



# The European offshore wind industry key 2011 trends and statistics

January 2012

A report by the European Wind Energy Association

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**Design:** EWEA  
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 Published in January 2012

# Executive summary

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## 2011 offshore wind power market

- 235 new offshore wind turbines, in nine wind farms, worth some €2.4 billion, were fully grid connected between 1 January and 31 December 2011, totalling 866 MW, 17 MW less than 2010.
  - 246 turbines were erected during 2011, an average of 2.6 MW per day. 81 of these turbines are awaiting grid connection.
  - Three experimental floating concepts were erected, one of which was a full-scale grid connected concept.
  - Offshore work began on a further five projects and preparatory onshore work on nine new projects.
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## Cumulative offshore wind power market

- 1,371 turbines installed and grid connected, totalling 3,813 MW in 53 wind farms in ten European countries: up from 1,136 turbines, totalling 2,946 MW in 45 wind farms in nine European countries end 2010.
  - 75% of substructures are monopiles, 21% gravity based, jackets 2% and tripiles 2%. There are also two full scale grid-connected floating turbines.
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## Market outlook

- Once completed, the nine offshore projects currently under construction will increase installed capacity by a further 2,375 MW, bringing cumulative capacity in Europe to 6,188 MW.
  - Preparatory work has started on nine other projects, these have a cumulative installed capacity of 2,910 MW.
- 

## Trends: turbines, foundations, water depth and distance to shore

- The average offshore wind farm size in 2011 was almost 200MW up 29% (45MW) on the previous year.
  - Average water depth in 2011 reached 22.8m, substantially more than last year.
  - Average distance to shore decreased, being 23.4km in 2011 compared to 27.1km the previous year. However, the distance of wind farms under construction is 33.2km.
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**Financing highlights and developments**

- In 2011 non-recourse debt financing for offshore wind farms increased by 40% on the previous year, from €1.46 billion to €2.05 billion with three transactions (Meerwind, Globaltech I, Baltic 1) closing in 2011.
- In 2011 with equity finance, more than 3 GW in net planned capacity changed hands, in addition to the investment commitments announced by a number of utilities and developers on projects they already own. DONG Energy has continued to be the most active equity player, both on the acquisition and on the sale side.

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**New turbine announcements**

- In 2011, 23 new wind turbine models were announced: 51 new models have been announced by 41 companies over the past two and a half years.

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**Offshore grid developments**

- The BritNed interconnector between Britain and the Netherlands was completed on time and within the established budget. Operation began in April 2011.
  - East-West link between Ireland and Britain is on track, whilst NorGer and NordLink cables between Norway and continental Europe have been delayed. The Cobra cable between Denmark and the Netherlands is awaiting final investment decision.
  - The European Commission is proposing €9.1 billion to accelerate planning and finance new energy infrastructure. Moreover, the EU's TEN-E plan has offered a grant to the NorthConnect project between Scotland and Norway.
  - A bottleneck in supply of High Voltage (HV) offshore cables is looming, but the prospects for supply of High Voltage Direct Current (HVDC) cables are brighter.
-

# 2011 annual market

## Offshore wind installations

During 2011, work was carried out on 15 offshore wind farms in Europe:

- two full-scale farms were fully completed and grid connected;
- three experimental floating concepts were tested, one of which full-scale and grid connected;
- five wind farms were partially completed and grid connected;
- one further turbine was installed at a pre-existing near-shore test site;
- in four other projects, offshore work has begun, but no turbines were connected during 2011.

Wind farm name	Status
Anholt (DK)	First foundation installed
Avedøre (DK)	Turbine installed and grid connected
Baltic 1 (DE)	Fully grid connected in 2011, all construction work completed in 2010
BARD offshore 1 (DE)	Turbines erected and grid connected, partially connected in 2010
Greater Gabbard (UK)	Most turbines erected, over half of the project online
Lincs (UK)	First foundations installed
London Array (UK)	First foundations installed
Ormonde (UK)	All turbines erected, over half grid connected
SeaTwirl (SE)	Installed and tested, subsequently de-commissioned
Sheringham Shoal (UK)	All foundations installed, most turbines erected, first turbines connected
SWAY (NO)	Installed, the experimental concept is not grid-connected
Thornton Bank phase 2 (BE)	First foundations installed
Walney 1 (UK)	Fully grid connected
Walney 2 (UK)	All foundations and turbines installed, partially grid connected
Windfloat (PT)	Installed and grid connected

Additionally, pre-piling has begun at Borkum West 2 in Germany and preparatory onshore work is beginning in eight further projects.

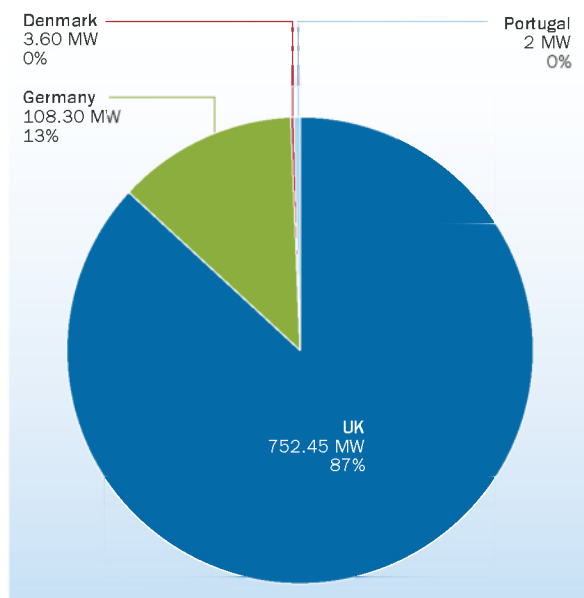


FIG 1: INSTALLED CAPACITY: SHARE OF 2011 INSTALLATIONS (MW)

With over 750 MW grid connected in British waters during 2011, 87% of new capacity was added in the United Kingdom. 108 MW were added in Germany (13%), a 3.6 MW turbine grid connected in Denmark.

Three experimental floating turbines were also installed in Norway, Sweden and Portugal. The latter being the only full-scale, grid connected model (2 MW) of the three and the first full-scale offshore turbine in southern European waters.

Country	United Kingdom	Germany	Denmark	Portugal	Total
No. of farms where turbines have been installed and connected in 2011	5	2	1	1	9
No. of wind turbines installed and connected in 2011	200	33	1	1	235
Capacity installed and grid connected in 2011 (MW)	752.45	108.30	3.60	2.00	866.35

## 2011 Annual market share – wind turbine manufacturers

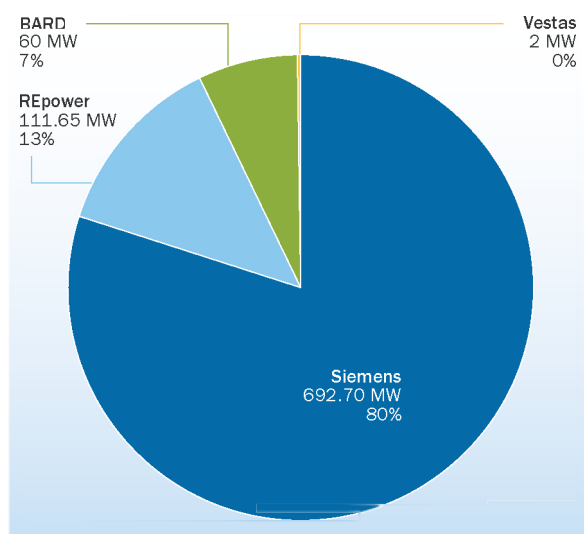


FIG 2: WT MANUFACTURERS: SHARE OF 2011 INSTALLATIONS (MW)

Siemens supplied the majority (80%) of the 2011 offshore wind player market. This confirms Siemens as a leading market player since the first offshore wind farms went online 20 years ago.

Siemens turbines accounted for almost 693 MW of grid connected capacity, followed by REpower (111.7 MW or 13% of the 2011 market) and BARD (60 MW, 7%). Vestas connected a full-scale 2 MW turbine on an experimental floating substructure in Portugal. The other experimental concepts installed in 2011 used down-scaled turbines and were not connected to the grid.

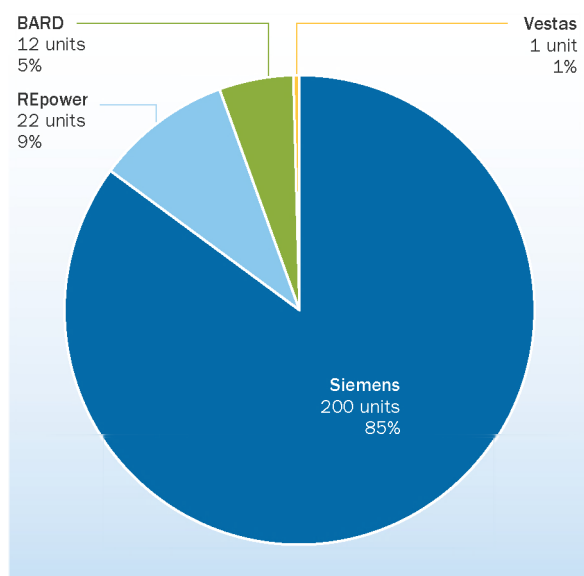


FIG 3: WT MANUFACTURERS: SHARE OF 2011 GRID CONNECTED TURBINES (UNITS)

Siemens installed and grid connected 200 turbines in 2011: 85% of all offshore turbines installed and connected during the year. REpower was in second place with 22 (9%), followed by BARD (12 turbines) and Vestas (one turbine).

## Wind turbine capacity

The average capacity of offshore wind turbines grid connected during 2011 was 3.6 MW.

## 2011 Annual market share – developers/utilities<sup>1</sup>

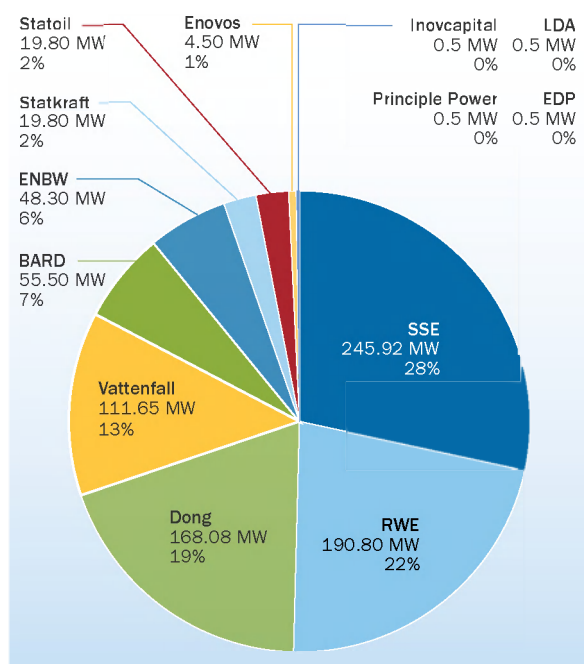


FIG 4: DEVELOPERS: SHARE OF 2011 OFFSHORE MARKET IN MW

Together SSE renewables (28%), RWE (22%), DONG (19%), Vattenfall (13%) and ENBW (6%) installed 88% of new offshore capacity in 2011, respectively 245.9 MW, 190.8 MW, 168.1 MW, 111.7 MW and 48.3 MW. Including investments made by Statoil, Statkraft and EDP's participation in an experimental project, over 90% of all offshore wind investments in 2011 were made by utilities. BARD (55.5 MW, 7%) is the only noticeable exception.

<sup>1</sup> The grid connected market shares are indicative only. Projects owned or developed by several companies have been split according to the respective shares. Where the shares are not known, they have been split in equal parts between the partners

## Substructure type

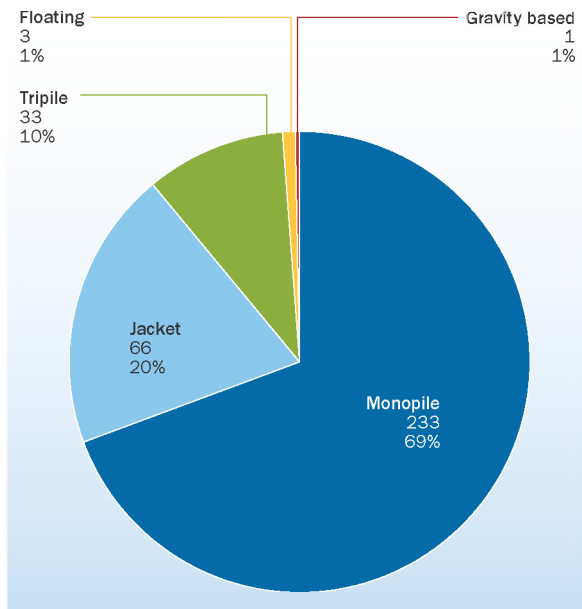


FIG 5: SUBSTRUCTURE TYPES IN 2011 OFFSHORE WIND FARMS

With 233 units installed in 2011, monopile foundations remain the most common substructure for offshore turbines. Their share (69.3%) is similar to the previous year. After monopiles, jackets (66 units) were the most commonly used substructures, followed by tripiles (33). One gravity based structure was used on a near-shore project and three floating substructures were also installed, more than in any other year.

## Water depth and distance to shore

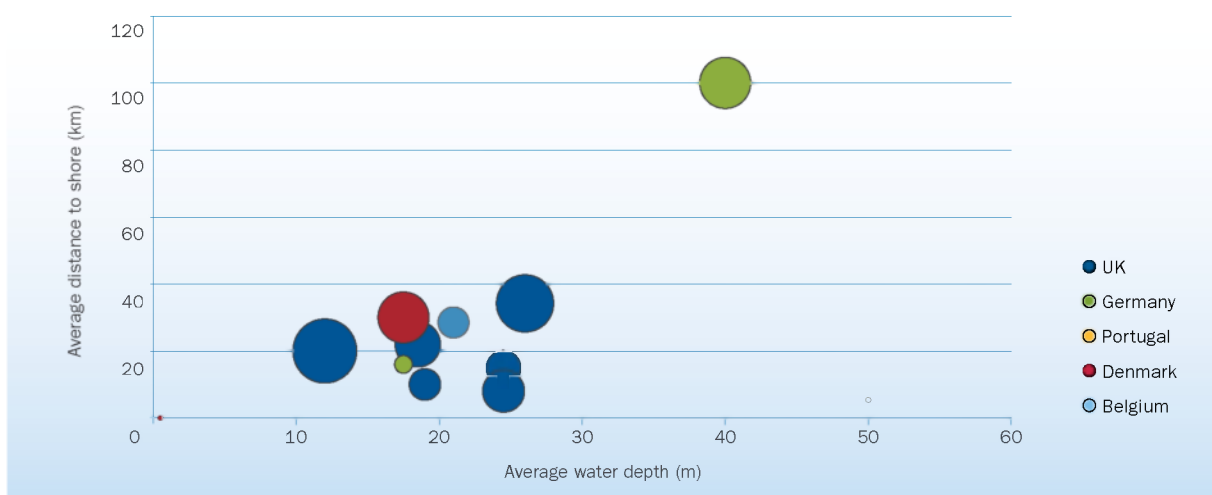
The average water depth of offshore wind farms where work was carried out during 2011 was 22.8 metres. This is substantially more (+31%) than in 2010 when average water depth was 17.4m.

The average distance to shore has decreased: 27.1 km in 2010, 23.4km in 2011. This is partly due to the

installation of one test turbine close to the harbour wall at Avedøre in Denmark. Removing the latter from the calculation, average distance to shore in 2011 was 25.3km.

Figure 6 shows average water depth and distance to shore of the wind farms under construction in 2011, their size in MW and colour coded per country.

FIG 6: AVERAGE DISTANCE TO SHORE AND WATER DEPTH OF OFFSHORE WIND FARMS





## Cumulative market

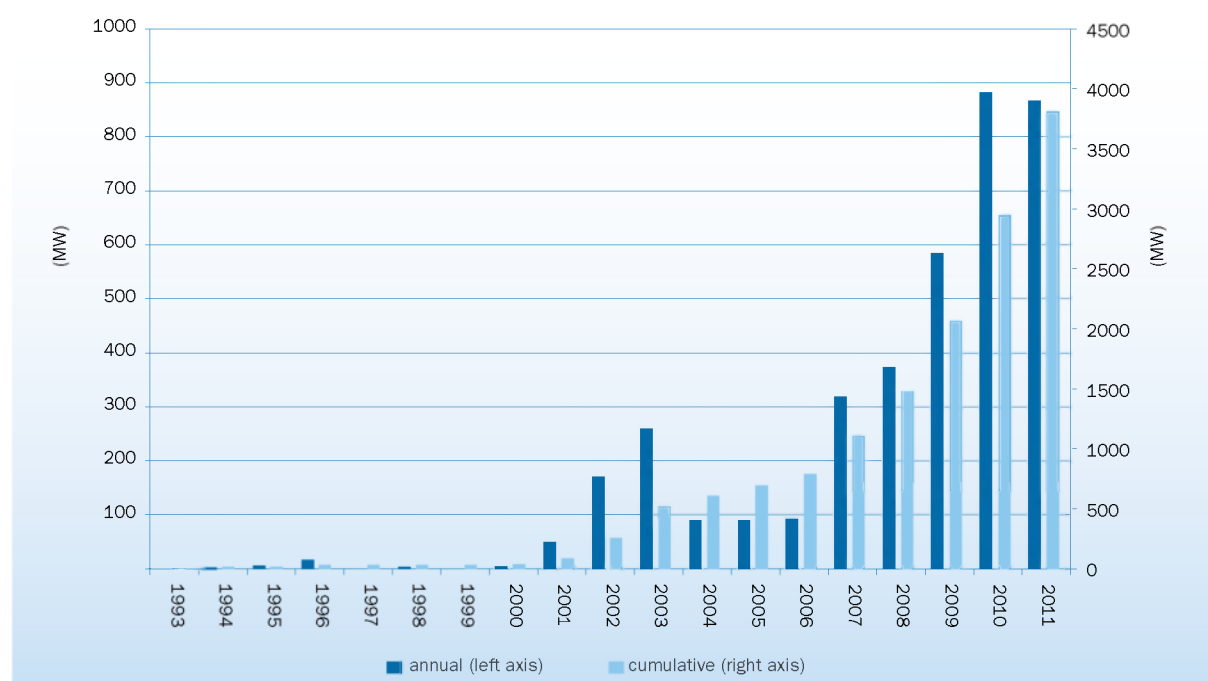
A total of 1,371 offshore turbines are now installed and grid connected in European waters totalling 3,812.6 MW spread across 53 wind farms in 10 countries. The offshore wind capacity installed by the end of 2011 will produce, in a normal wind year, 14 TWh of electricity, enough to cover 0.4% of the EU's total consumption.

In 2010, Thanet, a 300 MW project in the UK, was the largest offshore wind farm completed and fully grid connected in the world. During 2011 over 380 MW were installed at Greater Gabbard, also in the UK. Once completed, Greater Gabbard's total capacity will be 504

MW. However, construction has also started on the first phase of the London Array project. Once completed, it will be 630 MW.

The UK is by far the largest market with 2,094 MW installed, representing over half of all installed offshore wind capacity in Europe. Denmark follows with 857 MW (23%), then the Netherlands (247 MW, 6%), Germany (200 MW, 5%), Belgium (195, 5%), Sweden (164, 4%), Finland (26 MW in near-shore projects) and Ireland 25 MW. Norway and Portugal both have a full-scale floating turbine (2.3 MW and 2 MW respectively).

FIG 7: CUMULATIVE AND ANNUAL OFFSHORE WIND INSTALLATIONS (MW)



Country	UK	DK	NL	DE	BE	SE	FI	IE	NO	PT	Total
No. of farms	18	13	4	6	2	5	2	1	1	1	53
No. of turbines	636	401	128	52	61	75	9	7	1	1	1,371
Capacity installed (MW)	2,093.7	857.3	246.8	200.3	195	163.7	26.3	25.2	2.3	2	3,812.6

FIG. 8: INSTALLED CAPACITY: CUMULATIVE SHARE BY COUNTRY AT END 2011 (MW)

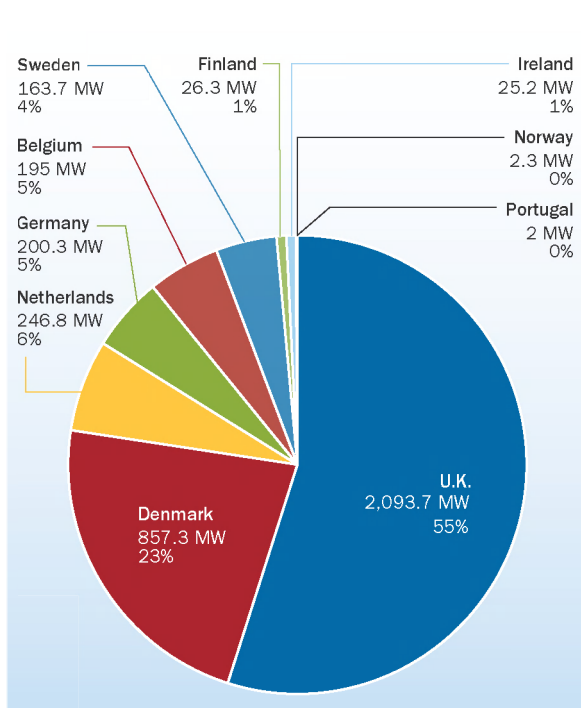
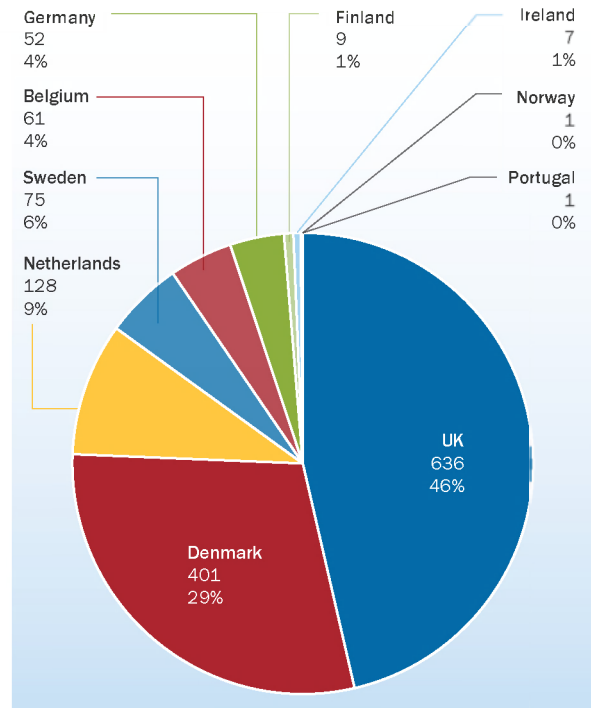
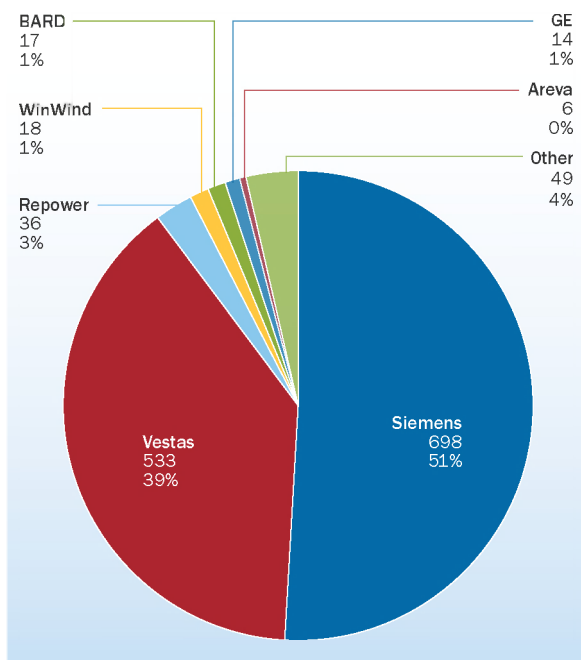


FIG. 9: INSTALLED TURBINES: CUMULATIVE SHARE BY COUNTRY AT END 2011



## Cumulative market share – wind turbine manufacturers

FIG. 10: WIND TURBINE MANUFACTURERS' SHARE OF INSTALLED AND CONNECTED OFFSHORE TURBINES



In terms of cumulative installed units, in 2011 Siemens had a market share of over 50% (698 units) of all installed offshore turbines in Europe. Vestas has the second biggest market share 39% or 533 units installed and grid connected. The remaining 10% of the market is distributed more evenly between REpower (3%), WinWind, BARD and GE all at 1%, followed by Areva Wind.

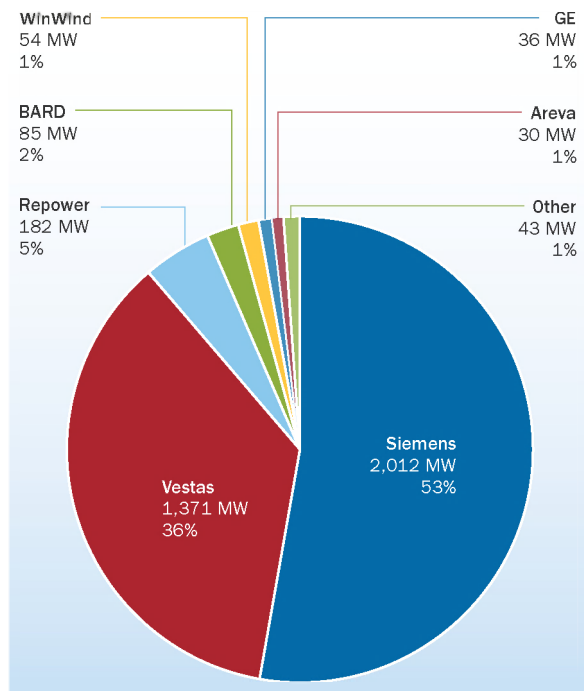


FIG. 11: WIND TURBINE MANUFACTURERS' CUMULATIVE MARKET SHARE AT END 2011 IN MW

Siemens also has the largest market share in terms of installed capacity (53%). Vestas, similarly, has the second biggest share (36%), followed by REpower (5%). However, although BARD has one less turbine installed than WinWind, its model's higher capacity means it has a larger market share.

## Cumulative market share – wind farm owners/developers

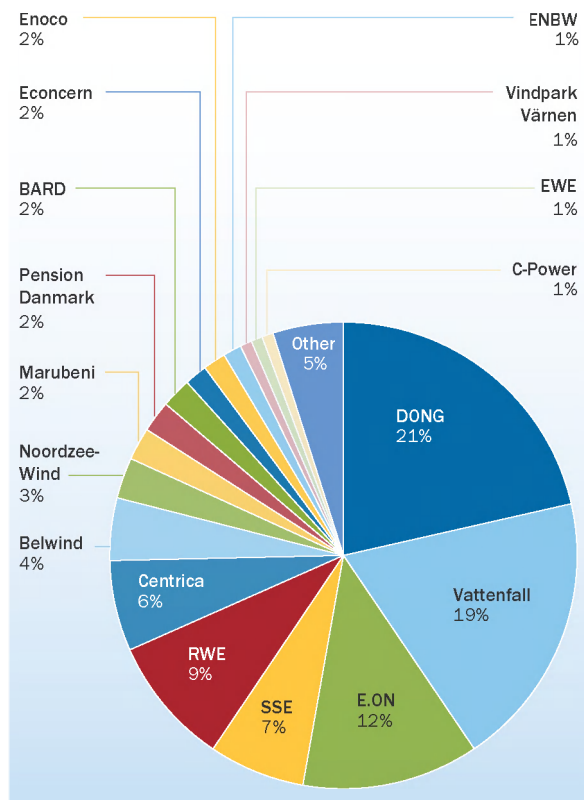


FIG. 12: OWNERS SHARE<sup>2</sup> OF INSTALLED CAPACITY IN MW

The vast majority (around 80%) of installed offshore capacity was developed and is owned by utilities. DONG, Vattenfall and E.ON together have around 53% of the market: 21%, 19% and 12% respectively.

The Belgian Belwind consortium<sup>3</sup> remains the biggest independent offshore developer in Europe with its Bligh Bank project whose first phase was completed in 2010 and second phase due to begin construction.

Projects owned or developed by several companies have been split according to the respective shares. Where the shares are not known, they have been split in equal parts between the partners.

<sup>2</sup> N.B. Market shares are indicative only

<sup>3</sup> The Belwind consortium is composed of Colruyt group, PMV, Rabobank and SHV

## Substructures

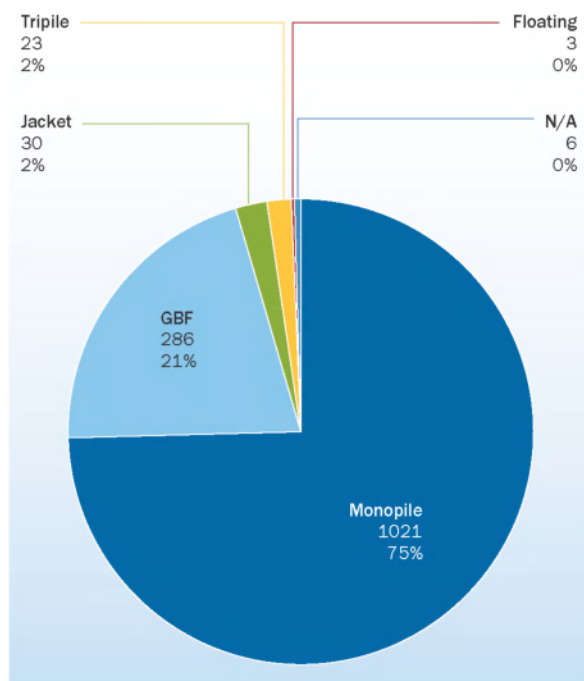


FIG 13: SHARE OF SUBSTRUCTURE TYPES FOR ONLINE WIND FARMS END 2011

The main substructure technology used is monopile supporting 1,021 grid connected turbines (75%), followed by 286 gravity based foundations (GBF), 30 jackets, 23 tripiles and three floating structures.

## Market outlook

Once completed, the 9 offshore projects under construction in 2011 will bring online a further 2,375 MW of capacity. These projects alone will bring total installed capacity in Europe to 6,188 MW, a 62% increase.

Furthermore, preparatory work started in 2011 on nine other projects, seven in Germany and two in the UK.

These projects have a cumulative capacity of 2,910 MW, 2,272 in Germany and 638 in the UK.

With these 18 projects completed, total installed offshore wind capacity in Europe would reach 9 GW. Furthermore, EWEA has identified 18 GW of fully consented projects in 12 European countries.

FIG 14: OFFSHORE MARKET: PROJECTS ONLINE, UNDER CONSTRUCTION AND CONSENTED (MW)

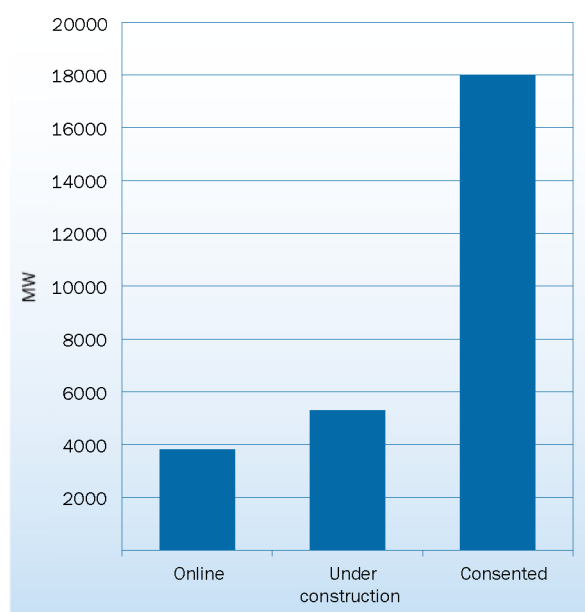
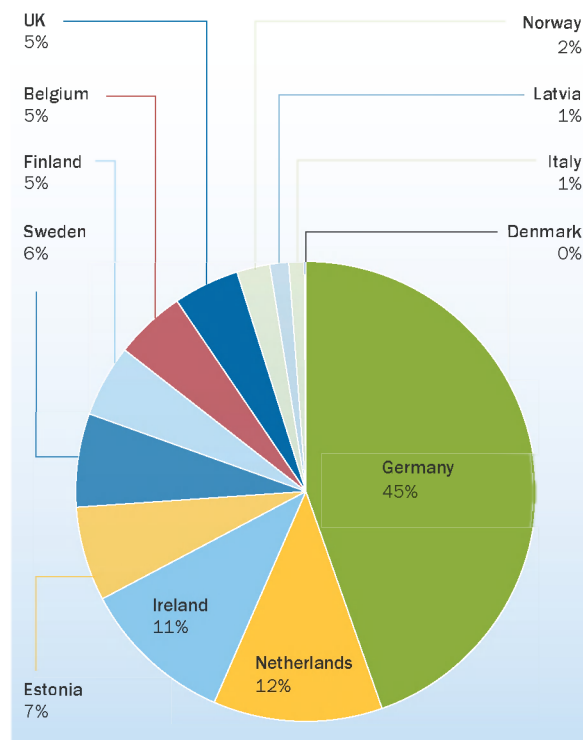


FIG 15: SHARE OF CONSENTED OFFSHORE CAPACITY (MW)



# Trends: turbines, water depth and distance to shore

## Wind farm size

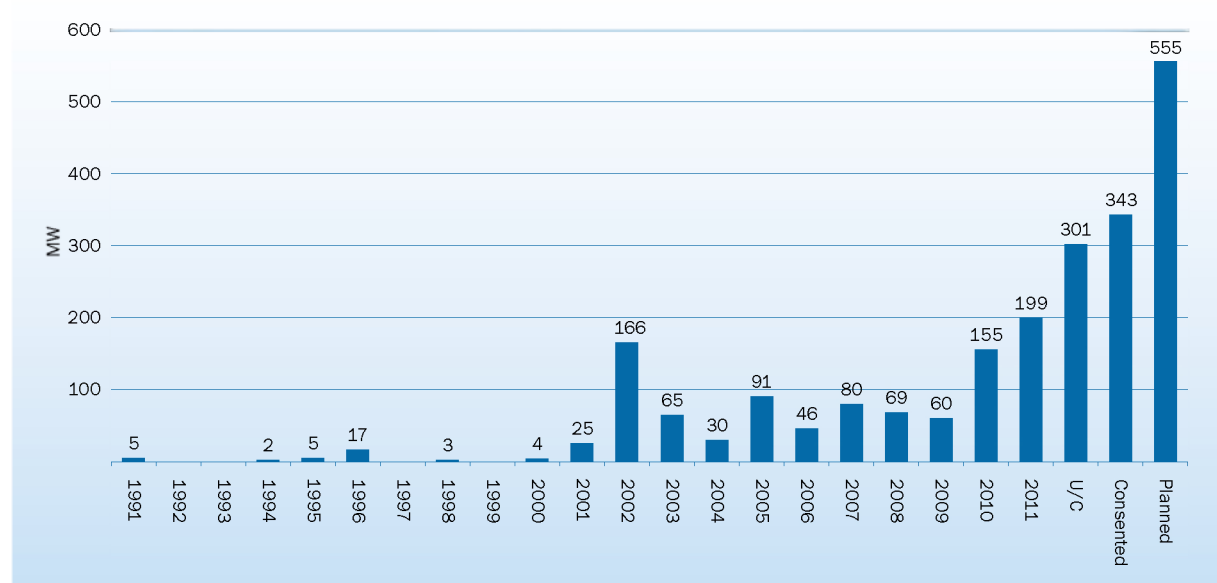
Since 2009, the average size of offshore wind farms has been increasing steadily. In 2011, the average size of the projects, once fully completed, is just under 200 MW, 45 MW (+29%) more than in 2010.

This trend is expected to continue and, indeed, accelerate as the average size of offshore wind farms currently under construction is almost 300 MW, and the average size of projects consented - but where construction

has not yet started - is 344 MW, 72% bigger than 2011 projects.

As the technology matures and it is expected that wind farms will continue to grow in size, the UK offshore wind “round 3” is an example of this. The average size of projects being planned by developers increases to 555 MW.

FIG 16: AVERAGE WIND FARM SIZE IN MW



## Wind turbine capacity

The average capacity of offshore wind turbines was 2 MW at end 2011. Average size of turbines grid connected during 2011 was 3.6 MW up from 3 MW in 2010.

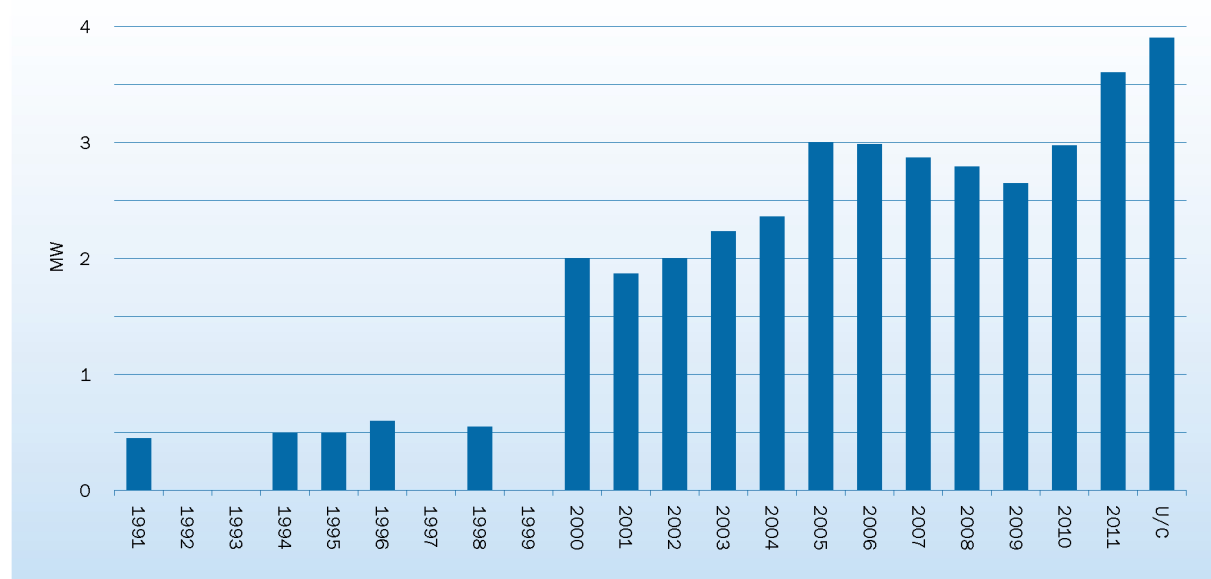
The first offshore wind turbines deployed in the nineties were not of the MW scale. In 2000 a first offshore wind farm using 2 MW turbines was built and grid connected. Since, the average size of offshore turbines has been increasing, albeit not linearly, and in the middle of the last decade turbines in the 3+ MW range were being deployed.

The first 5 MW turbines were used in 2007 at Beatrice in the UK and 2008 at Hooksiel in Germany. This

size turbine has, since, become more common and, by 2011 the average size of offshore turbines was 3.6 MW, 20% more than in 2010 (3 MW) and over 6 times more than the turbines used in the early nineties. Moreover, in 2011 REpower installed the first turbines with a rated capacity above 5 MW (5.075 MW) at Ormonde in the UK.

Looking at the under construction offshore wind farm pipeline (4,583 MW), the Siemens 3.6 MW turbine will continue to be used extensively. However, roll-out of 5 – 6 MW turbines means that the under construction pipeline averages 3.9 MW.

FIG 17: AVERAGE ANNUAL SIZE OF OFFSHORE WIND TURBINES IN MW



## Substructure trends

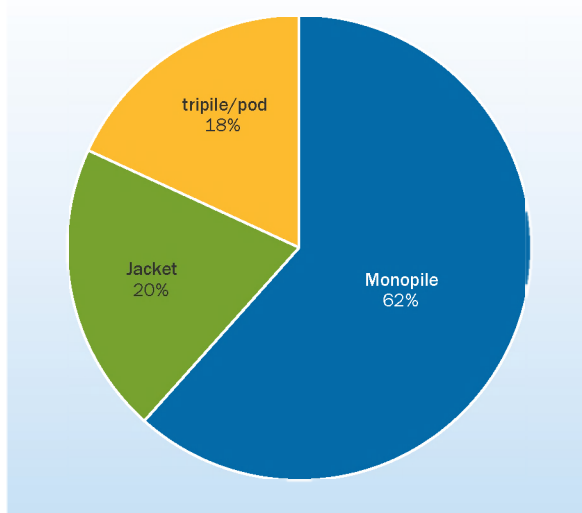


FIG 18: SHARE OF SUBSTRUCTURE TYPES IN WIND FARMS UNDER CONSTRUCTION

Five different types of substructures were used in fully connected offshore wind farms in 2011. Excluding floating concepts that are still at experimental or demonstration stage, four types of substructures have been used in offshore wind farms to date: monopile, gravity, jacket and tripile.

As fig. 18 shows, monopiles are by far the most common substructure used in offshore wind farms. Looking at wind farms that are currently under construction, the trend remains the same with monopiles maintaining an over 60% share. Jackets and tripiles make up the rest with similar shares (20% and 18% respectively).

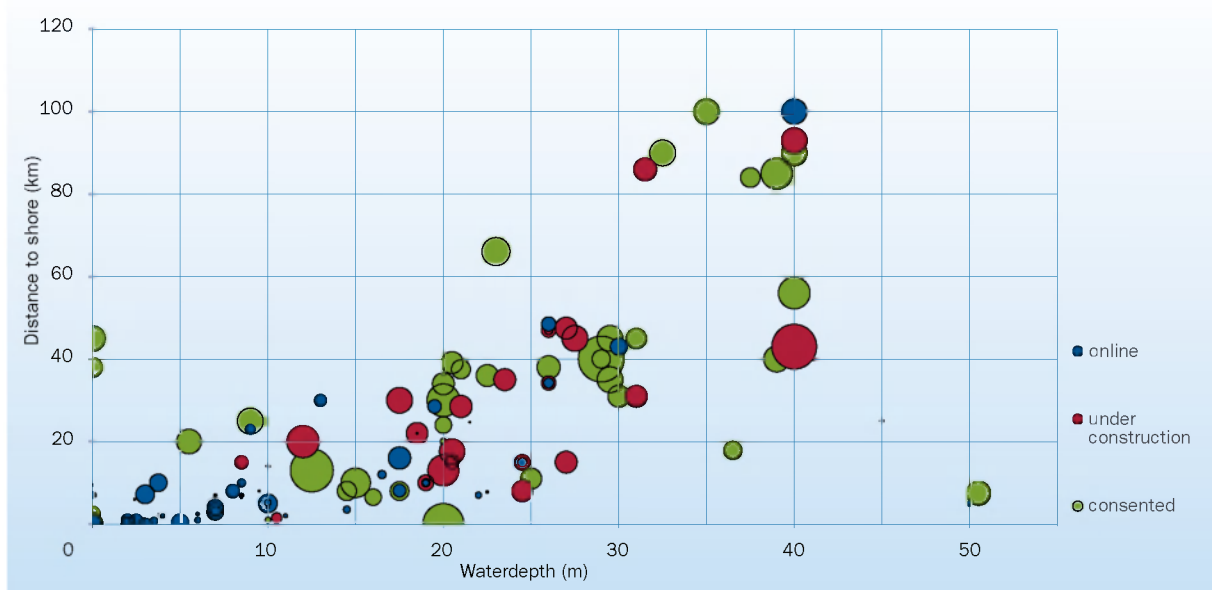
Currently, no gravity based foundations have been identified in the under construction pipeline. The latter are generally used in wind farms closer to shore.

## Water depths and distance to shore

FIG 19: AVERAGE SIZE, DISTANCE TO SHORE AND WATER DEPTH

Offshore wind farms are increasingly being built further from the coast and in deeper waters. Analysis of the planned projects pipeline shows that this trend will

continue. In 2011 average water depth of wind farms was 22.8m and average distance to shore 23.4km. For projects under construction, average depth is 25.3m and distance to shore 33.2km.





# Financing highlights and developments in 2011 and 2012 outlook

Financing activity in the offshore wind farm sector saw a number of pioneering transactions on both the debt

and equity sides during 2011, as well as an active pipeline for 2012.

## Non-recourse debt

Three transactions (Meerwind, Globaltech I, Baltic 1) were closed in 2011. More than twenty commercial banks were involved, taking construction risk in the largest two of these projects, in a sign of the sector's slowly increasing attractiveness to lenders. All transactions were in Germany, confirming its strong construction pipeline, and followed the major transactions signed in late 2010 (C Power, Belgium, 325 MW and Borkum West 2, Germany, 200 MW).

From 2010 and 2011 non-recourse debt financing for offshore wind farms (excluding the Offshore Transmission Owner transactions described below) increased by 40% - from €1.46 billion to €2.05 billion, and from 525 MW to 736 MW). The trend is likely to continue in 2012 with several deals officially in the banking market as of end 2011, including Lincs and Walney in the UK, and Butendiek and Gode Wind II in Germany.

The offshore wind sector is now increasingly seen as a core activity for project finance banks, as evidenced by numerous banks confirming they will continue to support the sector in 2012. Importantly, while no two projects are alike, the requirements of the banks are increasingly consistent across the market. However,

general uncertainties as to the ability of the banks to continue to provide long term financing to the economy may also touch the sector.

The Meerwind project (288 MW, €863 million in long term debt), closed in August. It was the first to take advantage of the new €5 billion programme set up by KfW, Germany's development bank, and the first to be brought to the market by a pure financial investor, Blackstone. It was supported by Eksport Kredit Fonden (EKF), the Danish export-credit agency.

The Globaltech 1 project followed. Developed by Windreich and owned by a group of German and Swiss utilities, it was supported by both the KfW programme and the European Investment Bank (EIB). This was the first transaction for a 400 MW project (€1,047 million in long term debt).

In November, German power company EnBW announced the successful post-completion refinancing of its Baltic 1 wind farm (48 MW, €138 million in long term debt), the first commercial offshore wind farm in Germany, again with EIB involvement.

## Offshore Transmission Owner (OFTO) transactions<sup>4</sup>

In 2011, several transactions involving the sale and non-recourse refinancing of offshore cables previously built and disposed of by their owners were closed (Robin Rigg in March, Gunfleet Sands in July, Barrow in September, Walney 1 in November). They had an aggregate amount of over £250 million (€300 million).

Several similar transactions are pending and are likely to close in 2012, allowing more funding to come to the industry.

<sup>4</sup> An additional sub-sector of activity for investors and financiers related to offshore wind is the OFTO process in the UK, whereby the offshore transmission cables need to be owned and operated by an entity distinct from the wind farm owners - and are then subject to specific regulation

## Policy-driven lenders

EKF and the EIB continued to support non-recourse lending to the sector, and were joined this year by KfW. The EIB also continued its policy of supporting offshore wind farms through corporate refinancing backed by the utilities. It provided a £150 million (€180 million) loan to Vattenfall to refinance the Thanet project (300 MW, UK) and joined the financing of the Walney 1 cable.

The UK's new Green Investment Bank will actively support the offshore wind sector. Some transactions should close during 2012, although it may only deploy its capital on a commercial basis until the EU has approved the scheme under State aid rules.

## Equity finance

DONG Energy has continued to be the most active player, both on the acquisition and on the sale side, continuing and expanding its policy to "recycle" minority stakes in existing assets to finance new investments:

- DONG Energy sold 50% of the Anholt project (Denmark, 400 MW) to Danish pension fund PensionDanmark and Danish company DKA (March); this was a ground-breaking transaction in that it took place before the project is actually built (DONG Energy provides completion guarantees to PensionDanmark and DKA);
- DONG Energy sold 49% of Gunfleet Sands (UK, 172 MW) to Marubeni, the Japanese company (September);
- DONG Energy purchased the Borkum Riffgrund West project (400 MW, Germany) from EnergiKontor (November);
- DONG Energy purchased projects at an earlier stage of development, including a 33% stake in the first two UK Round 3 projects (Heron and Njord, 500 MW each) developed by Mainstream Renewable Power and Siemens in the Hornsea concession (December);
- PNE Wind sold the Nautilus II project (560 MW) to Ventizz, a private equity fund (November);
- PNE Wind sold the Gode Wind II project (252 MW) to Brancor Capital Partners, a Danish financial investor (December);

- BARD sold the Buiten Zee project (600 MW, the Netherlands) to Typhoon Offshore and HVC;
- Blackstone continued to expand in its German offshore wind assets by purchasing the Nördlicher Grund project (261 MW) (August);
- Repsol and EDP acquired SeaEnergy's UK offshore wind assets (July);
- Vattenfall announced the acquisition of the Sandbank 24 project (480 MW, Germany) (November);

Overall, more than 3 GW in net planned capacity changed hands during the year. Of course, this comes in addition to the investment commitments announced by a number of utilities and developers on projects they already own. It is likely that 2012 will continue to see an active equity market with very diverse transactions and investors. The 2011 transactions have taken place at all stages of project development (from pre-contractual development, prior to construction or as operating assets). They have allowed an increasing variety of players to enter the sector, including financial investors, pension funds, and non-European utilities with transactions matching their desired risk profiles.

In conclusion, 2011 has been a largely positive year for offshore wind financing. Continued support from the early players, including multilaterals like the EIB and EKF, is coupled with the arrival of new players both on the equity and lending side. Investors and banks are beginning to see the sector as becoming established and more mature. Equally, they are beginning to better understand the risks.

## New turbine announcements

41 companies have, over the past two and a half years, announced their intention to launch new offshore-dedicated wind turbine models. In all, 51 new models were announced: 28 in 2010 and 23 in 2011. This indicates

that offshore wind energy is seen as a dynamic sector that will grow considerably in the future.

Interest in offshore wind has spread beyond Europe and is now global, with turbine announcements being made by companies in China, Japan, South Korea, USA and Israel. However, Europe maintains the lead in terms of companies actively planning to develop offshore wind turbines.

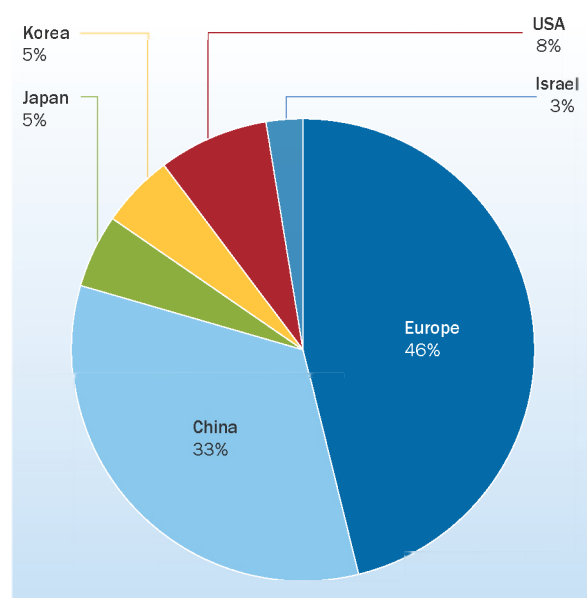
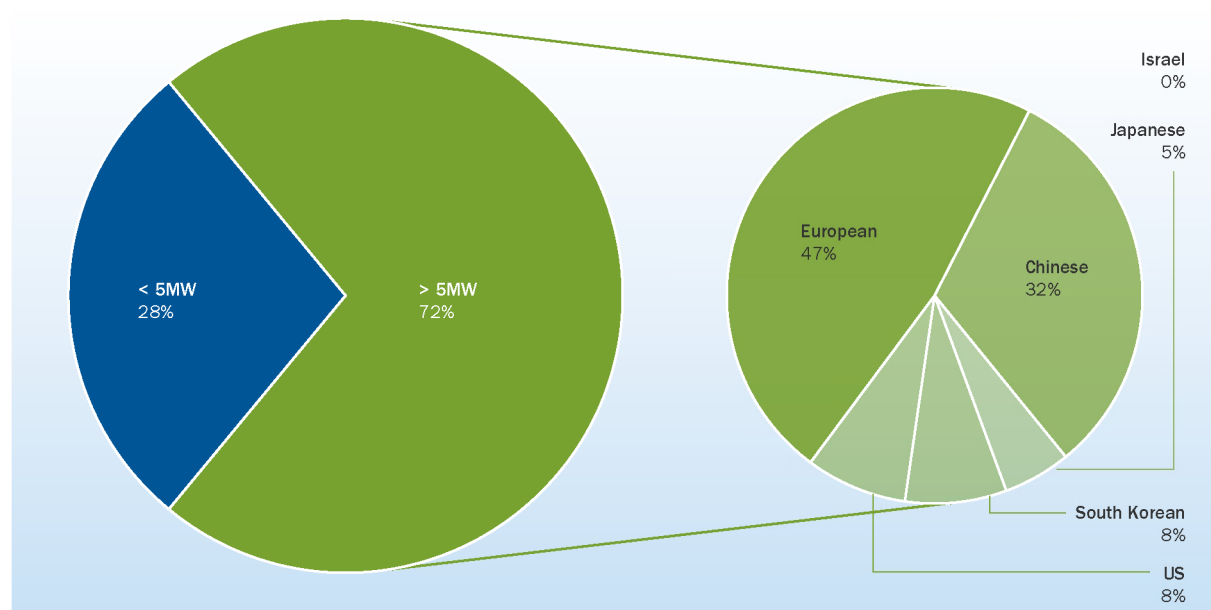


FIG 20: ORIGIN OF COMPANIES ANNOUNCING NEW OFFSHORE WIND TURBINE MODELS

Almost half of the companies announcing new models are based in Europe. China is second with 33%, then the US (8%), Japan, South Korea and Israel follow. This activity across the globe is creating a highly competitive environment.

The new models announced are mostly large machines with a rated capacity above 5 MW. Taking into account the models announced over the last two years, only 28% are less than 5MW, the rest (72%) consists of bigger machines.

FIG 21: OFFSHORE WIND TURBINE ANNOUNCEMENTS BY SIZE AND ORIGIN



In 2011 announcements, both in and outside of Europe, the trend towards larger turbines is marked. Vestas is ready to test its 7MW model and Alstom will launch a 6MW prototype. Siemens is testing a 6MW model in Denmark. Mervento, a Finnish company is working on a 5MW turbine that will be tested during 2012.

Two bladed offshore wind turbine designs are announced by Condor as well as Aerodyn SCD who supplied Mingyang with 3 and 6MW rotors. Dutch company MECAL has signed an agreement to build a 6MW turbine for Huayi Electric (CN). Mitsubishi has announced plans for a 7MW model and South Korean Samsung has revealed plans for up-scaling its

2.5MW machine for offshore use and new models with rated capacity up to 6MW.

Goldwind, Guodian United Power and Sinovel are looking into wind turbines in the 10 MW to 12 MW range. Similarly, GE has announced plans for a 15 MW turbine. In the EU, the Azimuth Offshore Wind Energy 2020 project, led by Gamesa, is planning a 15MW offshore wind turbine.

A new comer, Israel Aerospace Industries has announced a joint venture for the production of a 3MW offshore wind turbine, as a first step into the renewable energy business.



# Offshore grid developments

## European Infrastructure Package

In October 2011, the European Commission proposed a regulation for guidelines for trans-European energy infrastructure to accelerate and finance for new energy infrastructure. Support from the EU budget to priority projects is €9.1 billion, substantially more than was provided in the past TEN-E programme. The Commission plans to cut authorisation lead times for new priority European power lines by putting forward a binding timeline of three years for procedures concerning Projects of Common Interest (PCI). Priority 'corridors' will include, among others, the North Seas

(North and Baltic Sea). Regional project selection of the PCIs in this region will most likely be carried out by the North Seas Countries' Offshore Grid Initiative (NSCOGI) set up by nine Member States, Norway and the Commission, with the involvement of concerned TSOs, regulators and project promoters.

The proposed legislation is now being negotiated with the European Parliament and Council, with an agreement foreseen by end 2012.

## Interconnection work under way

Various prominent interconnection projects are on track or have been recently completed. The 'East-West Interconnector' between Ireland and Wales is well under way and on track for completion in 2012. It will add 500 MW of interconnection capacity to Ireland which currently only has one cable (Moyle) to Scotland.

BritNed between the UK and the Netherlands commenced trading operations on 1 April 2011. The respective national TSOs, National Grid and TenneT, established a joint venture that funded and operates the interconnector with a capacity of 1000 MW, independently from the TSO's regulated businesses. BritNed was completed on time and within the established €600 million budget. Since it went online, electricity has flowed from the Netherlands to the UK most of the time.

The Cobra Cable - a planned 700 MW HVDC interconnector between the Netherlands and Denmark - is still pending its final investment decision. After having received an €85 million grant from the European Economic Recovery Plan (EERP) as a particularly innovative project, the partners are obliged to look into the technical and economic options for connecting directly to wind farms in the German Bight. Technical issues such as the voltage levels (320 kV) have been clarified, however, legal questions regarding the alignment of differing national regulatory frameworks are still under discussion. These will influence the project's business case. If construction starts as planned, the connection is scheduled to be operational by 2016, but a delay is to be expected.

## Grid developments between Norway, UK and continental Europe

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Stricken with regulatory uncertainties and constant delays the investment decisions for two previously planned interconnection projects between Norway and continental Europe – NorGer and NordLink – seem to have been delayed to the latter half of the decade. In contrast, five partners, including Vattenfall

and SSE established the NorthConnect project company in February 2011, to build a merchant line between Scotland and Norway. The current trans-European network for energy (TEN-E) programme has granted funding to support the planning phase.

## Supply bottleneck for HV cables looming while HVDC cable provision advances

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With increasing project size and distance from shore demand for subsea cables and large high-voltage transformers is rising. A recent EWEA report<sup>5</sup> found that without increased capacity in manufacturing a shortage of high voltage (HV) subsea cables could become a critical bottleneck for the offshore industry. However, the historically limited range of suppliers of

high-voltage direct current (HVDC) cables has expanded. The substantial deployment of HVDC technology gives further momentum towards the development of multi-terminal capability which still requires further demonstration efforts to gain investor and system operator confidence.

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<sup>5</sup> Wind in our sails – the coming of Europe's offshore wind industry, EWEA, November 2011