile (1.8%) and Tripod (2.9%) saw no additional installations, although the share in jackets (6.9%) rose due to

# 3.

# MARKET OUTLOOK

In 2019 Europe will see another record of offshore wind power connected to the grid. This is mainly due to the delay of consenting Round 3 projects in the UK in 2016. There are 400 MW currently in construction there, which will connect to the grid throughout 2018. Germany will connect turbines from Merkur and Borkum Riffgrund projects in 2018 too. Belgium will connect turbines in Rentel and Norther wind farms too. Winning projects of recent tenders in Denmark and the Netherlands will start to connect capacity towards the end of 2018.

However, the number of grid-connected projects will fall towards 2020 as European Member States meet their National Renewable Energy Action Plans (NREAPs) under the current Renewable Energy Directive, which covers the period up to 2020. However, a good level of construction activity will continue.

By 2020 WindEurope expects a total European offshore wind capacity of 25 GW. The offshore market will concentrate mainly in the UK, with 3.3 GW of new grid-con-

nected capacity in the period between 2018 and 2020, followed by Germany with 2.3 GW, Belgium with 1.3 GW, the Netherlands with 1.3 GW and Denmark with 1.0 GW.

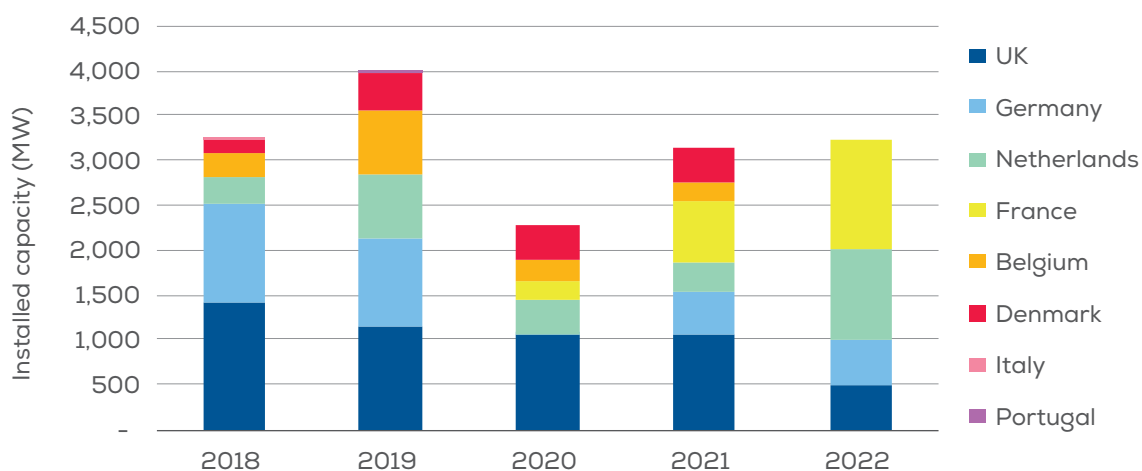
In 2021 and 2022, WindEurope expects 3.1 GW and 3.2 GW respectively. The first French projects are likely to start feeding electricity to the grid by 2021, making it the second largest market in that year after the UK. Projects in Germany, Belgium and the Netherlands will connect capacity too. The latter country will top the market by 2022 with the connection of Borselle III and IV and Hollandse Kust Zuid I, II, III & IV.

The projection to 2022 includes:

- Projects under construction and awaiting grid connection (2.9 GW);
- Projects consented (13.2 GW)
  - with a FID and for which construction will start before 2022, and
  - projects awarded in auctions but without FID.

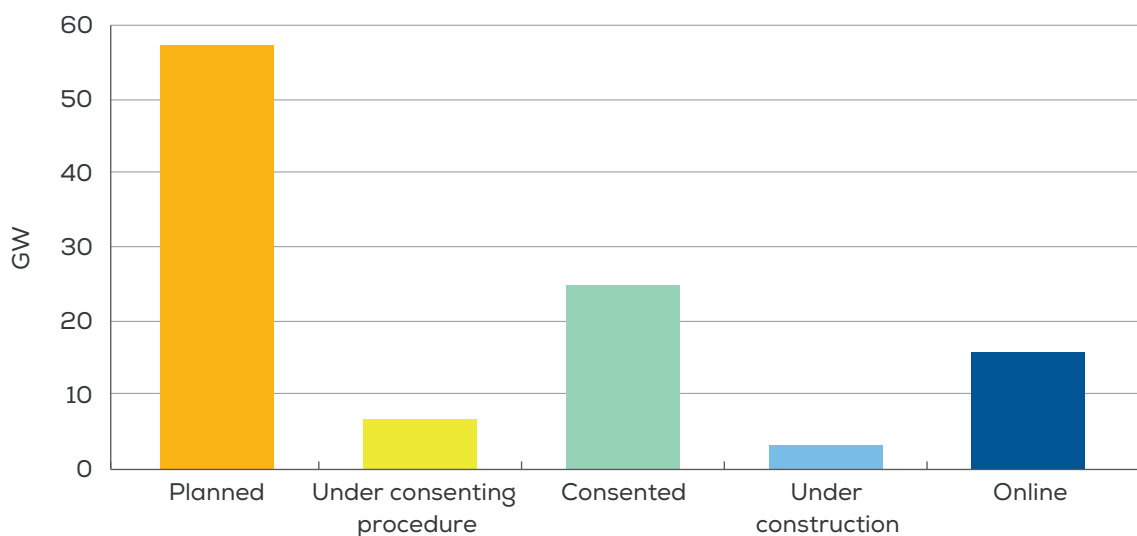


**FIGURE 19**  
Project pipeline: five year outlook<sup>8</sup>



Source: WindEurope

**FIGURE 20**  
Offshore market: Projects online, under construction and consented (GW)



Source: WindEurope

WindEurope has identified 11.4 GW which have obtained consent to construct, and a further 6.7 GW of projects that are applying for permits.

However, beyond 2022, there is uncertainty over the EU market for offshore wind. Member States have just started drafting their National Climate Action Plans (NCAPs) for the post-2020 period. A few countries have stated politi-

cal commitments, but today Germany is the only country with clear volume commitments enshrined in legislation. The Renewable Energy Act (EEG) commits to 700 MW of offshore wind power per year from 2023-2025 and 840 MW per year from 2026-2030.

The UK has recently announced the next Contract for Difference (CfD) auction will take place in spring 2019, with

1. Projection based on analysis of government data and in-house analysis. WindEurope C3 members and above can enquire for further outlook analysis.

up to £557m funding available for so-called less established renewables, such as offshore wind. The Netherlands has stated its ambition to install 1 GW per year between 2023 and 2030. These commitments partly cover the 57 GW of projects in the planning phase.

The EU post-2020 regulatory framework and cost reductions in industry will be key drivers for offshore wind towards 2030. WindEurope expects a total capacity of 70 GW

of offshore wind energy by 2030 in its Central Scenario<sup>9</sup>. Most of this capacity will be in the North Sea, with almost 48 GW. The uptake of offshore wind in the Baltic Sea will also play a key role, with potentially 9 GW of installed capacity by 2030.

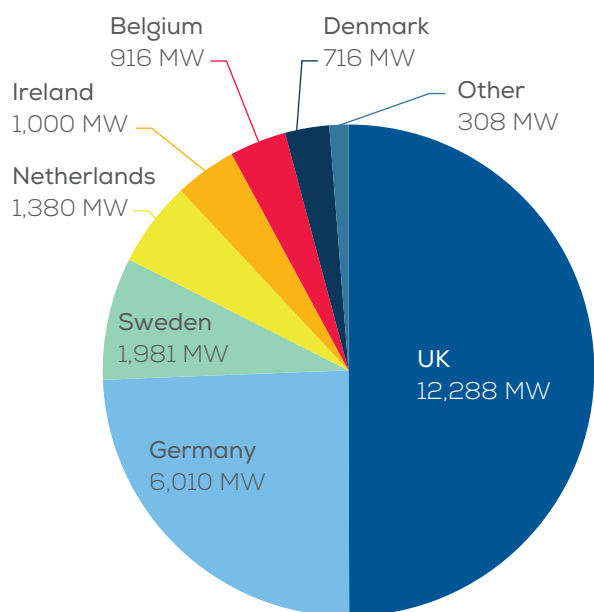
**TABLE 4**  
Offshore wind power cumulative capacity to 2030

	CENTRAL (MW)	LOW (MW)	HIGH (MW)
United Kingdom	22,500	18,000	30,000
Germany	15,000	14,000	20,000
Netherlands	11,500	4,500	18,500
France	7,000	4,300	11,100
Denmark	4,300	3,400	6,130
Belgium	4,000	1,600	4,000
Poland	3,200	2,200	6,000
Ireland	1,800	1,200	2,000
Estonia	600	-	1,200
Sweden	300	300	800
Portugal	150	-	175
Italy	-	-	650
<b>Total</b>	<b>70,200</b>	<b>49,500</b>	<b>98,930</b>

Source: WindEurope

1. Wind energy in Europe: Scenarios for 2030, WindEurope.

**FIGURE 21**  
Share of consented offshore wind capacity per country (MW)

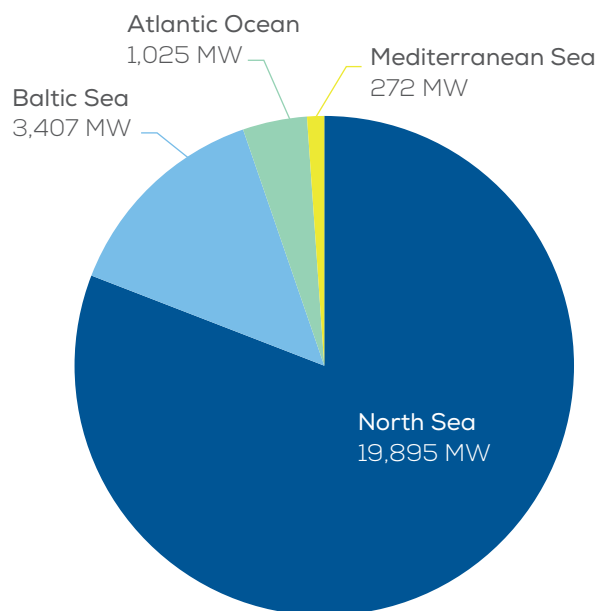


Source: WindEurope

The UK has the highest share of offshore wind capacity (50%) which has received government consent to construct, followed by Germany (24.4%), Sweden (8.1%), the Netherlands (5.6%) and Ireland (4.1%) in the top five.

However, there is no immediate outlook for projects to be constructed in Ireland or Sweden.

**FIGURE 22**  
Share of consented offshore wind capacity by sea basin (MW)



Source: WindEurope

In the medium term, an analysis of consented wind farms confirms that the North Sea will remain the main region for offshore deployment (80.9% of total consented capacity) followed by the Baltic Sea (13.9%).

An increase of 3 GW in the share of consented projects in the Atlantic (4.2%) is expected once French projects receive full consent.

There are consented projects in the Mediterranean Sea (1.1%), but no significant momentum is expected there before 2020. A few floating projects in France and one bottom-fixed project in Italy is planned for the period before 2020 in that sea basin. With the start of activities at the Walney extension project, there is no offshore deployment planned in the Irish Sea in the medium term.

# 4.

## TRENDS: TURBINE SIZE, DEPTH, DISTANCE FROM SHORE

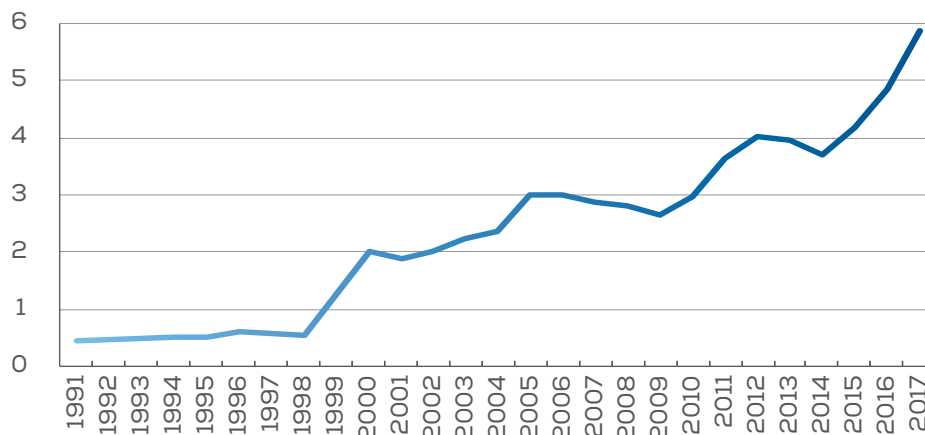
### 4.1 WIND TURBINE RATED CAPACITY

The rated capacity of offshore wind turbines has grown 102% over the past decade. The average rated capacity of newly-installed turbines in 2017 was 5.9 MW, 23% larger

than 2016. The first floating wind farm was installed and already feeds power to the grid, reflecting the rapid pace of technological development in the floating wind sector.

**FIGURE 23**

Yearly average of newly-installed offshore wind turbine rated capacity (MW)



Source: WindEurope

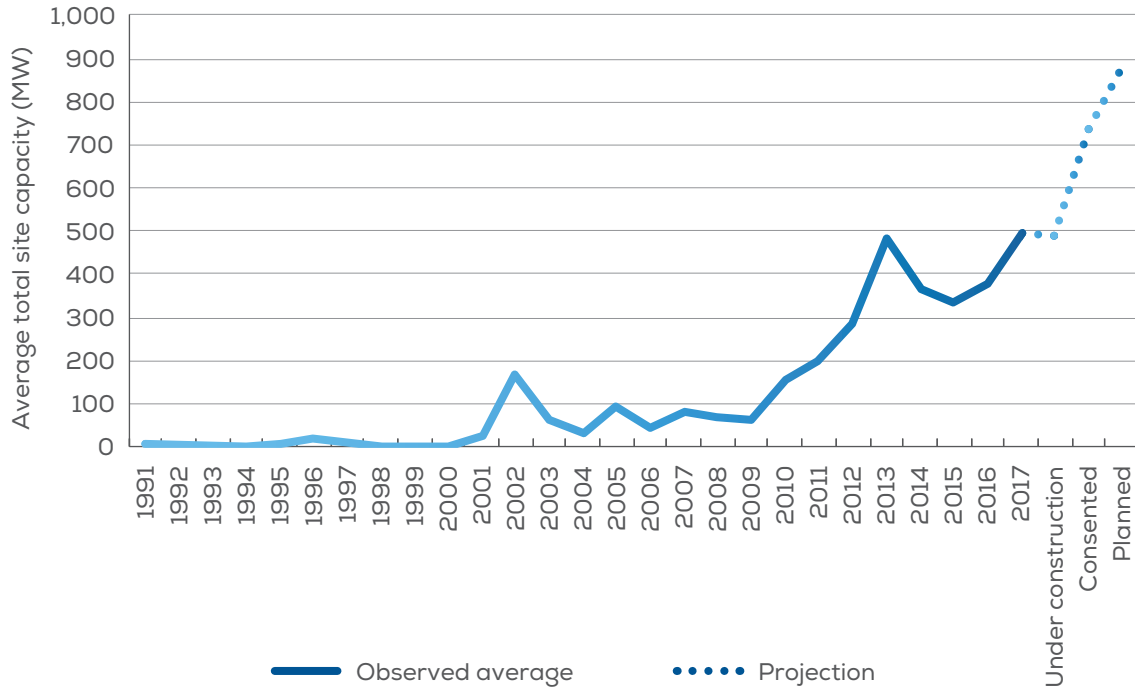
## 4.2 WIND FARM SIZE

In the last ten years, the average wind farm has increased in size dramatically, from 79.6 MW in 2007 to 493 MW for offshore wind farms under construction in 2017.

The 1.2 GW Hornsea One project is the largest offshore wind farm to reach Final Investment Decision (FID) to date, and construction will start in 2018.

**FIGURE 24**

Average size of offshore wind farm projects (MW) commissioned per year

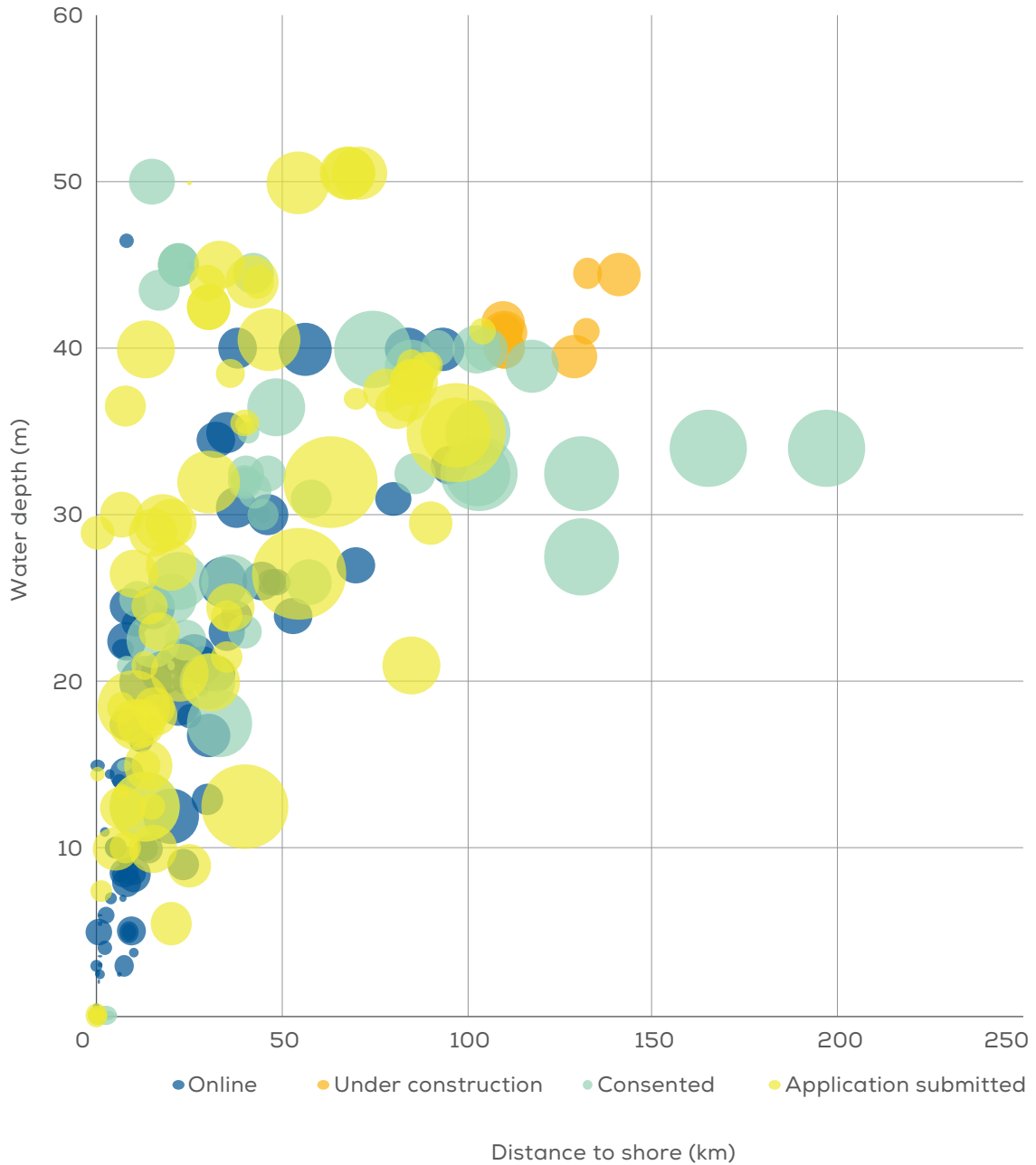


Source: WindEurope

### 4.3 WATER DEPTH AND DISTANCE TO SHORE

The average water depth of offshore wind farms with grid connections in 2017 was 27.5 m and the average distance to shore was 41 km.

**FIGURE 25**  
Average water depth and distance to shore of bottom-fixed offshore wind farms, organised by development status. The size of the bubble indicates the overall capacity of the site.



Source: WindEurope

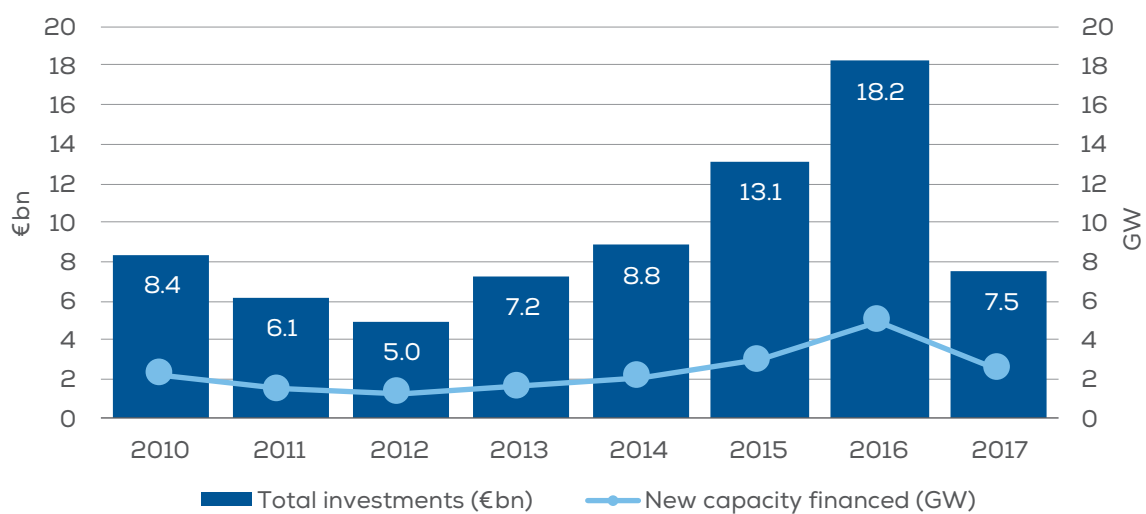
# 5. INVESTMENTS

## 5.1 FINANCING ACTIVITY IN 2017

New offshore wind investments in Europe saw a 60% decline in 2017, down to €7.5bn.<sup>10</sup> This is the first decrease the sector has experienced since 2012. The transition to

auctions has resulted in a lull in Final Investment Decisions (FID). WindEurope expects the auctions of the last two years now to lead to new project FIDs in 2018.

**FIGURE 26**  
New offshore wind investments and capacity financed: 2010 – 2017 (€bn)



Source: WindEurope

<sup>10</sup> Figures include estimates for undisclosed project values.

Six projects with a combined capacity of 2.5 GW reached Final Investment Decision (FID) in 2017. Investments in 2017 were concentrated in two countries: the UK and

Germany. The majority of the new capacity financed – a total of 56% – was in the UK, including Hornsea 2, the largest offshore wind farm to date to reach FID.

**TABLE 1**  
Investment in European offshore wind farms in 2017

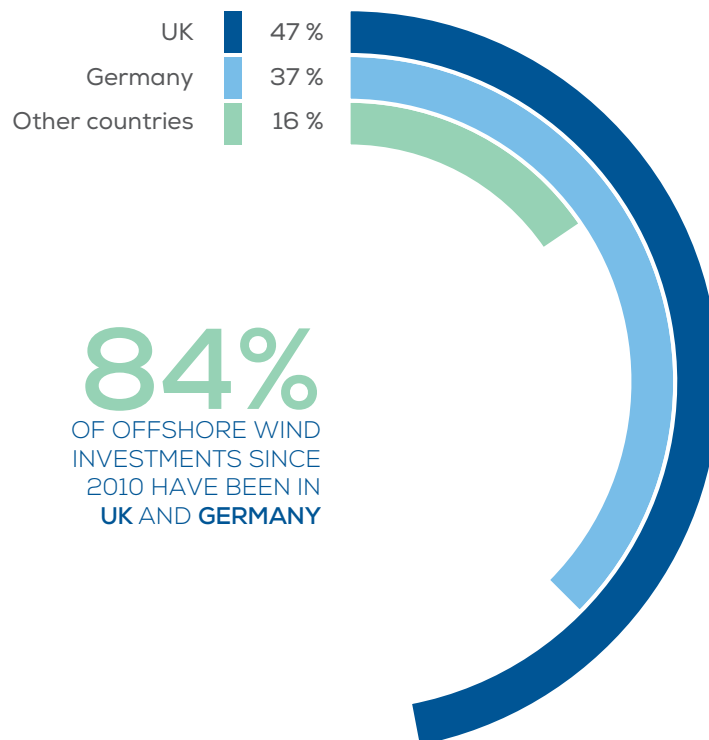
	NEW ASSETS FINANCED (€bn)	NEW CAPACITY FINANCED (GW)	NUMBER OF PROJECTS
Germany	3.8	1.1	4
UK	3.7	1.4	2
Total	7.5	2.5	6

Source: WindEurope

Since 2010 the UK has attracted 47% of new investments, worth €35bn, making it the biggest offshore wind market for capital spending commitments over the last eight

years. Germany follows with 37% or €28bn in investments since 2010.

**FIGURE 27**  
Geographical concentration of offshore wind investments since 2010



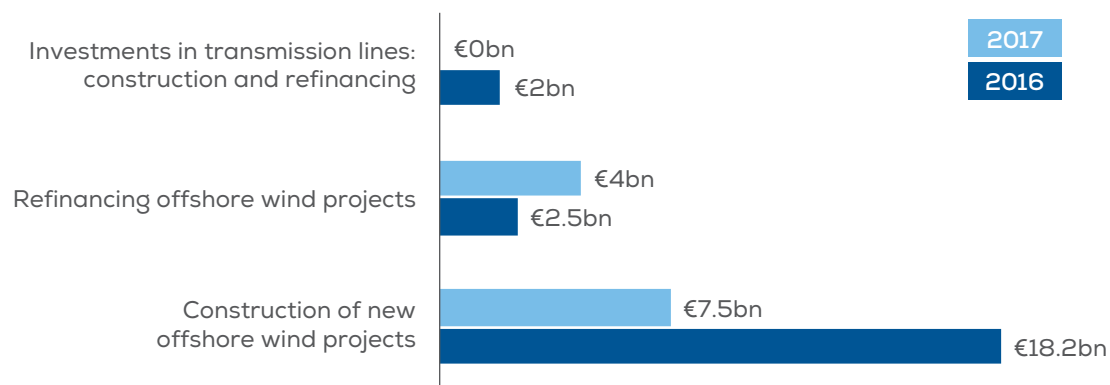
Source: WindEurope



In addition to the investments in new wind farms, 2017 also saw €4.6bn in refinancing transactions, an 85% increase over 2016. No new investments in transmission

assets were announced in 2017. Offshore wind generated a total financing activity of €12.1bn.

**FIGURE 28**  
Investments in the offshore wind sector in 2017 (€bn)



Source: WindEurope

## 5.2 OFFSHORE WIND DEBT FINANCE

Non-recourse debt remained an important instrument in offshore wind financing. In 2017 lenders extended €6.2bn of non-recourse debt across eight transactions for the financing of both new and operational wind farms.

Non-recourse debt for new asset finance dropped to €1.6bn in 2017. Only two new projects used non-recourse structures in 2017. These include Borkum West II Phase II and Deutsche Bucht in Germany.

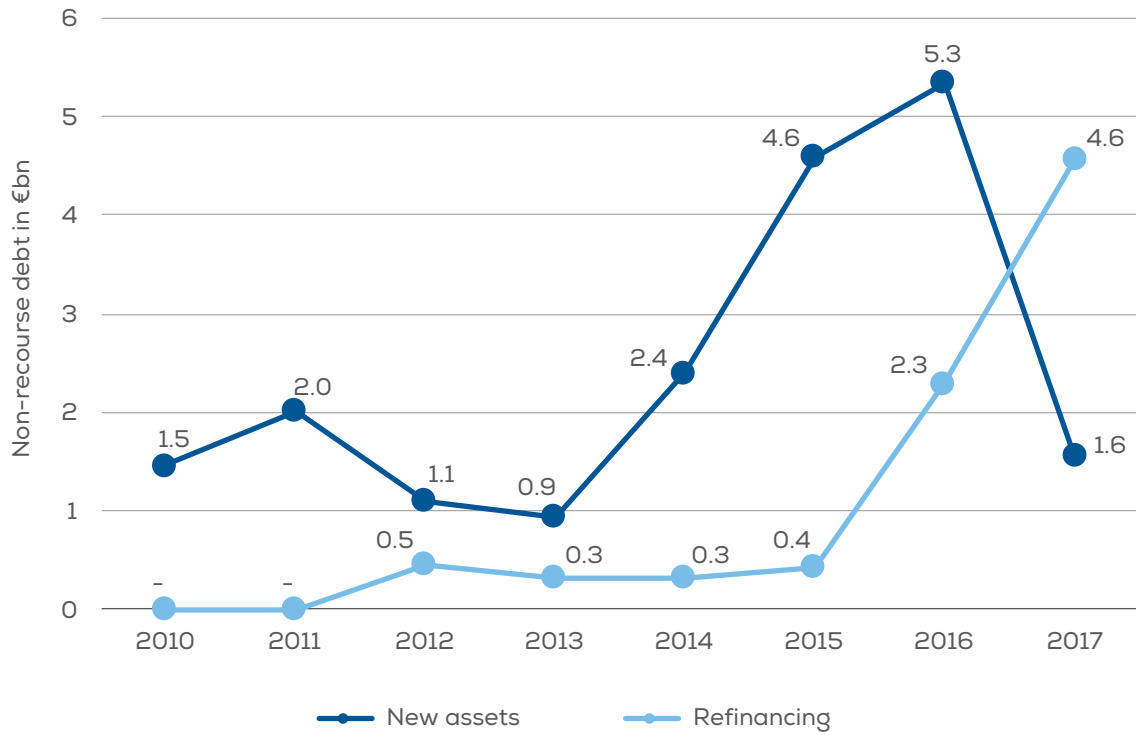
Refinancing in the European offshore wind market has risen steeply in the last three years. Six refinancing transactions in Belgium, Germany and the UK were finalised in 2017, raising a total of €4.6bn in non-recourse debt. Project sponsors have used the favourable market conditions and increased liquidity to restructure their project debt. This trend also accelerated due to changing financial structures. As power producers carry their projects through the FID phase on their balance sheets, refinancing activities or the sale of minority stakes are now incorporated early in the financial arrangement of projects.

The refinancing transactions of 2017 also included three project bonds reflecting the reduced risk perception for offshore wind projects. The three issuances combined raised a record €2.5bn and supported the refinancing of 1.3 GW of capacity under construction in Borkum Riffgrund 2, Walney Extension and Northwind. The last two also represent the first investment grade bonds issued for projects under construction in the UK and Belgium.

The attractive sector yields have diversified the profile of lenders. A mix of 20 lenders were active in 2017, including multilateral financial institutions, export credit agencies and commercial banks. As confidence grows in the European offshore wind sector, both Japanese and Canadian banks continued to strengthen their presence in the market.

**FIGURE 29**

Non-recourse debt trends per type of transaction (€bn)



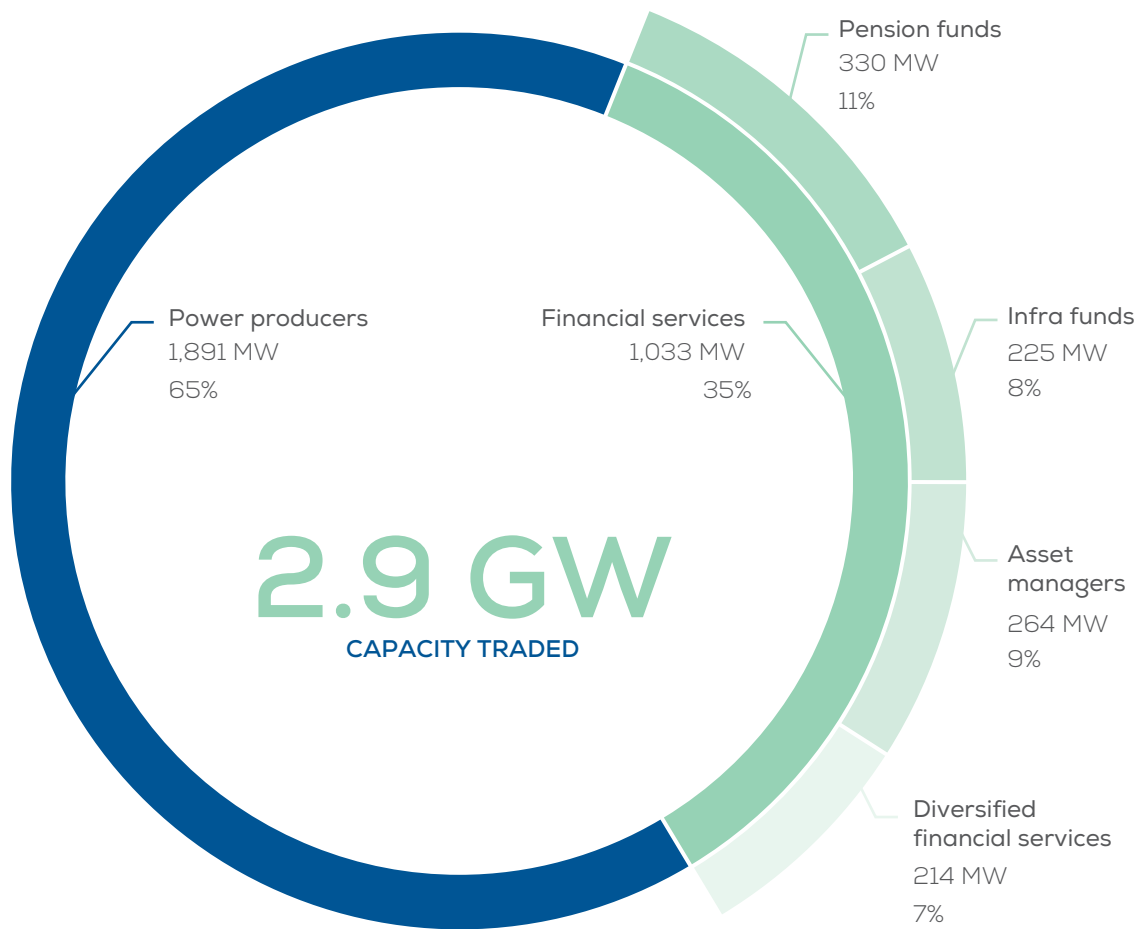
Source: WindEurope

### 5.3 PROJECT ACQUISITION ACTIVITY

With 2.9 GW, project acquisition activity sustained the same level as the year before. However, the equity mix continues to bring in more financial investors. The financial services industry, including infrastructure funds, pen-

sion funds, asset managers and diversified financial services own 35% of the capacity traded throughout 2017. This compares to only 27% in 2016.

**FIGURE 30**  
Project acquisition activity in 2017 by type of investor

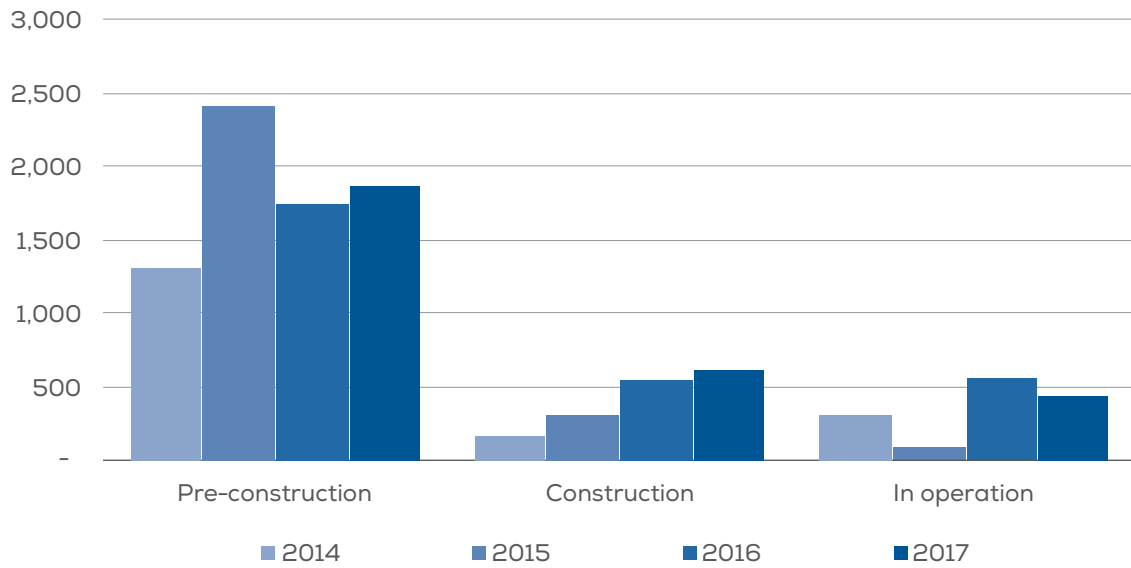


Source: WindEurope

The majority of these transactions happened at pre-construction stage, the most critical phase for a project’s fundraising. In the last three years, transactions at the construction and operation phase have increased significantly.

This is largely due to the increased presence in the equity mix of financial investors, who prefer to join a project at late construction or operational phase.

**FIGURE 31**  
Project acquisition activity in 2017 per project phase (in MW)



Source: WindEurope

## 5.4 OUTLOOK FOR 2018

Projects expected to go through FID in 2018 are estimated to have a combined capacity of 3.9 GW. This includes a number of projects in the UK, Denmark, the Netherlands,

as well as floating offshore wind projects in Portugal and France. Financing needs could top €9bn based on disclosed transaction costs.

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**EUROPE**

Rue d'Arlon 80, 1040 Brussels, Belgium  
T +32 2 213 1811 · F +32 2 213 1890  
[windeurope.org](http://windeurope.org)