



Wind in power

2016 European statistics

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EUROPE

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2016 European statistics

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windeurope.org

This report summarises new installations and financing activity in Europe's wind farms from 1 January to 31 December 2016.

WindEurope regularly surveys the industry to determine the level of installations of wind farms, and the subsequent dispatch of first power to the grid. The data represents gross installations per site and country unless otherwise stated. Rounding of figures is at the discretion of the author.

DISCLAIMER

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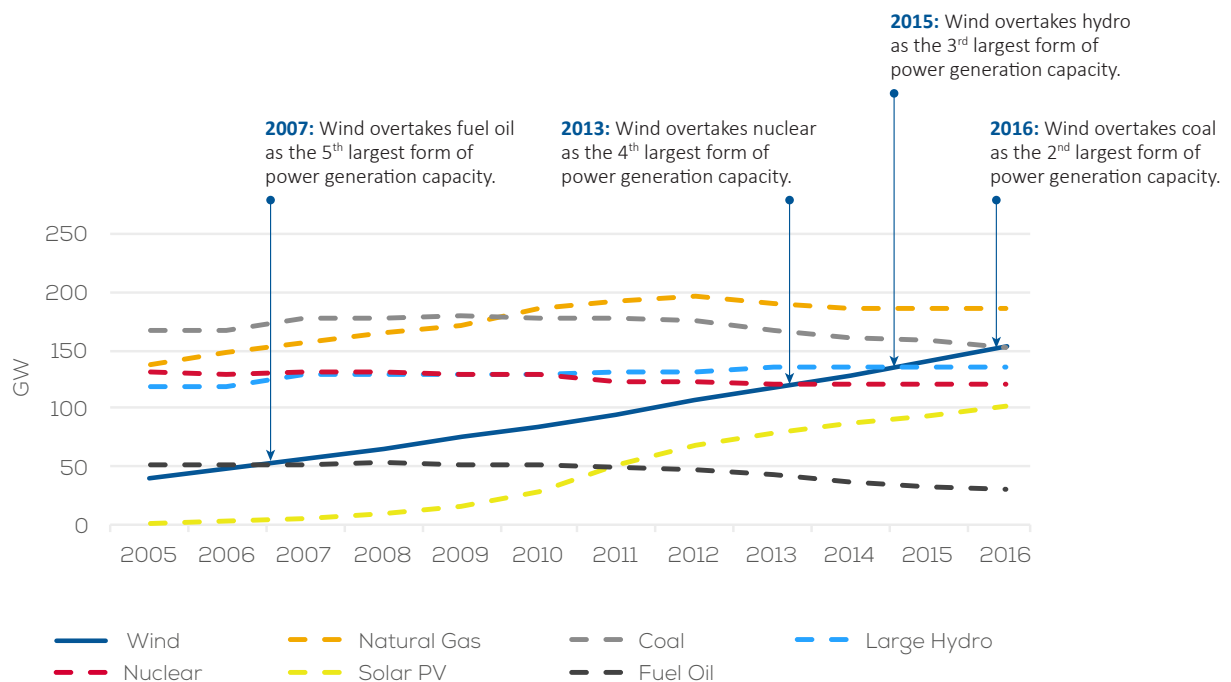
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EXECUTIVE SUMMARY

Europe installed 12.5 GW of gross additional wind capacity in 2016. This was 3% less than the new installations in 2015. With a total installed capacity of 153.7 GW, wind energy now overtakes coal as the second largest form of power generation capacity in Europe.

FIGURE 1

Cumulative power capacity in the European Union 2005-2016



Source: WindEurope

2016 annual figures

- 12.5 GW of new wind power capacity was installed and grid-connected in the EU during 2016, a decrease of 3% compared to 2015 annual installations. 10,923 MW were installed onshore, and 1,567 MW were installed offshore.
- Wind power installed more than any other form of power generation in Europe in 2016. Wind power accounted for 51% of total power capacity installations.
- Renewable energy accounted for 86% of all new EU power installations in 2016: 21.1 GW of a total 24.5 GW of new power capacity.
- With almost 300 TWh generated in 2016, wind power covered 10.4 % of the EU's electricity demand.
- €27.5 billion were invested in 2016 to finance wind energy development. This was 5% more than the total investment in 2015.

Country highlights

- Germany was the largest market in new wind power capacity installations, with 44% of the total EU installations.
- Germany remains the EU country with the largest installed wind power capacity, followed by Spain, the UK and France. 16 EU Member States have more than 1 GW wind power installed, nine of these have more than 5 GW installed.
- Five EU Member States had a record year in new wind energy installations in 2016: France (1.6 GW), the Netherlands (887 MW), Finland (570 MW), Ireland (384 MW) and Lithuania (178 MW).
- Turkey (1.4 GW) also broke its record for annual new installations.

Trends and cumulative installations

- There are now 153.7 GW of installed wind power capacity in the EU: 141.1 GW onshore and 12.6 GW offshore.
- Wind energy has overtaken coal as the second largest form of power generation capacity.
- Wind energy now accounts for 17% of Europe's total installed power generation capacity.
- The total net EU installed power generation capacity increased by 12 GW in 2016 to 918.8 GW.
- Conventional power sources such as fuel oil and coal continue to decommission more capacity than they install. Despite having decommissioned more than 2 GW this year net gas-fired generation capacity continues to remain positive.

WIND ENERGY CAPACITY IN 2016

Wind capacity installed in 2016 (MW)
TOTAL 12.5 GW

Cumulative wind installed capacity by country

- 40 - 50 GW
- 30 - 40 GW
- 20 - 30 GW
- 10 - 20 GW
- 5 - 10 GW
- 1 - 5 GW
- 0 - 1 GW

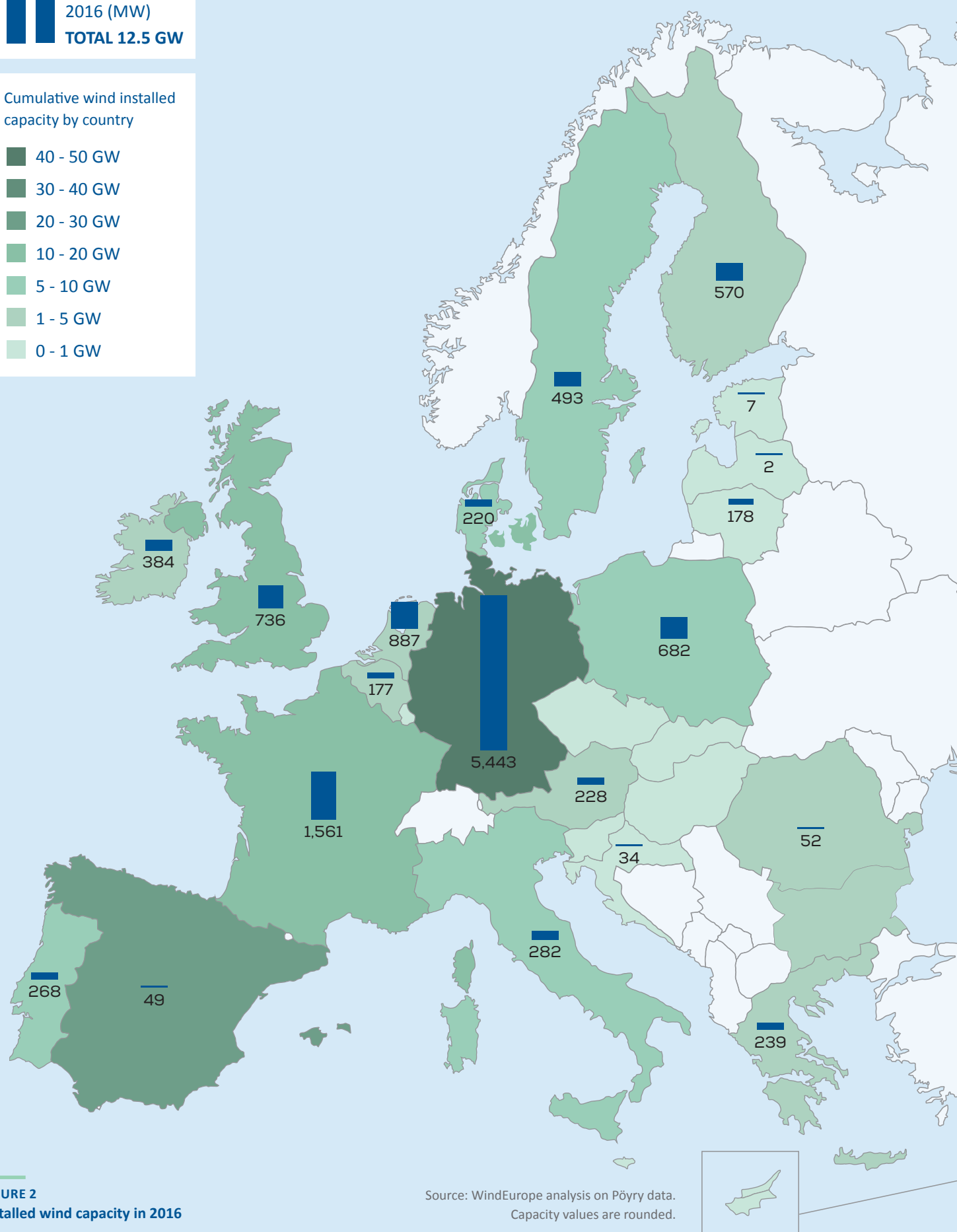


FIGURE 2
Installed wind capacity in 2016

Source: WindEurope analysis on Pöyry data.
Capacity values are rounded.

TABLE 1

Cumulative and new wind power capacity in 2015 and 2016

EU-28 (MW)	INSTALLED 2015	END 2015	INSTALLED 2016	END 2016
Austria	319	2,404	228	2,632
Belgium	266	2,218	177	2,386
Bulgaria	-	691	-	691
Croatia	45	387	34	422
Cyprus	11	158	-	158
Czech Republic	-	281	-	281
Denmark	234	5,063	220	5,227
Estonia	1	303	7	310
Finland	379	1,011	570	1,539
France	1,073	10,505	1,561	12,065
Germany	6,008	44,946	5,443	50,019
Greece	156	2,135	239	2,374
Hungary	-	329	-	329
Ireland	224	2,446	384	2,830
Italy	306	8,975	282	9,257
Latvia	-	62	2	63
Lithuania	27	315	178	493
Luxembourg	-	58	-	58
Malta	-	-	-	-
Netherlands	621	3,443	887	4,328
Poland	1,266	5,100	682	5,782
Portugal	120	5,050	268	5,316
Romania	23	2,976	52	3,028
Slovakia	-	3	-	3
Slovenia	-	3	-	3
Spain	-	23,025	49	23,075
Sweden	615	6,029	493	6,519
UK	1,149	13,809	736	14,542
TOTAL EU-28	12,842	141,726	12,490	153,730

CANDIDATE COUNTRIES (MW)	INSTALLED 2015	END 2015	INSTALLED 2016	END 2016
FYROM	-	37	-	37
Serbia	10	10	-	10
Turkey	956	4,694	1,387	6,081
TOTAL	966	4,741	1,387	6,128

EFTA (MW)	INSTALLED 2015	END 2015	INSTALLED 2016	END 2016
Iceland	-	3	-	3
Liechtenstein	-	-	-	-
Norway	7	822	16	838
Switzerland	-	60	20	75
TOTAL	7	882	36	913

OTHER (MW)	INSTALLED 2015	END 2015	INSTALLED 2016	END 2016
Belarus	-	3	-	3
Faroe Islands	-	18	-	18
Russia	-	15	-	15
Ukraine	17	514	12	526
TOTAL	17	548	12	559

	INSTALLED 2015	END 2015	INSTALLED 2016	END 2016
TOTAL EUROPE	13,831	147,852	13,925	161,330

Source: WindEurope

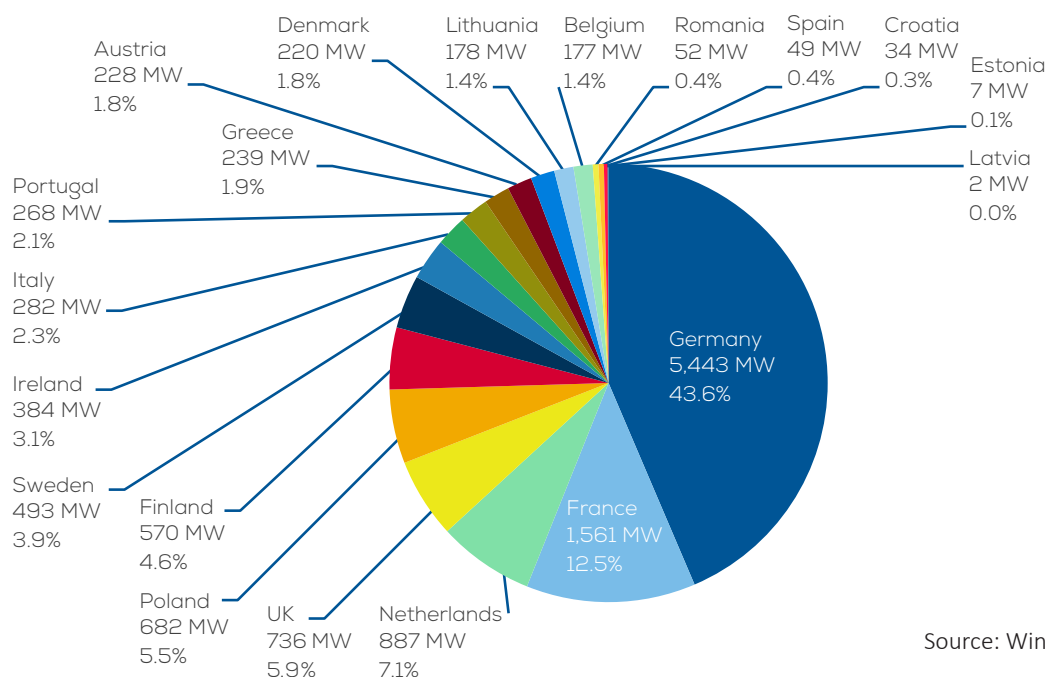
1. ANNUAL MARKET IN 2016

1.1 WIND POWER INSTALLATIONS

During 2016 13.9 GW of wind power were installed across Europe, 12.5 GW of which were installed in the European Union.

FIGURE 3

EU market shares for new wind energy capacity installed during 2016. Total 12,490 MW



Source: WindEurope

Of the capacity installed in the EU, 10,923 MW was onshore and 1,567 MW offshore. The annual onshore installations increased by 11%, and offshore installations were down almost 50%. Overall, EU wind energy annual installations decreased by 3% compared to 2015 installations.

Germany was the largest market in 2016 in terms of annual installations, with 5,443 MW of new capacity, 818 MW of which was offshore (15% of total capacity installed in Germany). France came second with a record year of 1,560 MW installations, an increase of 45% on 2015. The Netherlands came third with record installations of 887 MW.

Four other countries had a record year in installations: Turkey (1,394 MW), Finland (570 MW), Ireland (384 MW) and Lithuania (178 MW).

75% of the total installations took place in just five markets, a similar trend as in 2015.

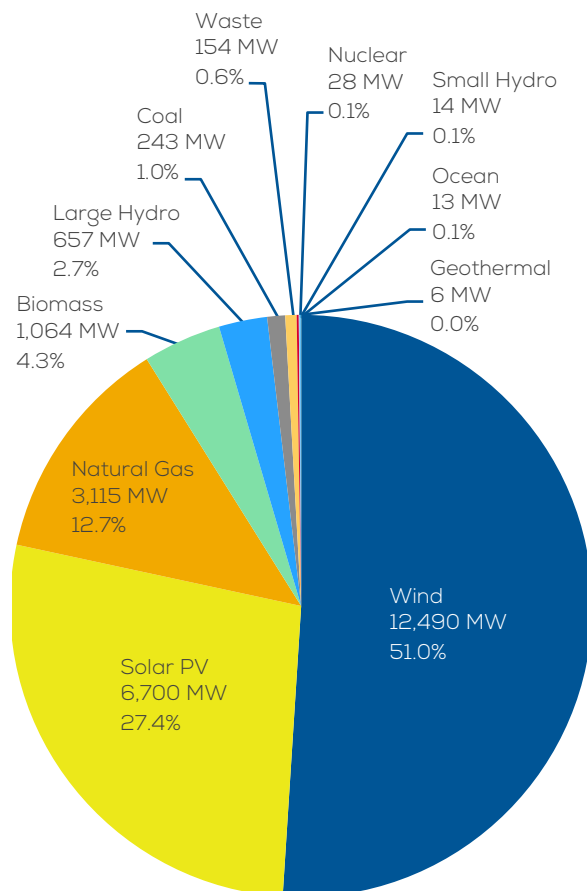
5 EU MEMBER STATES

HAD A RECORD YEAR IN WIND ENERGY INSTALLATIONS

1.2 POWER CAPACITY INSTALLATIONS

FIGURE 4

Share of new installed capacity. Total 24,484 MW



In 2016 24.5 GW of new gross power generation capacity were installed in the EU, 6.3 GW less than in 2015.

Wind power was the energy technology with the highest capacity installations in 2016. With 12.5 GW, it accounted for 51% of all new installations. Solar PV came second with 6.7 GW (27%) and natural gas followed with 3.1 GW (13%).

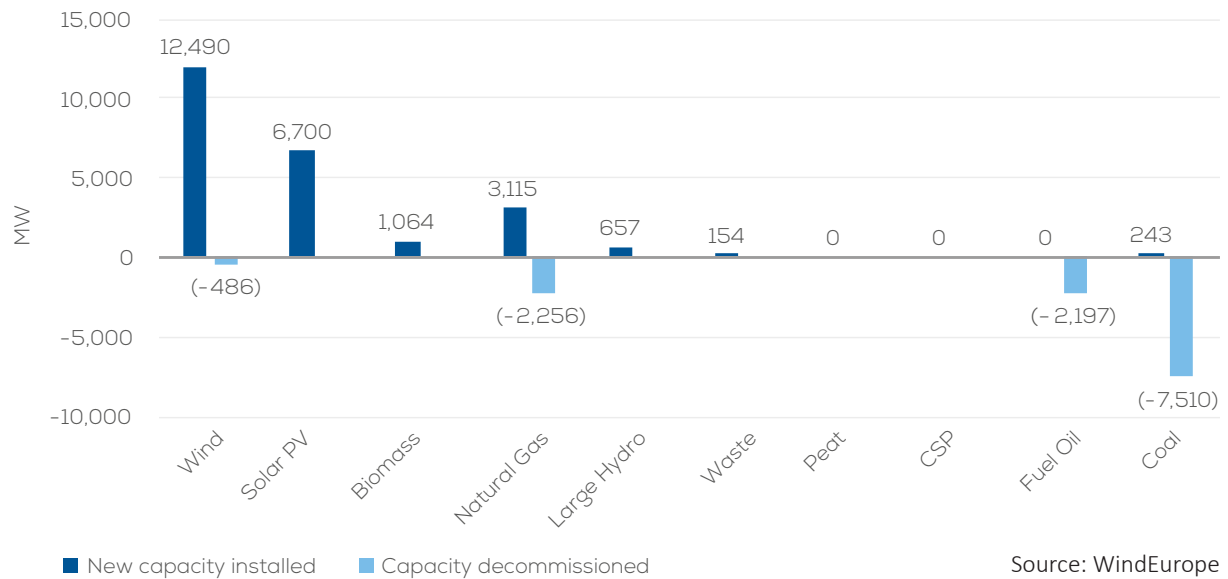
Biomass installed 1.1 GW (4% of total installations), hydro 657 MW (3%), coal 243 MW (1%), and waste 154 MW (0.6%).

During 2016 Member States decommissioned 7.5 GW of coal capacity, 2.3 GW of natural gas capacity, and 2.2 GW of fuel oil capacity.

Source: WindEurope

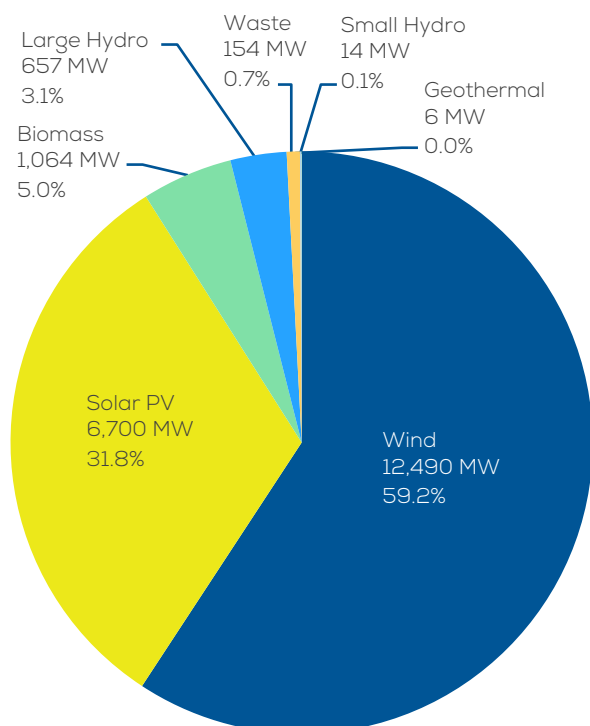
51% OF NEW POWER CAPACITY
IN THE EU CAME
FROM WIND

1. Based on estimation from Q1-Q3 2016 installation figures.

FIGURE 5**Newly installed and decommissioned capacity in the EU**

1.3 RENEWABLE POWER INSTALLATIONS

In 2016 renewables accounted for a total of 21.1 GW of new capacity, 86% of all new installed capacity in the EU-28. It was, furthermore, the ninth year in a row where renewables contributed over 55% of all additional power capacity in the EU.

FIGURE 6**Share of new renewable power installations. Total 21,098 MW**

86% OF NEW POWER CAPACITY
IN THE EU CAME FROM
RENEWABLES IN 2016

Source: WindEurope

2.

TRENDS AND CUMULATIVE INSTALLATIONS

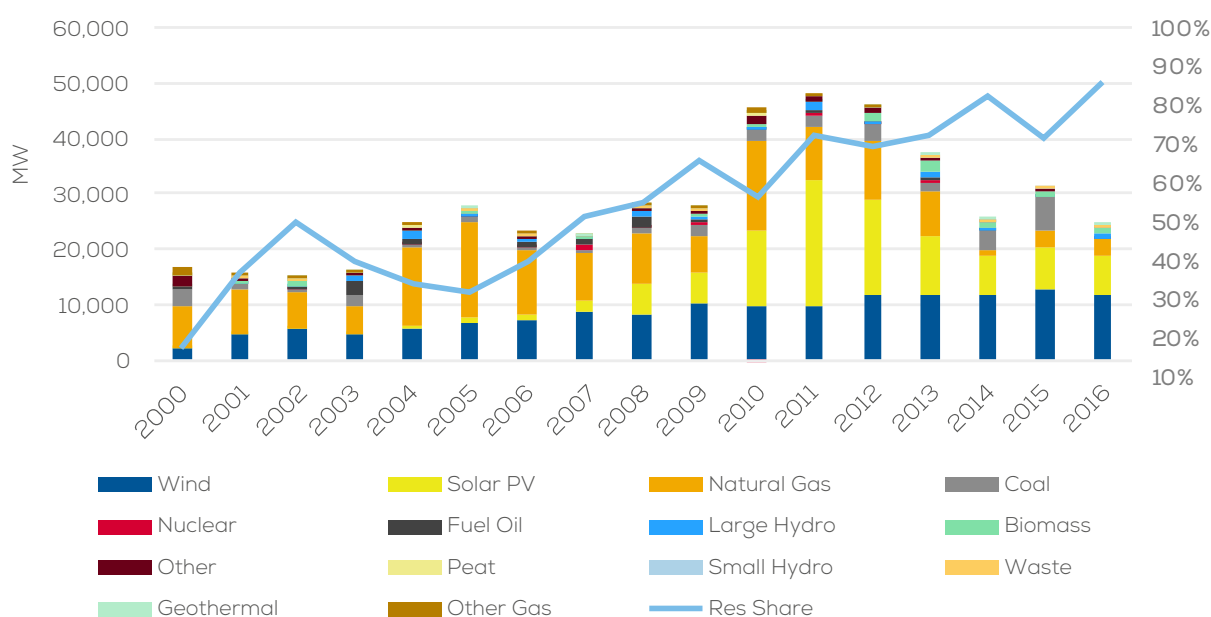
2.1 RENEWABLE POWER INSTALLATIONS

In 2000 new renewable power capacity installations totalled a mere 2.7 GW, accounting for less than 20% of new power installations that year. Since 2010, Europe added between 21 GW and 35 GW of new renewable capacity every year.

The share of renewables in total new power capacity additions reached the 50% threshold in 2007. Since then it continued to grow and peaked at 86% in 2016.

466 GW of new power capacity has been installed in the EU since 2000. 31% of it has been wind power and 59% renewables.

FIGURE 7
Annual installed capacity and renewable share



Source: WindEurope

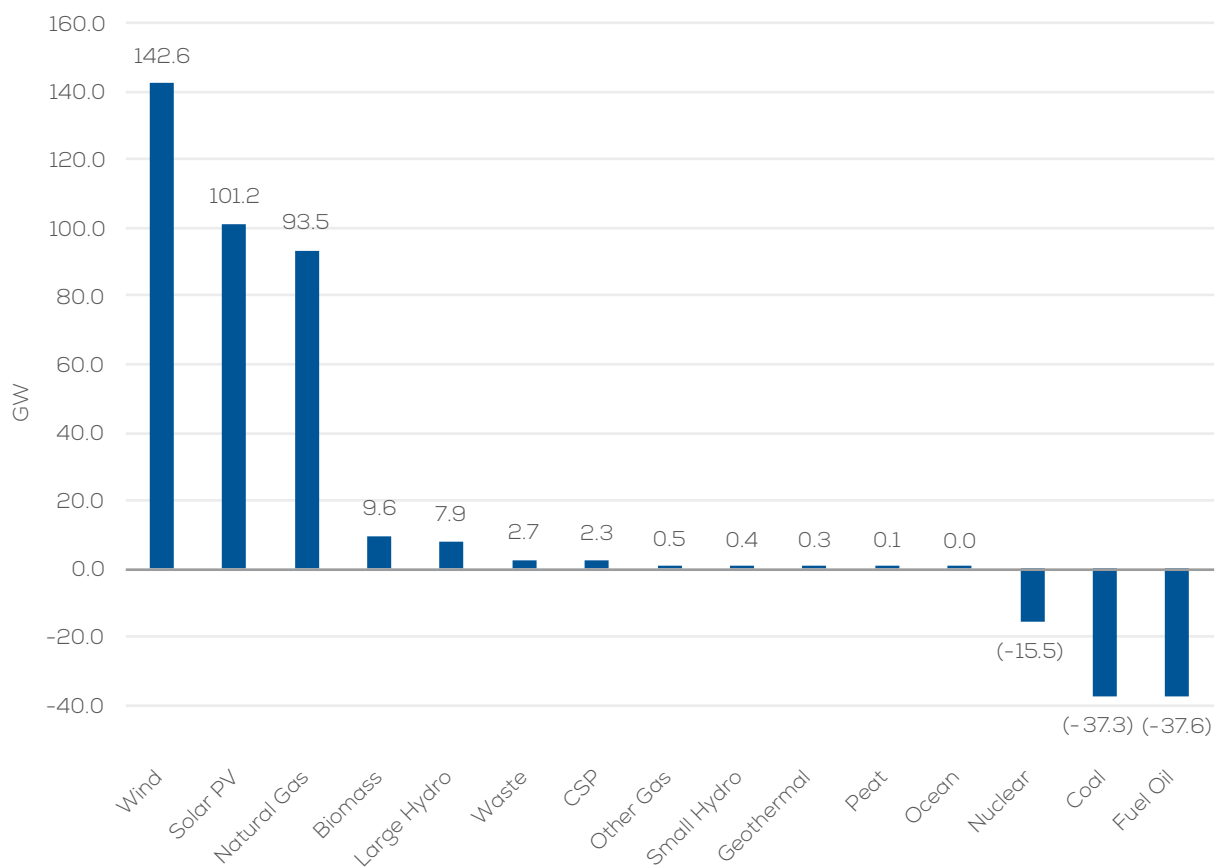
2.2 NET CHANGES IN EU INSTALLED POWER CAPACITY 2000-2016

Since 2000, the net growth of wind power (142.6 GW), solar PV (101.2 GW) and natural gas (93.5 GW) capacity has coincided with the net reduction in fuel oil (down 37.6 GW), coal (down 37.3 GW) and nuclear (down 15.5 GW).

The EU's power sector continues to move away from fuel oil, coal, and nuclear while increasing its total installed generation capacity with wind, solar PV and other renewables. With a net growth of 93.5 GW since 2000, natural gas remains the technology with largest installed capacity in the EU.

FIGURE 8

Net electricity installations in the EU from 2000 to 2016



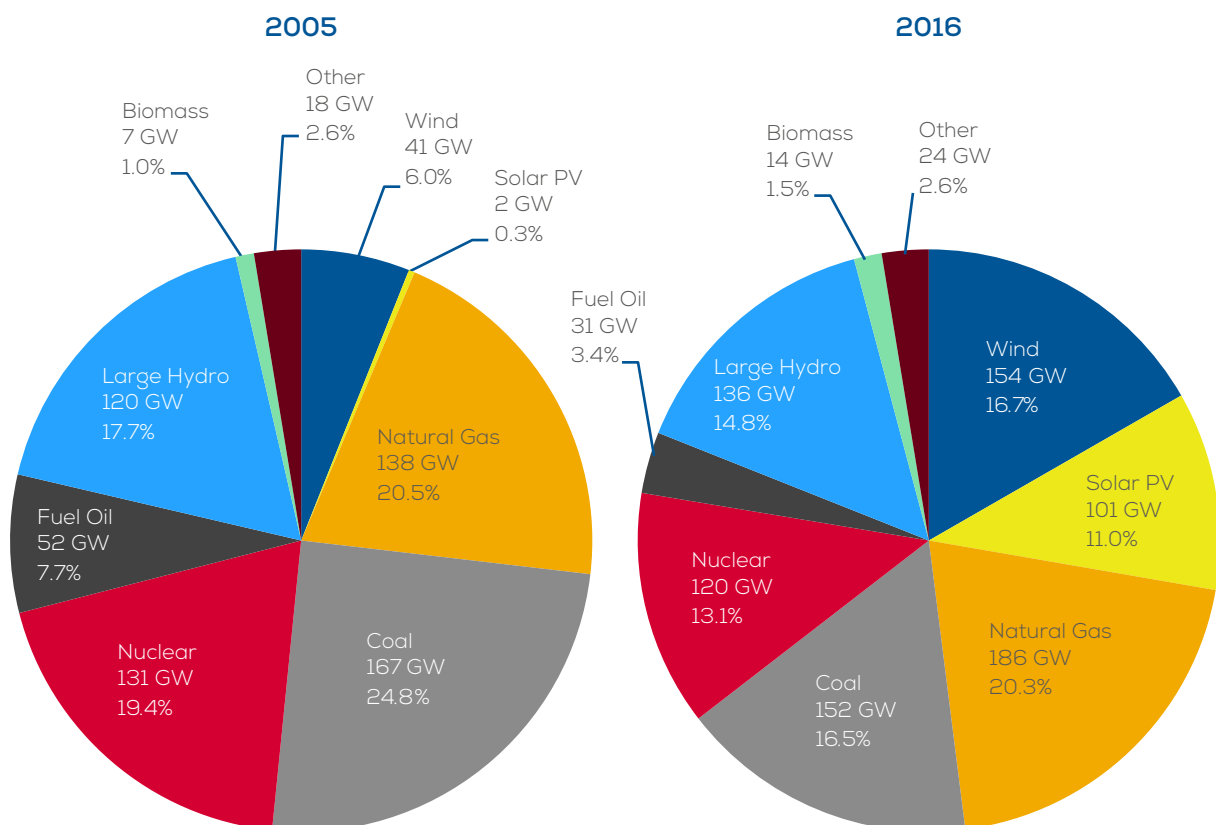
Source: WindEurope

2.3 TOTAL INSTALLED POWER CAPACITY

The share of wind power in total installed power capacity has increased from 6% in 2005 to 16.7% in 2016, overtaking coal as the second largest form of power generation capacity in the EU and remaining the first among renewables. Over the same period renewables increased their share from 24% of total power capacity in 2005 to 46% in 2016.

WIND IS NOW THE
2nd LARGEST POWER
GENERATING CAPACITY
IN THE EU

FIGURE 9
Share in installed capacity in 2005 and 2016



Source: WindEurope

3.

A CLOSER LOOK AT WIND POWER INSTALLATIONS

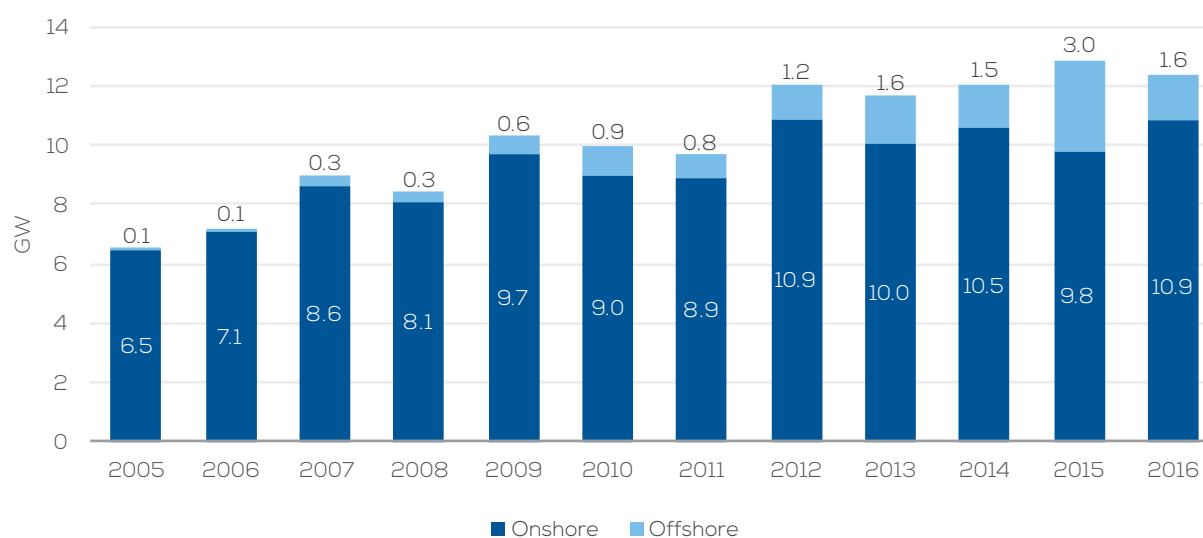
3.1 ONSHORE AND OFFSHORE ANNUAL MARKETS

Annual wind power installations in the EU have increased steadily over the past 16 years from 2.3 GW in 2000 to 12.5 GW in 2016, with a maximum level in 2015 of 12.8 GW.

Offshore wind represented 13% of the annual EU wind energy market with 1,567 MW of new gross capacity connected to the grid in 2016. This is a 48.4% decrease compared with 2015, which was an exceptional year in grid-connections due to grid-connection delays in Germany being resolved.

FIGURE 10

Annual onshore and offshore wind installations in the EU

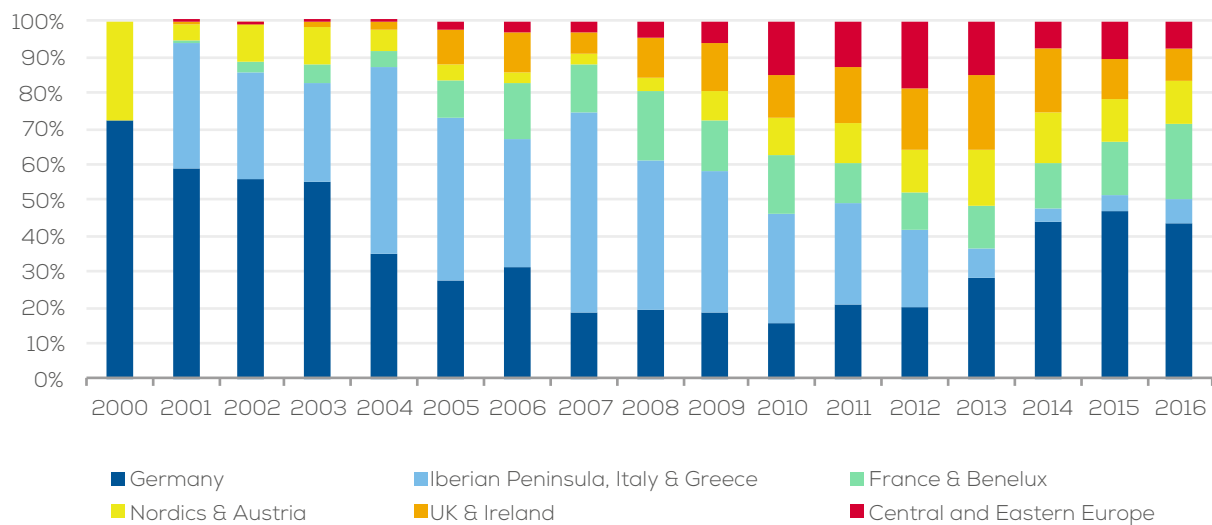


Source: WindEurope

3.2 NATIONAL BREAKDOWN OF WIND POWER INSTALLATIONS

In 2016 44% of the total EU wind capacity was installed just in Germany. France and Benelux had 21% of the installed capacity, up from 15% in 2015. The wind installations in the countries that joined the EU after 2005 represent less than 10% of EU's total.

FIGURE 11
Geographical concentration of the annual wind market²

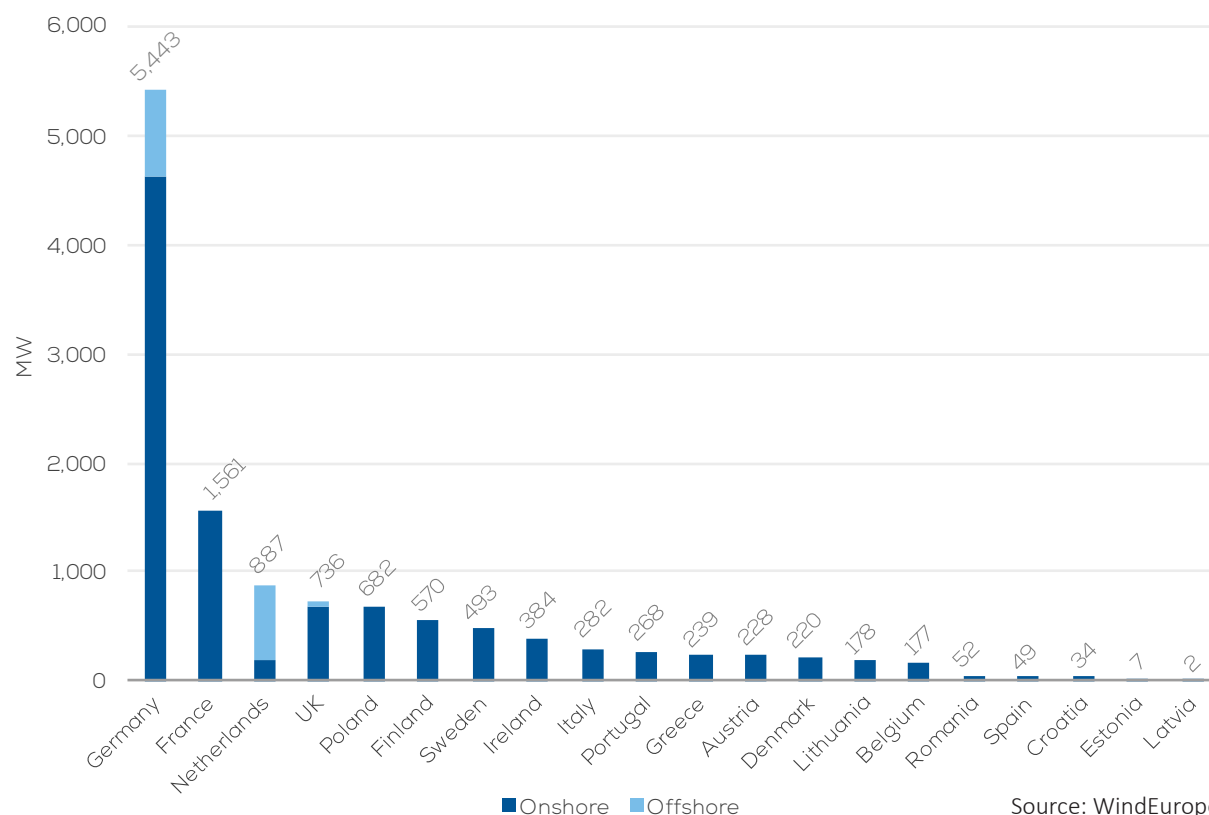


Source: WindEurope

44% OF EU'S WIND POWER
**WAS INSTALLED
IN GERMANY**

With over three times more newly installed capacity than any other EU country, Germany (5.4 GW) remains the largest wind energy market in Europe. France and Finland benefitted from supportive regulatory frameworks and increased their annual installations to their best result ever with 1,560 MW and 570 MW respectively. The boom in installed capacity observed in the Netherlands (887 MW) is largely due to offshore wind with the completion of Gemini (600 MW), the second largest offshore wind project ever built.

2. Central Eastern Europe includes Poland, Czech Republic, Hungary, Romania, Lithuania, Latvia, Estonia, Croatia, Bulgaria, Slovenia, Cyprus, Malta and Slovakia.

FIGURE 12**EU Member State 2016 installed wind capacity onshore and offshore. Total: 12,490 MW**

With new installed wind capacity of 178 MW in 2016, and an average power consumption of 1.1 GW, Lithuania is the Member State with the highest level of installed wind capacity relative to its power consumption (ratio of 16%³). Ireland (13%), and Germany (10%) follow with notable ratios too.

TABLE 2

Top 10 EU Member States wind markets relative to their power consumption
 (ratio installed capacity in 2016/average 2016 power consumption)

RANKING	COUNTRY	RATIO
1	Lithuania	15.7%
2	Ireland	12.8%
3	Germany	10.0%
4	Netherlands	7.1%
5	Finland	6.2%
6	Denmark	6.0%
7	Portugal	4.8%
8	Greece	4.1%

RANKING	COUNTRY	RATIO
9	Poland	3.6%
10	Sweden	3.2%

LITHUANIA

IS THE EU MEMBER STATE WITH MOST 2016 INSTALLATIONS RELATIVE TO ITS POWER CONSUMPTION

3. The ratio Installed capacity/average power consumption is an indicator that reflects the size of national wind energy markets relative to their electricity demand. It is a performance indicator to compare annual installations between distinct countries.

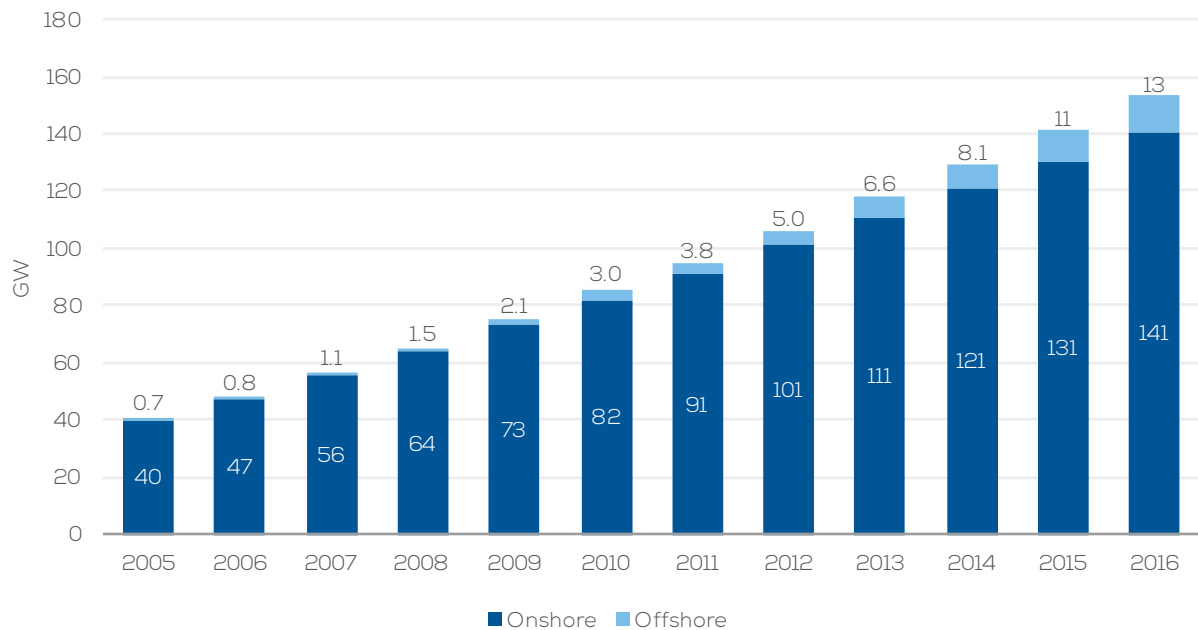
3.3 CUMULATIVE WIND POWER INSTALLATIONS

153.7 GW are now installed in the European Union with growth of 11% in 2016. Germany remains the EU Member State with the largest installed capacity, followed by Spain, the UK, France and Italy. Four other EU countries (Sweden, Denmark, Poland and Portugal) have more than 5 GW installed. Seven additional EU countries have over 1 GW of installed capacity: Austria, Belgium, Finland, Greece, Ireland, the Netherlands and Romania.

153.7 GW
OF WIND POWER ARE
NOW INSTALLED IN THE EU

FIGURE 13

Cumulative installations onshore and offshore in the EU. Total 153.7 GW

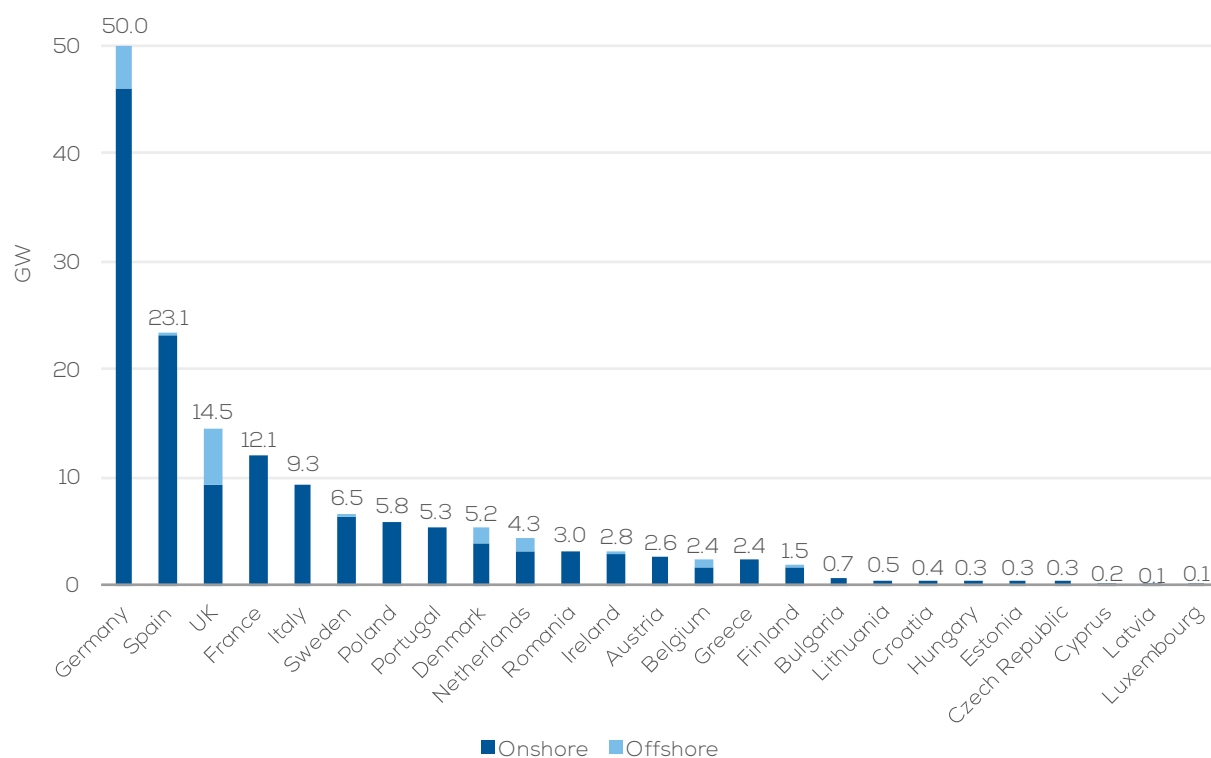


Source: WindEurope

Germany (50 GW) and Spain (23.1 GW) have the largest cumulative installed wind energy capacity in Europe. Together they represent 48% of total EU capacity. The UK, France and Italy follow with 14.5 GW (9.5% of total EU capacity), 12.1 GW (7.8%) and 9.3 GW (6.0%) respectively.

FIGURE 14

Cumulative installations onshore and offshore in the EU. Total 153.7 GW



Source: WindEurope

3.4 WIND POWER PENETRATION

In 2016 wind energy generated enough electricity to meet 10.4% of the EU-28 total electricity demand.

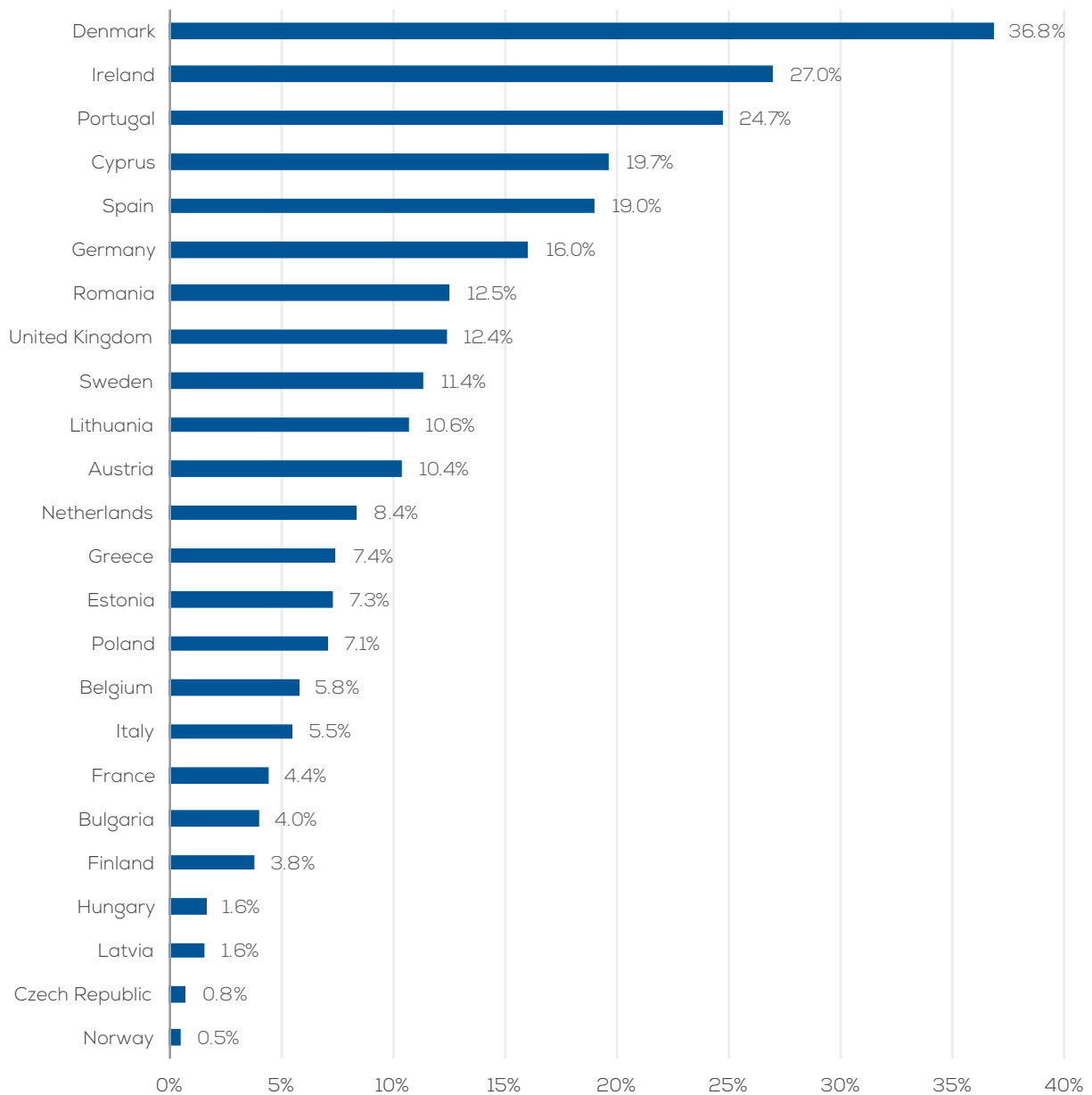
TABLE 3

Electricity production from wind power (TWh)

TOTAL EU ELECTRICITY CONSUMPTION (TWH)	ONSHORE WIND ENERGY PRODUCTION (TWH)	OFFSHORE WIND ENERGY PRODUCTION (TWH)	WIND ENERGY PRODUCTION (TWH)	SHARE OF EU CONSUMPTION MET BY WIND ENERGY
2,860	259	37	296	10.4%

Source: WindEurope

Denmark was the EU Member State with the highest penetration rate (37%), followed by Ireland (27%) and Portugal (25%). 11 out of the 28 Member States had a wind penetration rate of more than 10%.

FIGURE 15**Wind penetration rates in European countries⁴**

Source: WindEurope

4. The figures represent the average of the penetration rates captured hourly from ENTSO-E and corrected thanks to national TSOs and BEIS data. All European countries data is not available.

3.5 ONSHORE WIND TURBINES

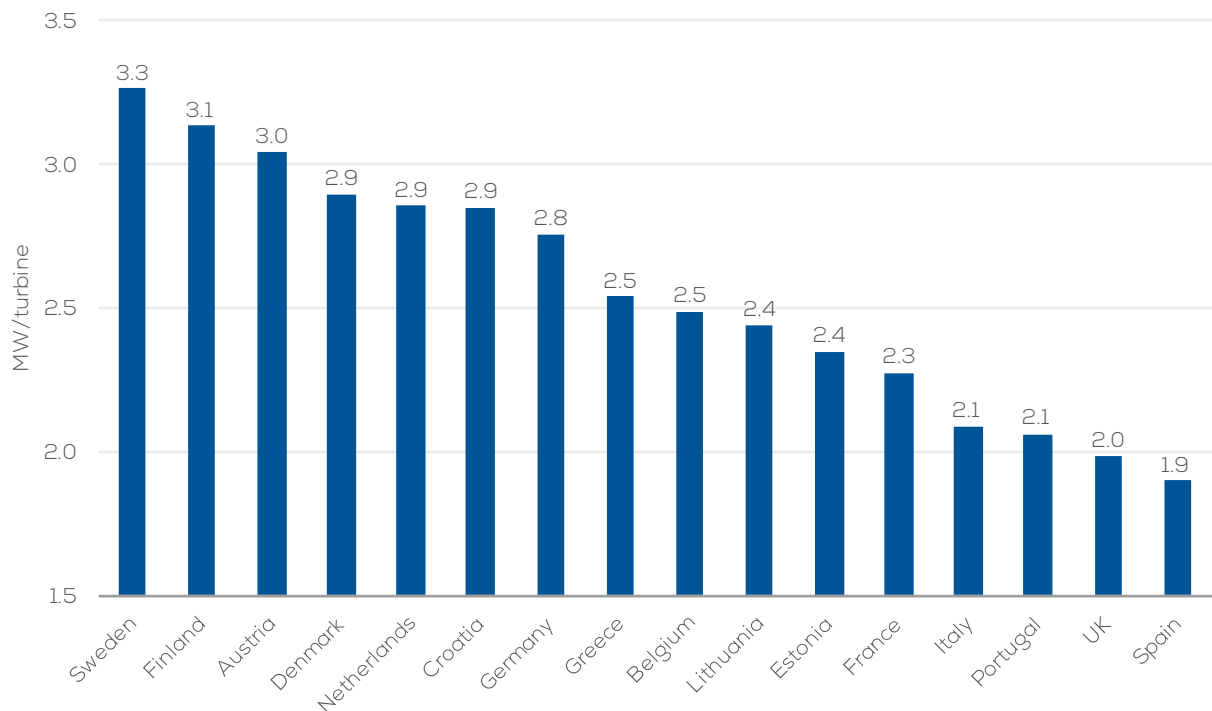
The size and type of wind turbines installed in the EU in 2016 varied significantly between different Member States. The wind turbines in Sweden and Finland had an average power rating of more than 3.1 MW. By contrast, the turbines installed in the UK and Spain had an average rating of less than 2 MW.

The differences in wind turbines ratings observed in the different Member States is due to three main factors:

- Regulatory restrictions on tip height
- Duration of projects
- Wind regimes (low speed or high speed)

FIGURE 16

Average 2016 turbine ratings in EU Member States



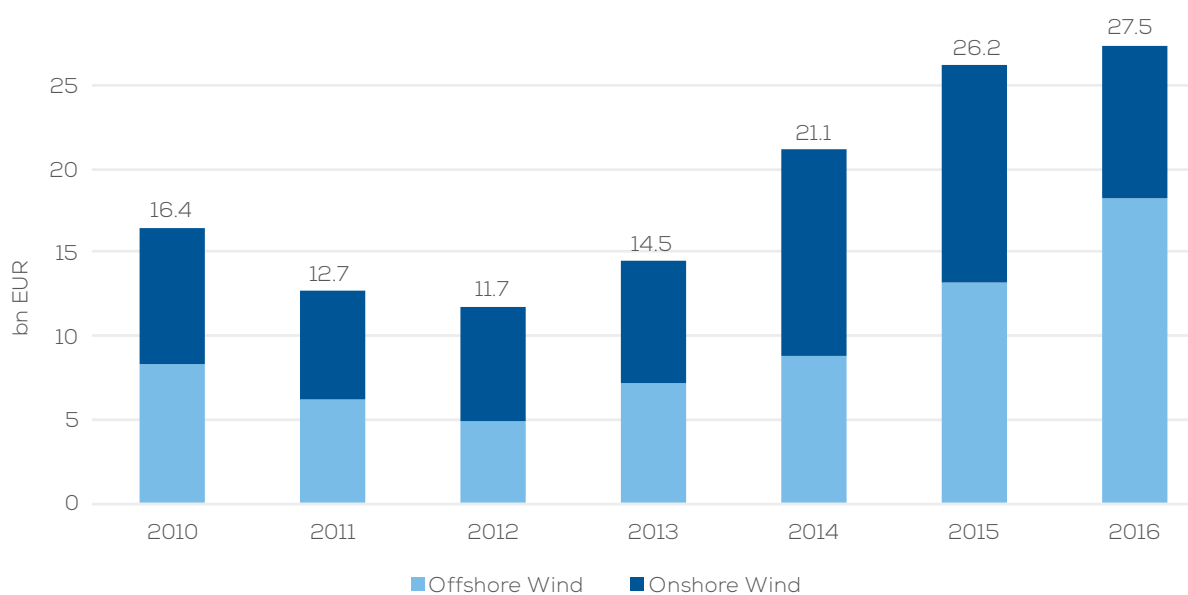
Source: WindEurope

4.

INVESTMENT NUMBERS IN 2016

FIGURE 17

New asset finance in wind energy 2010 – 2016⁵



Source: WindEurope

Europe invested a total of €27.5bn in wind energy, a 5% increase from 2015. This is largely due to investments in offshore wind, which increased by 39% on 2015. Onshore wind investments dropped to €9.3bn, their first decrease in the last five years. In total, there were 10.3 GW of new wind capacity financed in 2016.

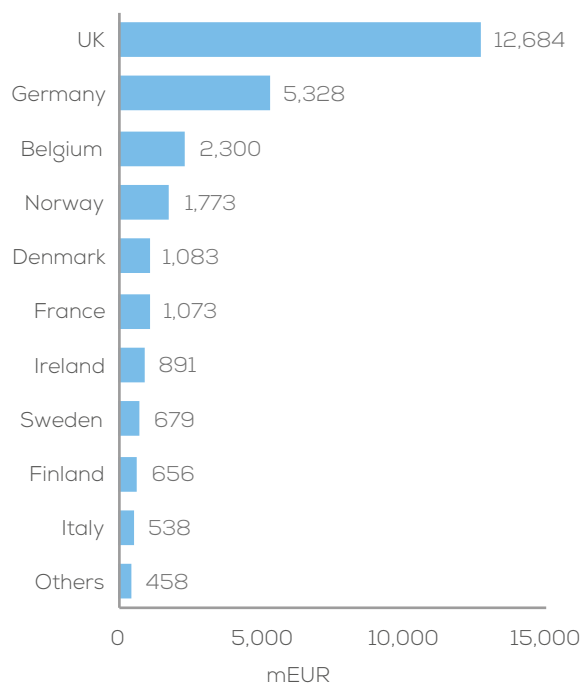
15 EU MEMBER STATES
ANNOUNCED NO NEW WIND
ENERGY INVESTMENTS IN 2016

5. Figures include only new asset financing. Project refinancing and public markets are not included in the investment activity.

FIGURE 18**New asset financing in 2016 by country (mEUR)**

For the second consecutive year, the United Kingdom was the biggest investor in wind energy. The country generated a total financing activity of €12.7bn for the construction of new onshore and offshore wind farms. This accounts for 46% of the total wind energy investments made in 2016.

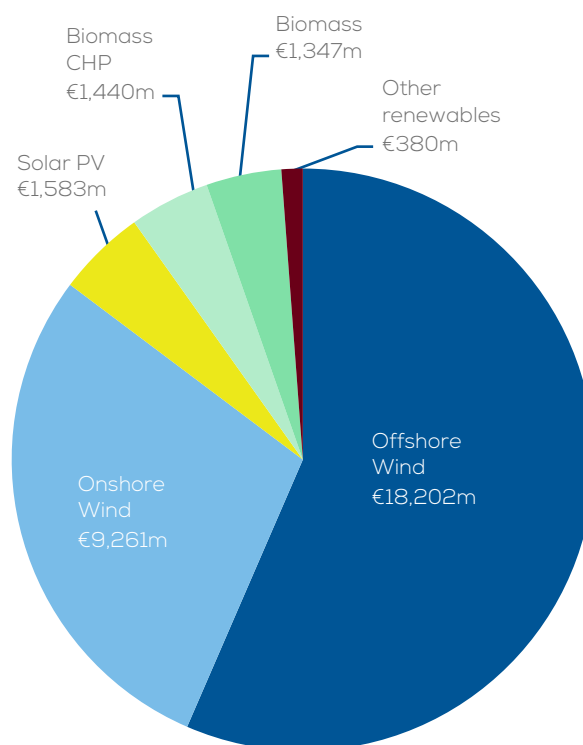
46% OF INVESTMENTS
ANNOUNCED IN 2016 WERE
IN THE UNITED KINGDOM



Source: WindEurope

FIGURE 19**Clean energy investments in 2016 (mEUR)⁶**

Wind energy investments accounted for 86% of the new clean energy finance in 2016, compared to 67% in 2015. Offshore wind projects alone were responsible for more than half of the investment activity in the renewable energy sector.



Source: WindEurope

6. Figures include only new asset financing. Residential ownership is not included in new investment numbers.



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