



**EWEA**

THE EUROPEAN WIND ENERGY ASSOCIATION



# Wind in power

2015 European statistics

February 2016

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## Data collection and analysis

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## Data sources

Clean Energy Pipeline, January 2016

Platts PowerVision, January 2016

EWEA, wind energy data

OEE, ocean energy data

EPIA, solar PV data

ESTELA, CSP data

## EWEA acknowledges the kind cooperation of the following National Associations and institutions:

IG Windkraft (AT) – BOP, EDORA and ODE (BE) - BGWEA (BG) - RP Global Projekti (HR) - K. Ellinas Energy (CY) - CSVE (CZ)– DWIA (DK) – Tuulenergia (EE) – SEV (FO) – Suomen Tuulivoimayhdistys ry (FI) – France Énergie Éolienne and Syndicat des Énergies Renouvelables (FR) – BWE, VDMA and Stiftung Offshore Windenergie (DE) – HWEA (EL) – HWIA (HU) – IWEA (IE) – Landsvirkjun (IS) – ANEV and assoRinnovabili (IT) – LWEA (LV) – LWPA (LT) – Energy Institute Hrvoje Pozar (HR) – Ministry of Sustainable Development and Infrastructures (LU) – NWEA (NL) – PWEA (PL) – APREN (PT) – NorWEA (NO) - RWEA (RO) – Continental Wind Partners (SRB) – Slovak Renewable Energy Agency (SK) – University of Maribor (SI) – RAWI (RS) – Svenskvindenergi (SE) – AEE (ES) - Suisse Eole (CH) – TÜREB (TK) – UWEA (UA) – RenewableUK (UK).

Photo cover: Courtesy of GE Renewable Energy

## Executive summary

### 2015 annual installations

- 12,800 MW of wind power capacity was installed and grid-connected in the EU during 2015, an increase of 6.3% on 2014 installations. 9,766 MW were installed onshore and 3,034 MW offshore.
- Wind power installed more than any other form of power generation in 2015. Wind power accounted for 44.2% of total 2015 power capacity installations.
- Renewable energy accounted for 77% of all new EU power installations in 2015: 22.3 GW of a total 29 GW.
- Big variations between countries in their 2015 new installations reflect the relative effectiveness of policy and regulatory frameworks and uncertainty over future energy policy in EU Member States.

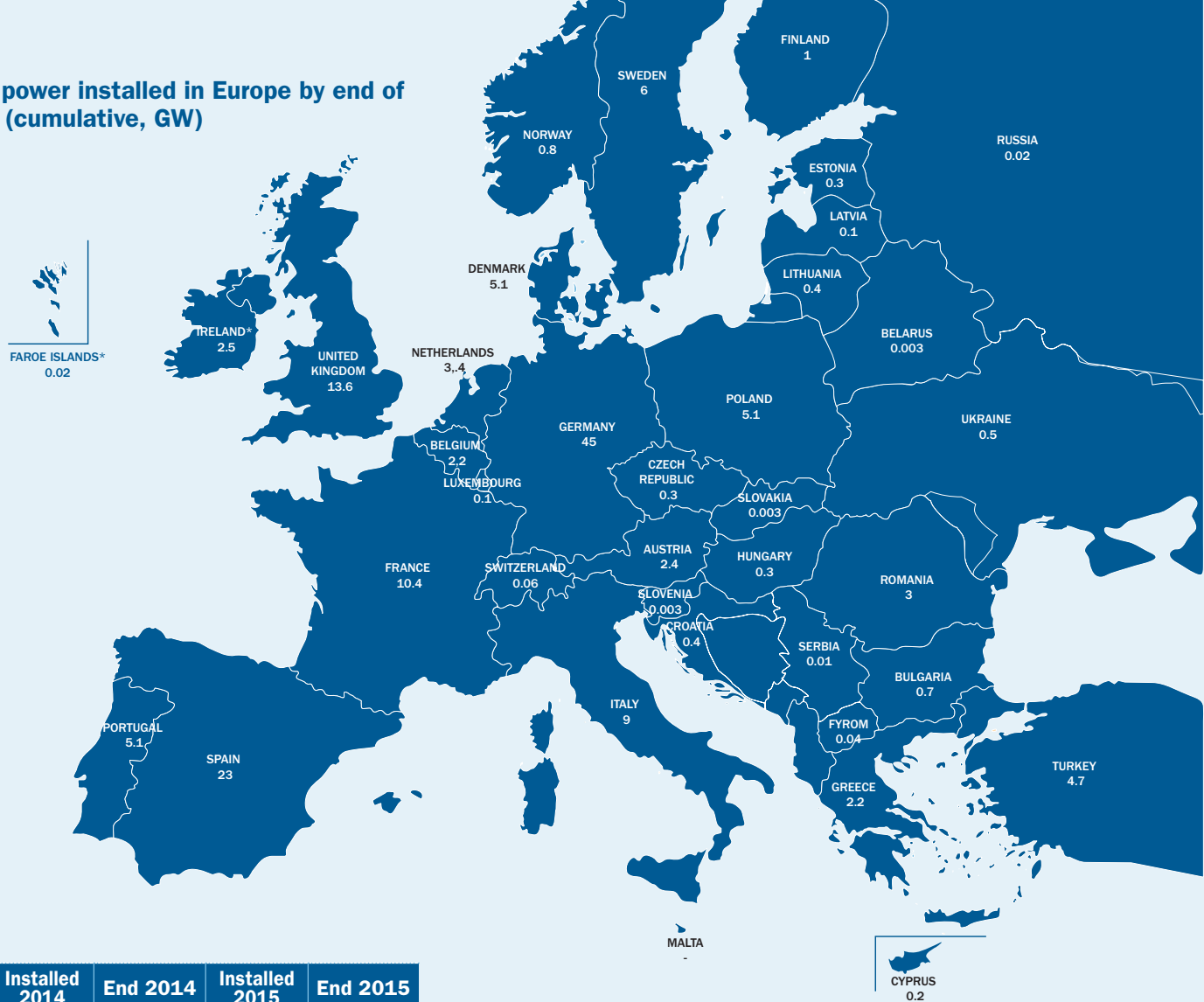
### Trends and total installations

- There is now 142 GW of installed wind power capacity in the EU: 131 GW onshore and 11 GW offshore.
- The EU total installed power capacity increased by 11 GW net in 2015 to 908 GW.
- Wind energy has overtaken hydro as the third largest source of power generation in the EU with a 15.6% share of total power capacity.
- Wind power accounts for one third of all new power installations since 2000 in the EU.
- Conventional power sources such as fuel oil and coal continue to decommission more capacity than they install. Gas installations also saw a high rate of capacity decommissioning in 2015.

### Wind power installations

- Germany remains the EU country with the largest installed capacity (45 GW), followed by Spain (23 GW), the UK (14 GW) and France (10 GW). 16 EU countries have over 1 GW wind power capacity installed, nine of these have more than 5 GW.
- 47% of all new installations in 2015 took place in just one country: Germany. Poland, France and the UK followed with 1.3 GW, 1 GW and 970 MW respectively.
- The total wind power capacity installed at the end of 2015 could produce 315 TWh and cover 11.4% of the EU electricity consumption in a normal wind year.
- €26.4 billion was invested in Europe in 2015 to finance wind energy development. This was 40% more than the total investment in 2014.

## Wind power installed in Europe by end of 2015 (cumulative, GW)



	Installed 2014	End 2014	Installed 2015	End 2015
<b>EU Capacity (MW)</b>				
Austria	405	2,089.2	323	2,411.5
Belgium	293.5	1,958.7	274.2	2,228.7
Bulgaria	10.1	691.2	-	691.2
Croatia	85.7	346.5	76.2	422.7
Cyprus	-	146.7	10.8	157.5
Czech Republic	14	281.5	-	281.5
Denmark	104.9	4,881.7	216.8	5,063.8
Estonia	22.8	302.7	0.7	303.4
Finland	184.3	626.7	379.4	1,000.5
France	1,042.1	9,285.1	1,073.1	10,358.2
Germany	5,242.5	39,127.9	6,013.4	44,946.1
Greece	113.9	1,979.9	172.2	2,151.7
Hungary	-	328.9	-	328.9
Ireland*	213.0	2,262.3	224	2,486.3
Italy	107.5	8,662.8	295	8,957.8
Latvia	0.4	61.7	-	61.7
Lithuania	0.5	279.6	144.7	424.3
Luxembourg	-	58.3	-	58.3
Malta	-	-	-	-
Netherlands	175	2,865	586	3,431
Poland	444.3	3,833.8	1,266.2	5,100
Portugal	222	4,947	132	5,079
Romania	354	2,952.9	23	2,975.9
Slovakia	-	3.1	-	3.1
Slovenia	0.9	3.4	-	3.4
Spain	27.5	23,025.3	-	23,025.3
Sweden	1,050.2	5,424.8	614.5	6,024.8
UK	1,923.4	12,633.4	975.1	13,602.5
<b>Total EU-28</b>	<b>12,037.4</b>	<b>129,060.1</b>	<b>12,800.2</b>	<b>141,578.8</b>

European Union: 141,579 MW  
 Candidate Countries: 4,741 MW  
 EFTA: 901 MW  
 Total Europe: 147,772 MW

	Installed 2014	End 2014	Installed 2015	End 2015
<b>Candidate Countries (MW)</b>				
FYROM	37	37	-	37
Serbia	-	-	9.9	9.9
Turkey	804	3,738	956	4,694
<b>Total</b>	<b>841</b>	<b>3,775</b>	<b>965.9</b>	<b>4,740.9</b>
<b>EFTA (MW)</b>				
Iceland	1.2	3	-	3
Liechtenstein	-	-	-	-
Norway	48.0	819.3	22.5	837.6
Switzerland	-	60.4	-	60.4
<b>Total</b>	<b>49.2</b>	<b>882.7</b>	<b>22.5</b>	<b>901</b>
<b>Other (MW)</b>				
Belarus	-	3.4	-	3.4
Faroe Islands	11.7	18.3	-	18.3
Russia	-	15.4	-	15.4
Ukraine	126.3	497.5	16.6	514.1
<b>Total</b>	<b>138.0</b>	<b>534.7</b>	<b>16.6</b>	<b>551.3</b>
<b>Total Europe</b>	<b>13,065.6</b>	<b>134,252.7</b>	<b>13,805.2</b>	<b>147,772</b>

\* Provisional data

Note: Annual installations figures reflect the total new capacity added in one year. As such, they are gross figures, not including decommissioning. Cumulative capacity figures are net, including decommissioning year over year. Due to 281 MW of decommissioned capacity, the total 2015 end-of-year cumulative capacity is not exactly equivalent to the sum of the 2014 end-of-year total plus the 2015 annual additions.

# 2015 annual installations

## Wind power capacity installations

During 2015, 13,805.2 MW of wind power was installed across Europe, 5.4% more than in the previous year. 12,800.2 MW of it was in the European Union.

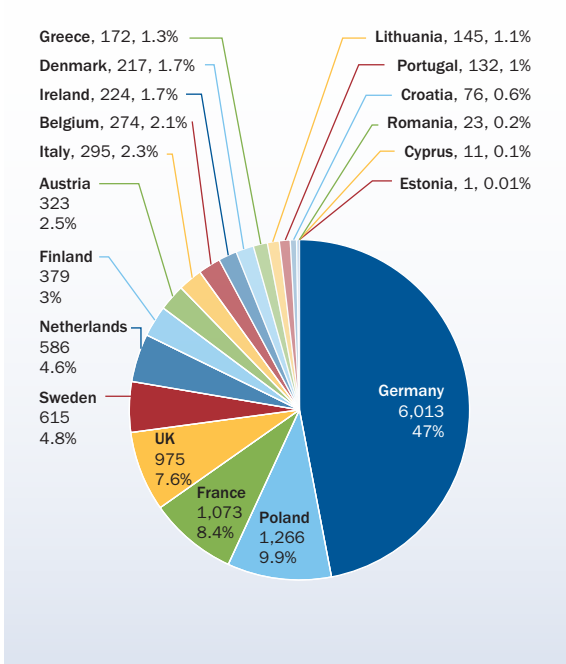
Of the capacity installed in the EU, 9,765.7 MW was onshore and 3,034.5 MW offshore. In 2015, the annual onshore market decreased in the EU by 7.8 %, and offshore installations more than doubled compared to 2014. Overall, EU wind energy annual installations increased by 6.3% compared to 2014 installations.

Germany was the largest market in 2015 in terms of annual installations, installing 6,013.4 MW of new capacity, 2,282.4 MW of which was offshore (38% of total capacity installed in Germany). Poland came second with 1,266.4 MW, more than twice the annual installations in 2014 and one quarter of its national cumulative capacity at end 2015. France was third with 1,073.1 MW and the UK fourth with 975.1 MW, 59% of which was offshore (572.1 MW).

Almost half of the new capacity installed in 2015 came from the pioneering markets of Germany and Denmark. This is mainly due to the stability of the regulatory frameworks in these countries, which gives investors visibility on future projects' cash flows and favours investments in wind energy.

47% of all new EU installations in 2015 took place in Germany and 73% occurred in the top four markets, a similar trend to the one seen in 2014.

**FIGURE 1: EU MEMBER STATE MARKET SHARES FOR NEW WIND ENERGY CAPACITY INSTALLED DURING 2015 (MW), TOTAL 12,800.2 MW**



Offshore wind accounted for 24% of total EU wind power installations in 2015, double the share of annual additions in 2014. This confirms the growing relevance of the offshore wind industry in the development of wind energy in the EU.

### Power capacity installations

In 2015, 28.9 GW of new power generating capacity was installed in the EU, 2.4 GW more than in 2014.

Wind power was the energy technology with the highest installation rate in 2015: 12.8 GW, accounting for 44% of all new installations. Solar PV came second with 8.5 GW (29% of 2015 installations) and coal third with 4.7 GW (16%).

Gas installed 1.9 GW (6.4 % of total installations), CSP 370 MW (1.3%), hydro 238.5 MW (0.8%), biomass 232.4 MW (0.8%), waste 118.5 MW, nuclear 100 MW, geothermal 4.3 MW and ocean 4.1 MW. Peat and fuel oil did not install any capacity in 2015.

During 2015, Member States decommissioned 8 GW of coal capacity, 4.3 GW of gas, 3.3 GW of fuel oil, 1.8 GW of nuclear energy capacity, 518 MW of biomass and 281 MW of wind energy.

FIGURE 2: SHARE OF NEW POWER CAPACITY INSTALLATIONS IN EU (MW). TOTAL 28,948.7 MW

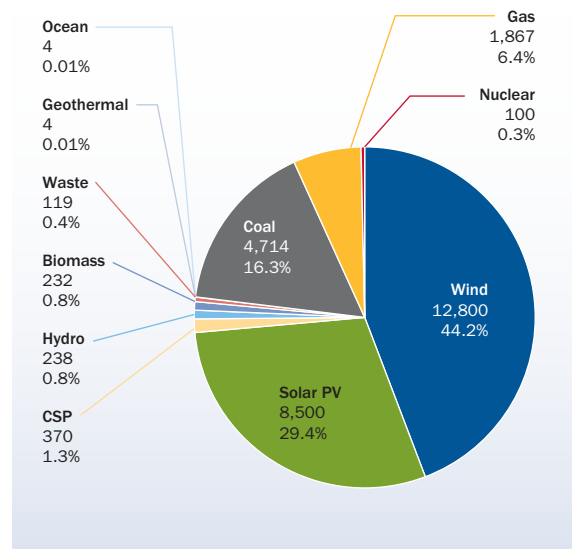
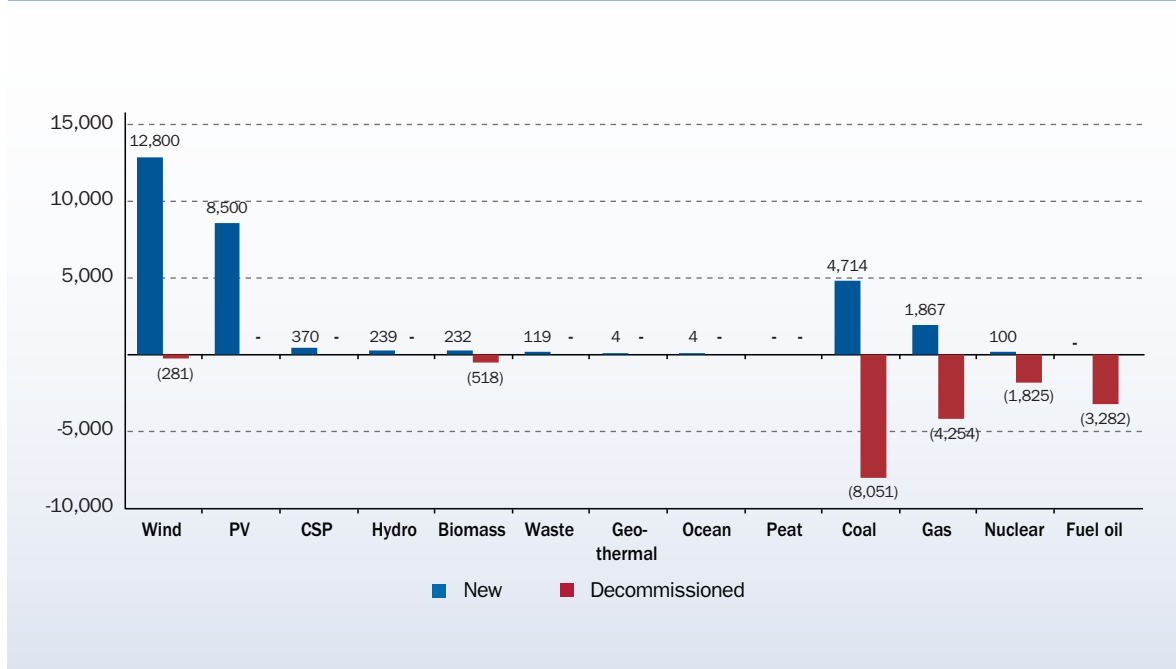


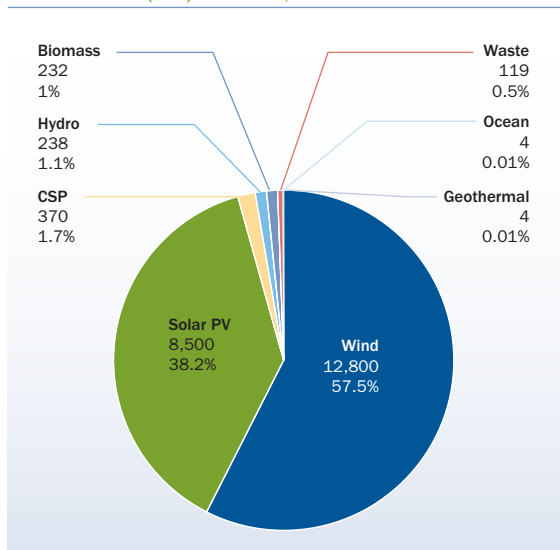
FIGURE 3: NEW INSTALLED AND DECOMMISSIONED POWER CAPACITY IN EU (MW)



## Renewable power capacity installations

In 2015, renewables installations accounted for a total of 22.3 GW, 77% of all new installed capacity in the EU. It was, the eighth year in a row where renewables contributed over 55% of all additional power capacity in the EU.

FIGURE 4: 2015 SHARE OF NEW RENEWABLE POWER CAPACITY INSTALLATIONS (MW). TOTAL 22,267.9 MW



## Trends & cumulative installations

### Renewable power capacity installations

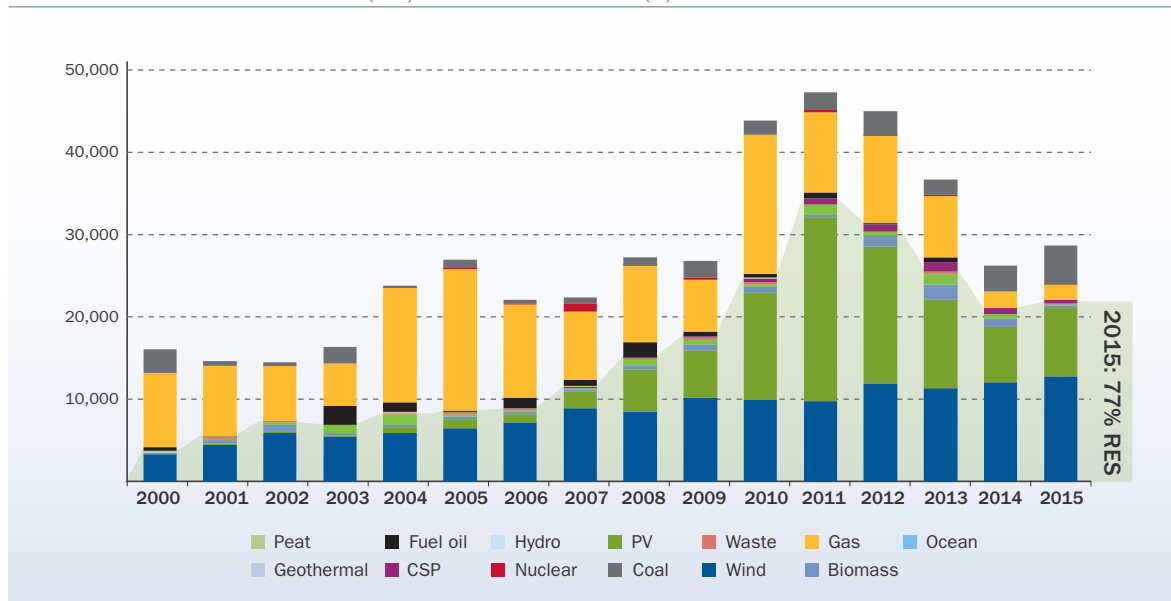
In 2000, new renewable power capacity installations totalled a mere 3.6 GW. Since 2010, annual renewable capacity additions have been between 21 GW and 35 GW, six to ten times higher than in 2000.

The share of renewables in total new power capacity additions has also surged. In 2000, the 3.6 GW

represented 22.4% of new power capacity installations, increasing to 22 GW representing 77% in 2015.

443 GW of new power capacity has been installed in the EU since 2000. Of this, 30% has been wind power and 58% renewables.

FIGURE 5: ANNUAL INSTALLED CAPACITY (MW) AND RENEWABLE SHARE (%)

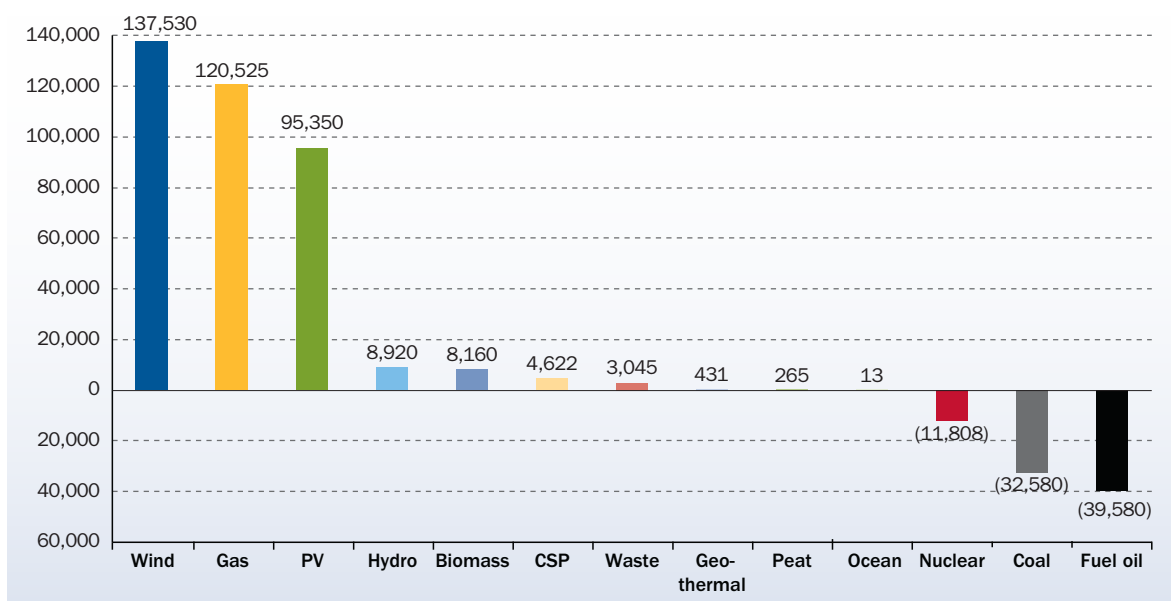


### Net changes in EU installed power capacity 2000-2015

Since 2000, the net growth of wind power (137 GW), gas (120 GW) and solar PV (93 GW) coincided with the net reduction in fuel oil (down 39 GW), coal (down 32 GW) and nuclear (down 2 GW). The other renewable technologies (biomass, hydro, waste, CSP, geothermal and ocean energies) have also been increasing their installed capacity over the past decade, albeit more slowly than wind and solar PV.

The EU's power generation capacity continues to move away from fuel oil, coal, nuclear and gas to a higher share of wind, solar PV and other renewables. Since 2013, gas decommissioned more MW than what it installed but still has the most overall installed capacity.

FIGURE 6: NET ELECTRICITY GENERATING INSTALLATIONS IN THE EU, 2000-2015 (MW)



### Total installed power capacity

Wind power's share of total installed power capacity has increased six-fold since 2000, from 2.4% in 2000 to 15.6% in 2015, overtaking hydro as the third largest power generation capacity in the EU and the

first renewable energy technology in capacity installed. Over the same period, renewables increased their share from 24% of total power capacity in 2000 to 44% in 2015.

FIGURE 7: EU POWER MIX 2000 (MW)

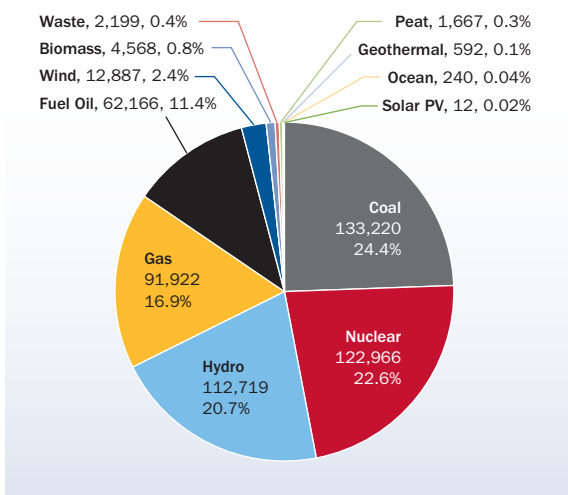
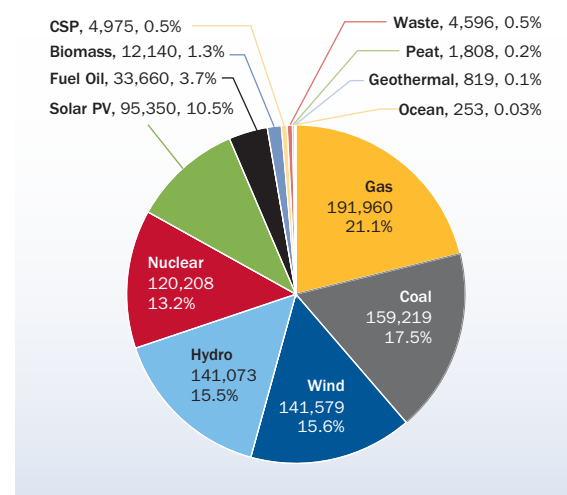


FIGURE 8: EU POWER MIX 2015 (MW)



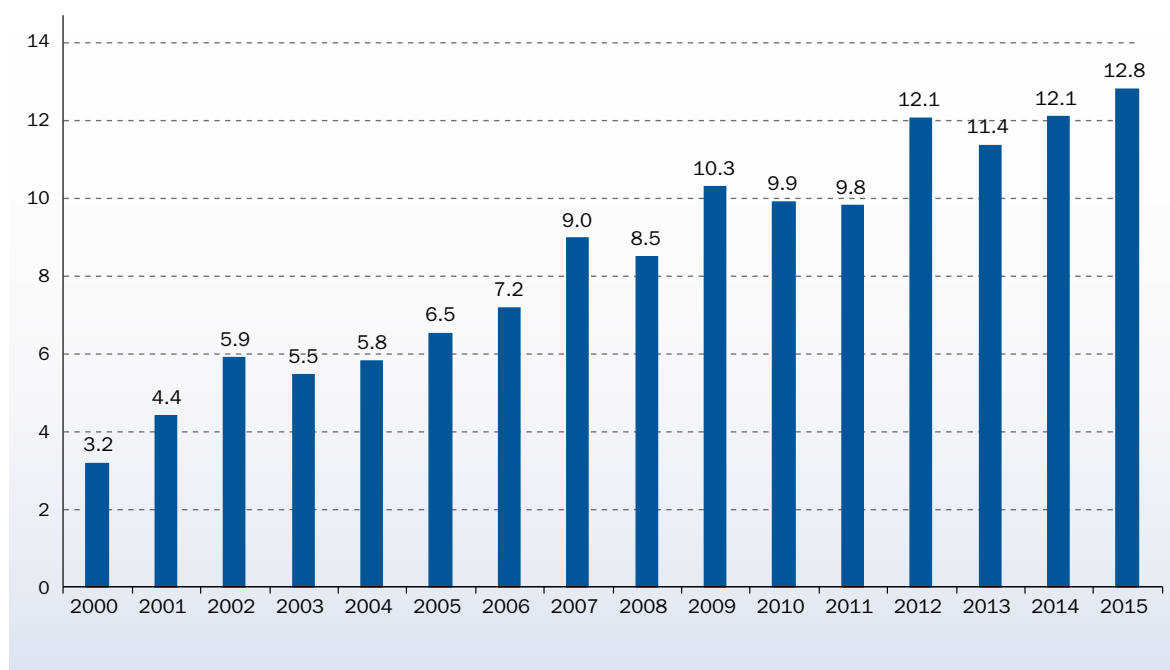


## A closer look at wind power installations

### Total installed power capacity

Annual wind power installations in the EU have increased steadily over the past 15 years from 3.2 GW in 2000 to 12.8 GW in 2015, a CAGR of 9%.

FIGURE 9: ANNUAL WIND POWER INSTALLATIONS IN EU (GW)

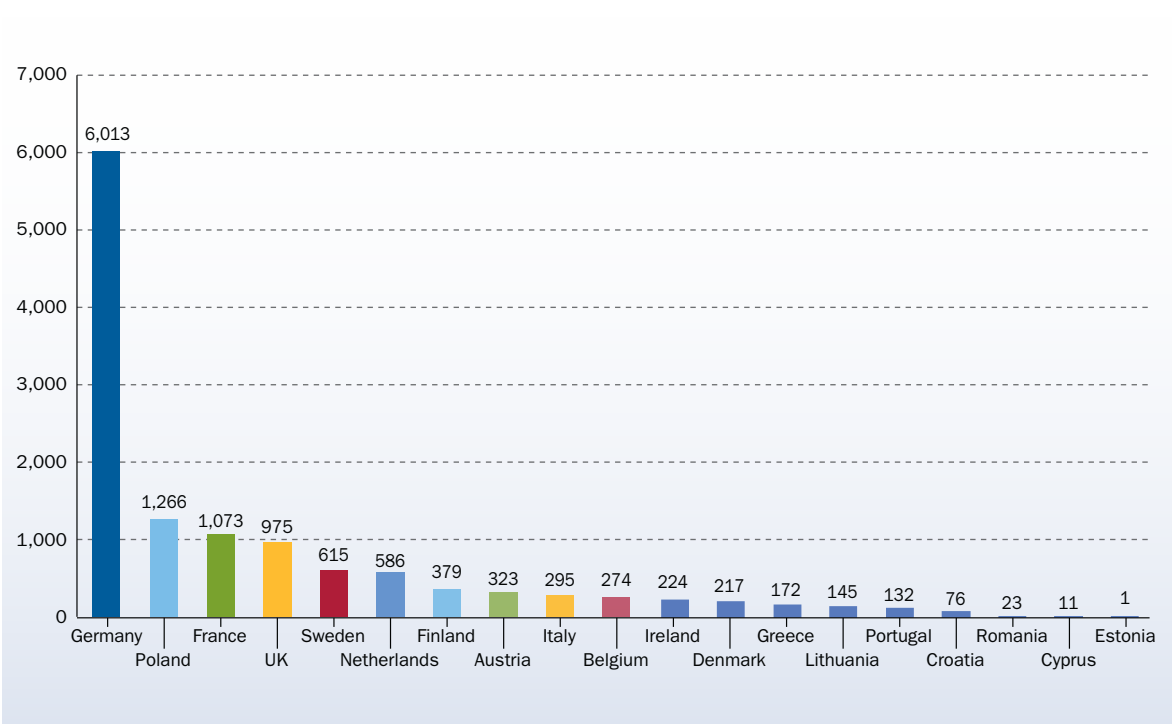


### National breakdown of wind power installations

2015 showed important variations between countries in their capacity additions. Germany led with over 6 GW newly installed, reflecting the traditional size and strength of its wind energy market. Three factors facilitated growth: effective policies, the connection of large amounts of offshore capacity installed but not grid-connected in 2014, and a desire by the industry to complete installations before Germany moves to market-based arrangements in 2017. Similarly, Polish developers made use of existing policies and installed over 1,200 MW before the new scheme applies in 2016.

By contrast, the lack of political visibility and ineffective regulations led in some countries to fewer installations in 2015 than in previous years. In particular, Spain, which has been a very strong market, saw new installations fall to zero as a result of inadequate policies. The wind energy industry suffered from changing regulations also in Romania. Stable regulatory frameworks and visibility therefore remain imperative to provide investors with certainty and growing wind power in all parts of Europe.

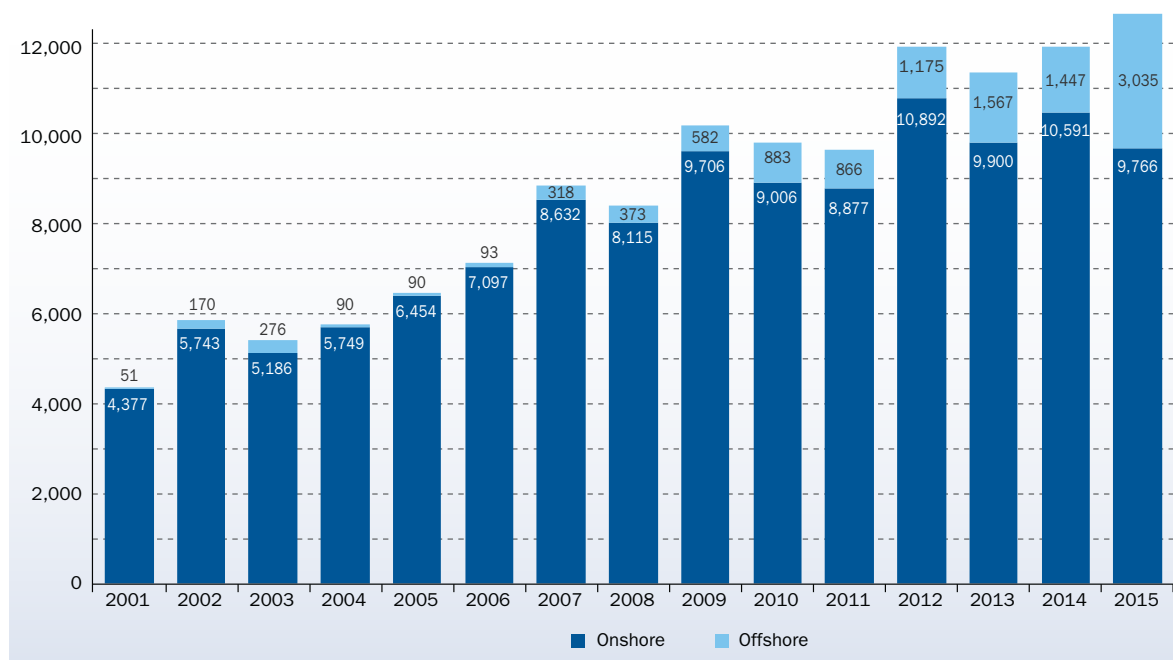
FIGURE 10: EU MEMBER STATE MARKET SHARES FOR NEW WIND ENERGY CAPACITY INSTALLED DURING 2015 (MW). TOTAL 12,800.2 MW



## Onshore and offshore annual markets

New offshore wind installations more than doubled in 2015 compared to 2014, with 3,034.5 MW of new gross capacity grid-connected. Offshore wind power installations represented 24% of the annual EU wind energy market, up from 13% in 2014.

FIGURE 11: ANNUAL ONSHORE AND OFFSHORE INSTALLATIONS (MW)



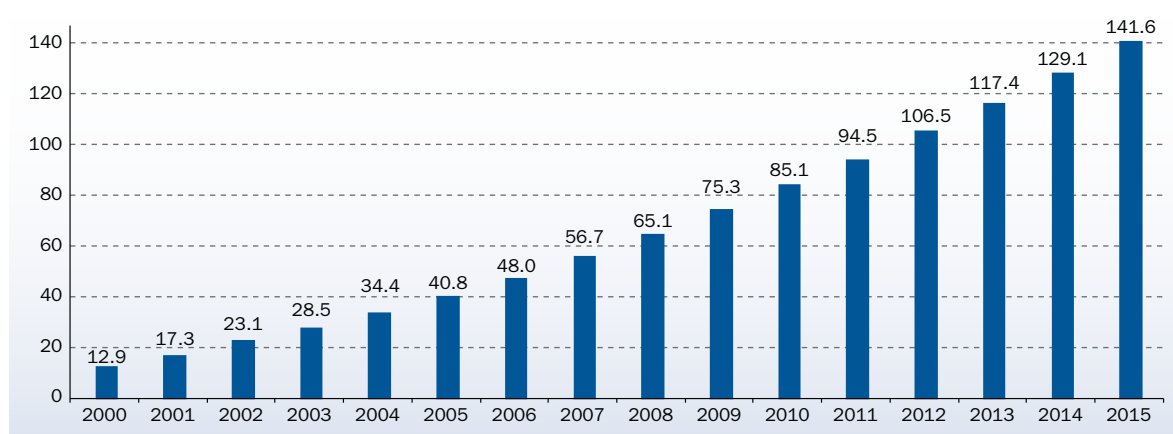
## Cumulative wind power installations

A total of 141.6 GW is now installed in the European Union due to a record growth of 9.7 % in 2015. Germany remains the EU country with the largest installed capacity, followed by Spain, the UK, France and Italy. Eleven other EU countries have over 1 GW of installed capacity: Austria, Belgium, Denmark, Finland, Greece,

Ireland, the Netherlands, Poland, Portugal, Romania and Sweden.

Four of the latter (Sweden, Denmark, Poland and Portugal), have more than 5 GW installed.

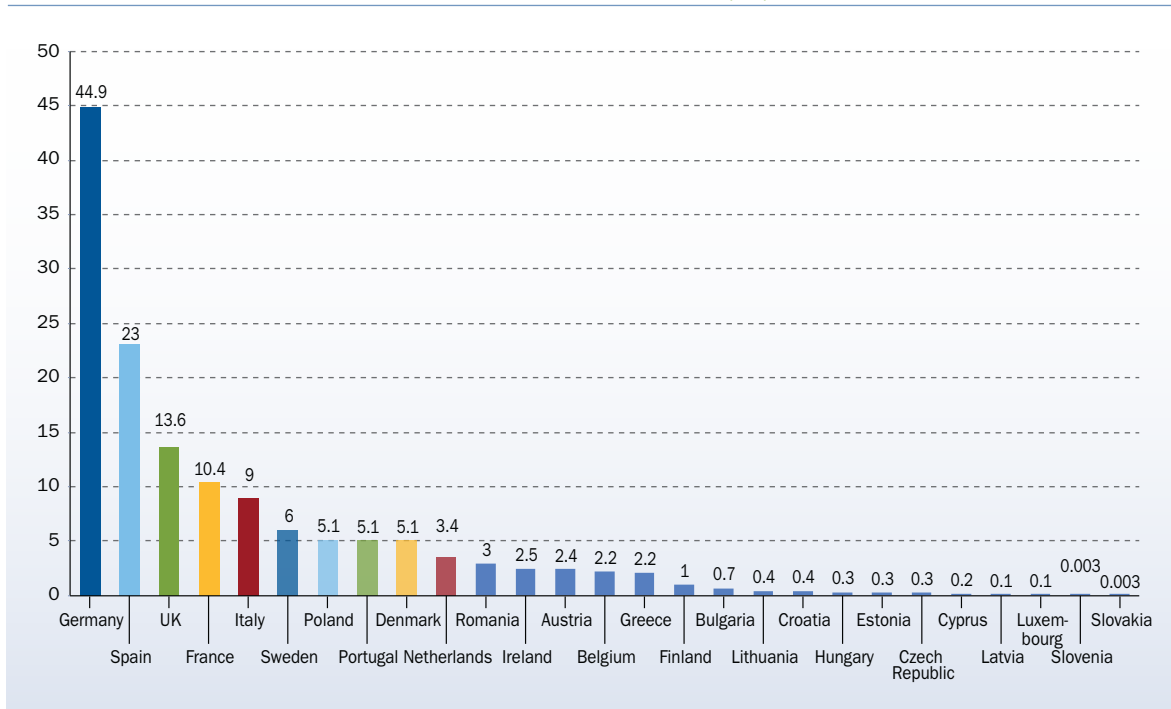
FIGURE 12: CUMULATIVE WIND POWER INSTALLATIONS IN THE EU (GW)



Germany (44.9 GW) and Spain (23 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 13.6 GW (9.6% of total EU capacity), 10.4 GW (7.3%) and 9 GW (6.3%) respectively.

Thanks to this record year in annual installations, Poland, with 5.1 GW (3.6% of cumulative capacity), is now the seventh country per capacity installed, having overtaken Denmark and Portugal.

FIGURE 13: EU MEMBER STATE MARKET SHARES FOR TOTAL INSTALLED CAPACITY (GW). TOTAL 141.6 GW



## Wind power penetration

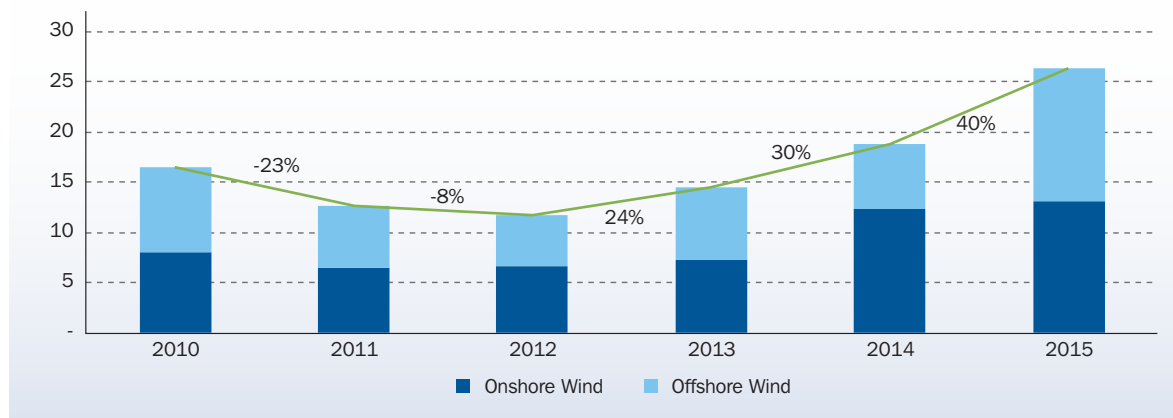
The wind energy capacity currently installed in the EU would produce in an average wind year 315 TWh of electricity, enough to cover 11.4% of the EU's total electricity consumption<sup>1</sup>.

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 onshore wind (TWh)	Share of EU consumption met by offshore wind	Share of EU consumption met by wind energy
2,770	274.5	40.6	315	9.9%	1.5%	11.4%

<sup>1</sup> Wind energy penetration levels are calculated using average capacity factors onshore and offshore and Eurostat electricity consumption figures (2013). Consequently, table 1 indicates the approximate share of consumption met by the installed wind energy capacity at the end of 2015. The figure does not represent real wind energy production over a calendar year. The most recent data (2013) for EU28 final energy consumption of electricity from Eurostat, is 2,770 TWh. Eurostat, online table code [nrg\_105a], extracted on 26 January 2016.

## Investment highlights: trends and developments in 2015

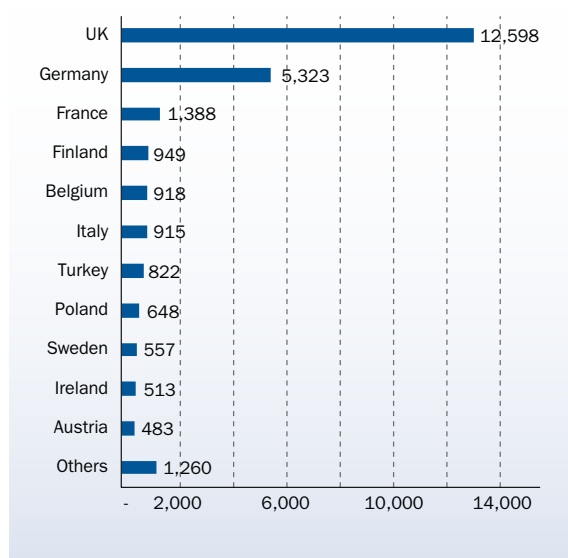
FIGURE 14: TOTAL ANNUAL INVESTMENTS IN WIND ENERGY 2010–2015. FIGURES INCLUDE INVESTMENTS IN NEW ASSETS (€ BN)



2015 was a record year for investments in the wind energy sector. Financial commitments in new assets reached a total of €26.4 billion (bn), a 40% increase from 2014. While investments in new onshore wind

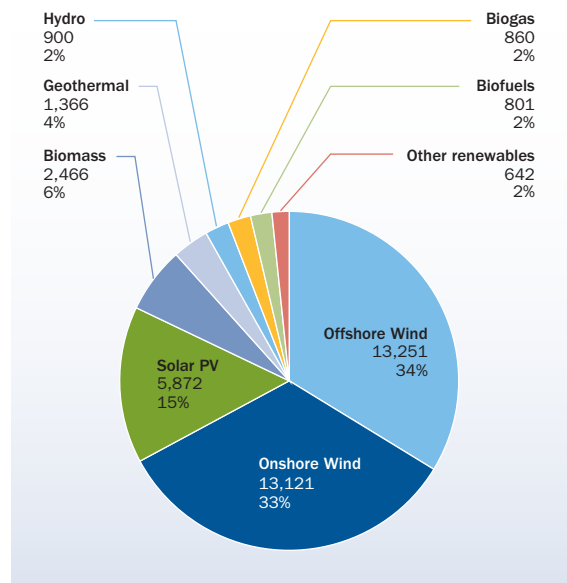
generating assets increased by 6.3% in 2015, those in the offshore wind sector doubled compared to the previous year. In total, 9.7 GW of new gross capacity was financed.

FIGURE 15: INVESTMENTS IN THE WIND ENERGY SECTOR IN 2015. FIGURES INCLUDE INVESTMENTS IN NEW ASSETS (€ MILLION)



The UK had the highest level of investments in 2015, attracting €12.6 bn for the construction of new onshore and offshore wind farms. This accounts for 48% of the total investments made in 2015.

FIGURE 16: CLEAN ENERGY INVESTMENTS IN 2015 (€ MILLION)



66.7% of the new financial commitments in 2015 for renewable energies went to the wind power sector, followed by solar PV (15%), biomass (6%) and geothermal technologies (4%).

# EWEA Technology Workshops

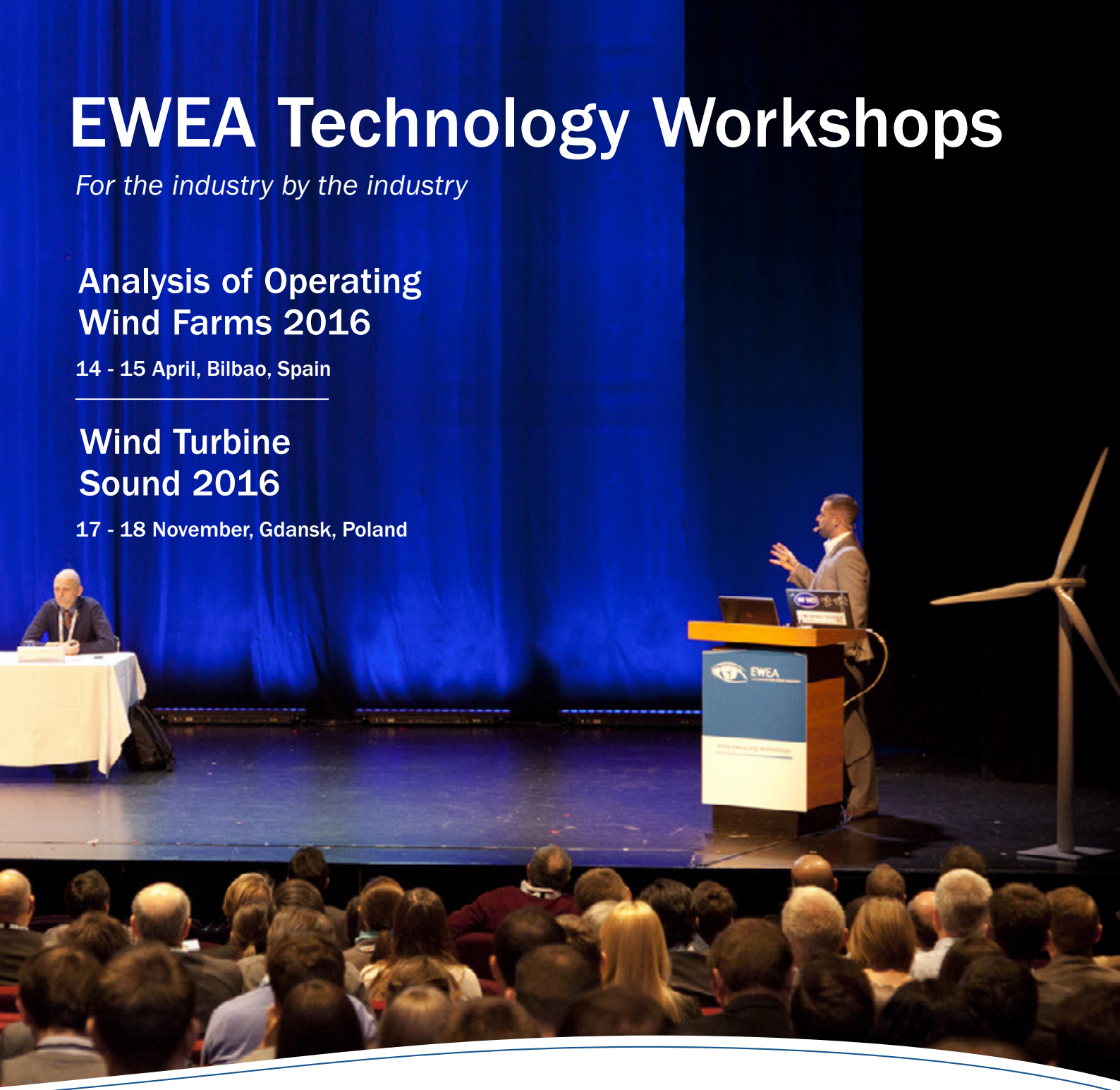
*For the industry by the industry*

## Analysis of Operating Wind Farms 2016

14 - 15 April, Bilbao, Spain

## Wind Turbine Sound 2016

17 - 18 November, Gdansk, Poland



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ECMWF, at EWEA's Technology Workshop, Leuven, October 2015

*"Interesting, well organised with a good equilibrium between conference and networking opportunities."*

Representative of Gamesa at EWEA 2<sup>nd</sup> Edition Analysis of Operating Wind Farms 2014