The offshore wind turbines of Borkum Riffgrund 1, North Sea (Germany), commissonned the 9 october 2015.

PAUL-LANGROCK.DE

303.5 TWh

The estimated electric production from wind power in the EU in 2015

WIND ENERGY BAROMETER

A study carried out by EurObserv'ER.

EurObserv'ER

The spectacular rise of China's wind power market that resulted in connecting at least 30.5 GW, catapulted the global installation level to 62.7 GW in 2015– a 22% more than in 2014! The US and German markets also performed very well, the former because its tax credit mechanism remained in force and the latter because many of its offshore wind farms in the North Sea were connected to the grid. Global wind turbine capacity has increased by 17% and now stands at 432.6 GW.

62.7 GW

Worldwide wind power capacity installed during 2015

12.5 GW

Wind power capacity installed in the EU during 2015

ASIAN DEVELOPMENT BANK/FLICKR

An onshore wind park in a rural aera of the Democratic People's Republic of China.

The world wind energy market figures bear out the fact that energy transition is in full swing only weeks after an historic climate agreement was signed by 195 countries and national delegations in Paris. First available data suggest that at least 62 732 MW of wind turbine capacity was installed worldwide in 2015, i.e. 22% more than in 2014. The spectacular performance of the Chinese market (30.5 GW), which is now driving world growth, the lifting of uncertainties in the USA (8.6 GW) and continued growth in emerging markets such as Brazil (2.8 GW), India (2.6 GW) and Turkey (1 GW) must take much of the credit for the global wind energy market's excellent figures **(table 1).**

432 560 MW IN THE WORLD

THE ENERGY MARKET RIDING ON THE SLIPSTREAM

The wind energy market's dazzling growth sends a strong signal about the world electricity system's ongoing metamorphosis. The continuing fall in wind power production costs following the launch of more profitable, efficient wind turbines, even on low-wind sites **(see industrial section p. 12)** means that wind power is now in head-on competition with fossil fuel. These new prospects have created footholds in many emerging markets – in Latin America, Africa and Asia – which are set to become the industry's main growth drivers in the next decade, sparking off their own energy transitions in turn.
Wind energy's capacity build-up is deep-rooted. In just two decades, installed capacity across the world has already increased by a factor of 90 **(graph 1),** to reach 432 560 MW. The world's installed fleet has more than doubled since the start of this decade. To give some idea of what this really means, if we assume a mean load factor of 2200 hours per turbine, output comes to more than 950 TWh of output, which equates to Japan's annual electricity consumption!
The major electricity consuming countries are also the main investors in wind energy. China alone has more than 100 GW of installed capacity (145.1 GW at the end of 2015) and this year overtook the European Union's combined installed capacity figure (141.7 GW at the end of 2015). The USA and Germany, similarly very active countries, hold the middle ground with respective capacities to date of 74.5 GW and 44.9 GW. They are followed by five other countries with capacities in excess of 10 GW: India (25.1 GW), Spain (23 GW), the UK (13.9 GW), as well as Canada and France, the two new club members with 11.2-GW and 10.3-GW fleets respectively. They will very certainly be joined by Brazil next year (now with 8.7 GW).
Regional distribution shows that 40.6% of the world's installed wind energy capacity **(graph 2)** is now concentrated in Asia and is broadening the gap with Europe (34.2%) and North America (20.5%). In 2015, every other new wind turbine was installed in Asia (53.6%), compared to almost 2 out of 10 in Europe (21.6%) and fewer than 2 out of 10 in North America (17.2%).

NEWS FROM THE TWO MARKET LEADERS

China would welcome a change of air

As we write, it is difficult to put an accurate figure to the Chinese market in 2015 and of the proportion effectively hooked up to the grid. Yet China confounded the forecasts by announcing spectacular additional capacities. Preliminary statistics released by the Chinese Wind Energy Association (CWEA) suggest 30.5 GW of additional capacity in 2015, which would take China's capacity to date to 145.1 GW.
It is now clear that the Chinese government has taken a proactive stance on minimising its recourse to coal-fired power plants, which are responsible for the polluting smog choking its major cities. The analysts put this stronger-than-expected growth down to the policy of speeding up project implementation once the necessary administrative approvals have been received. In 2014, this impetus drove the government to reduce the Feed-in Tariff of onshore wind energy by 0.02 CNY/kWh (about € 0.03/kWh) for all projects approved prior to 2015 but not on stream in 2016. At the end of 2015, the Chinese government announced a further Feed-in Tariff reduction plan for 2016 and 2018 (drops of 0.02 CNY/kWh and 0.03 CNY/kWh respectively) to keep the pressure on its wind energy developers. We should point out that the preliminary National Energy Administration (NEA) indicators

Methodology note

It should be pointed out that the sources used to create the indicators of this theme-based barometer (listed at the end of the survey) may differ from those used in our recent publication: *The state of renewable energies In Europe, 2015 edition.* EurObserv'ER prefers to use the same source for the two years it is presenting in the interests of statistical consistency and to chart market trends more accurately. This choice may explain the slight differences from the indicators previously published sourced from official bodies that will become available later on in the year.

Tabl. n° 1

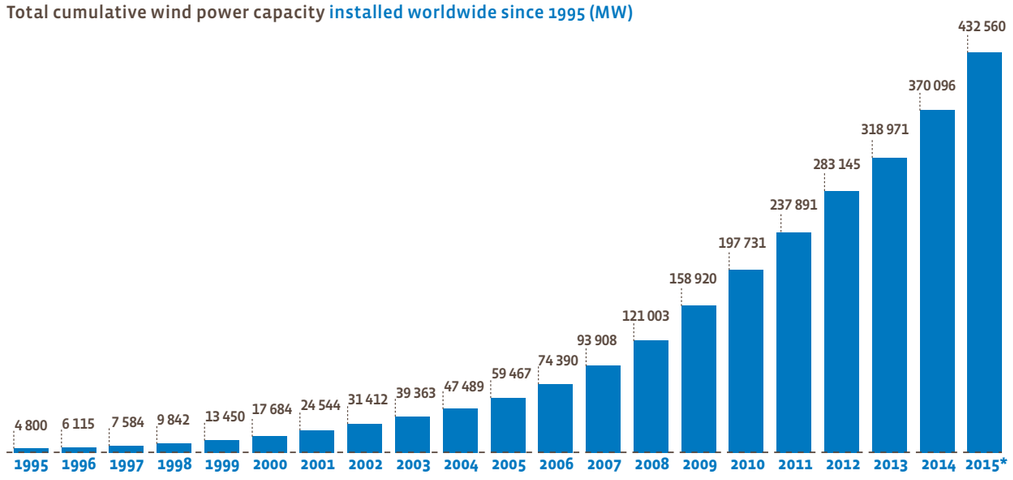
Worldwide installed wind power capacity at the end of 2015* (MW)

	2014	2015	Capacity installed in 2015	Decommissioning in 2015
European Union	129 459.6	141 718.2	12 518.3	259.8
Rest of Europe	5 192.4	6 193.2	1 005.0	4.2
Total Europe	134 652.0	147 911.4	13 523.3	264.0
United States	65 877.0	74 472.0	8 598.0	3.0
Canada	9 694.0	11 200.0	1 506.0	0.0
Mexico	2 359.0	3 073.0	714.0	0.0
Total North America	77 930.0	88 745.0	10 818.0	3.0
China	114 604.0	145 104.0	30 500.0	0.0
India	22 465.0	25 088.0	2 623.0	0.0
Japan	2 794.0	3 038.0	245.0	1.0
Other Asian countries	2 105.0	2 343.0	238.0	0.0
Total Asia	141 968.0	175 573.0	33 606.0	1.0
Africa & Middle East	2 536.0	3 289.0	753.0	0.0
Latin America	8 568.0	12 220.0	3 652.0	0.0
Pacific region	4 442.0	4 822.0	380.0	0.0
Total world	370 096.0	432 560.4	62 732.3	268.0

** Estimate.* ***Sources: EurObserv'ER 2016 (European Union figures)/ AWEA 2016 for United-States, GWEC 2016 (others).***

Graph. n° 1

Total cumulative wind power capacity installed worldwide since 1995 (MW)



** Estimate.* ***Source: EurObserv'ER 2016.***

The Dillon wind park, 45 MW, developed by Iberdrola in California, USA, and commissonned in 2008.

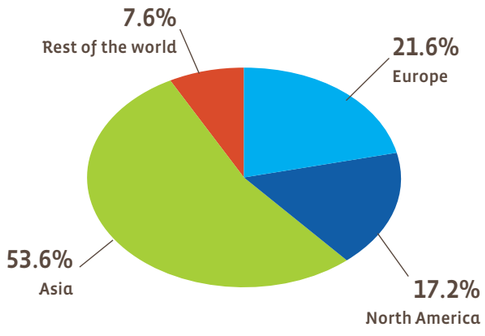
announced early in February paint a slightly different picture, attesting to a higher on-grid capacity figure of 33 GW, but lower installed capacity to date (129 GW at the end of 2015). The resulting electricity output is put at 186.5 TWh and now covers 3.3% of the country's power production. These tentative figures will probably be consolidated in the next few months. Whatever happens, China's wind energy's growth potential is staggering. The NEA claims that the total capacity of authorized wind energy projects amounted to 216 GW at the start of 2016, which is 43 GW more than in 2014, and that construction of 87 GW of this total was underway. At this pace, the 2016-2020 five-year plan's 200-GW installation target could soon be bettered. China's wind energy industry, represented by the China Renewable Energy Industry Association, is already forecasting that 250 GW will be installed by that timeline.

The USA's Clean Power Act is put on hold

In 2015, the performance of the US market was remarkable, thanks, once again to the unwavering pace of installation during the fourth quarter (5 001 MW went on stream between October and December). According to the American Wind Energy Association (AWEA), the USA installed an impressive 8 598 MW in 2015, which amounts to a 77% increase over 2014. Altogether, the USA has 74 472 MW of installed capacity. It claims that market growth should be steady over the next few years, thanks to support by the American Congress, which voted to extend the Production Tax Credit (PTC) through to 2019. At the start of 2016, the country already had more than 9 400 MW of wind energy capacity under construction, which should result in a new output record in 2016. The AWEA reckons that the removal of uncertainties about wind energy funding settles one of its industry's major issues, but there are other challenges to rise to, such as fast development of new transmission power lines to expand the grid so that wind energy can be delivered at low cost from rural areas to the country's densely populated megacities. According to its CEO, Tom Kiernan, "The time has never been better for states and utilities to lock in low-cost, stably-priced wind energy to achieve their Clean Power Plan carbon reductions." This plan presented by the US President on 3 August 2015, aims to reduce electricity generating-related CO_2 emissions by 32% from 2005 levels by 2030. To achieve this target, coal's share of electricity production needs to be reduced to 27% by the 2030 timeline (compared to 39% in 2014) while the renewable energy share needs to rise to 28% (compared to 11% in 2014). The individual States will be responsible for operational implementation of this climate plan and they must submit their plans to the Environmental Protection Agency (EPA) by 2018, and bring them into force starting in 2022. Implementation will not be all smooth sailing because the country's coal lobby wields great influence. Proof of this is that the conservative-leaning Supreme Court suspended its application on 9 February 2016, holding that it could not be enacted before the end of legal proceedings brought by 27 mainly Republican States, and certain industries.

Graph. n° 2A

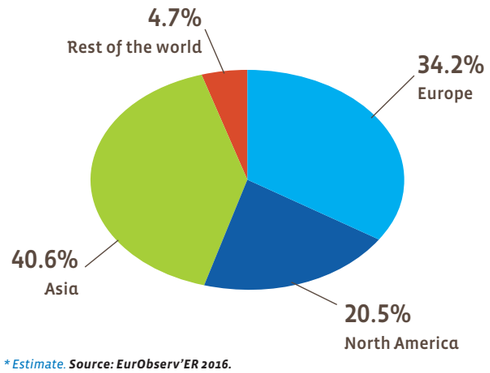
World wind turbine market - breakdown for 2015*



*Estimate. **Source: EurObserv'ER 2016.**

Graph. n° 2B

Cumulative breakdown as the end of 2015*



*Estimate. **Source: EurObserv'ER 2016.**

THE EUROPEAN MARKET IN DISARRAY

In 2015, Germany propped up the European Union market. According to data held by EurObserv'ER, in 2015 the EU market rose lightly from its 2014 level of about 12.2 GW, to 12.5 GW, which takes EU-wide installed capacity at the end of the year to about 141.7 GW **(table 2).** The onshore and offshore segments differ in their distribution over the two years 2014 and 2015. Offshore took the upper hand in 2015 with approximately 24% of the total wind capacity connected to the grid during 2015 as opposed to 11.7% in 2014.

We should point out as we track the markets and the capacity connected up in the individual member states, that there may be discrepancies between the official

Tabl. n° 2

Connected wind power capacity in the European Union at the end of 2015 (MW)

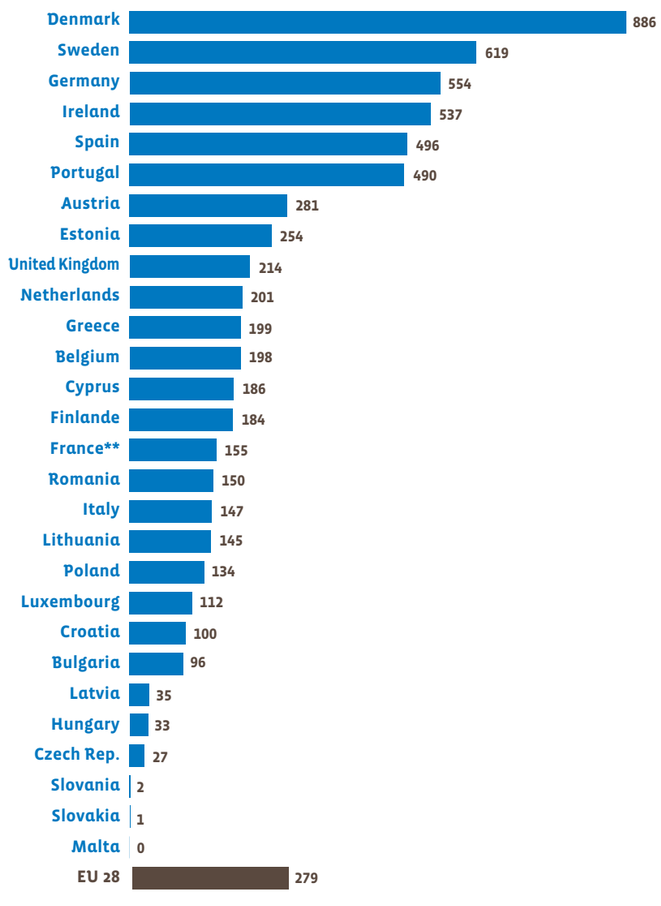
	Cumulative capacity at the end of 2014	Cumulative capacity at the end of 2015*	Capacity installed in 2015*	Decommissionned in 2015*
Germany	39 128.2	44 946.4	6 013.4	195.2
Spain	23 025.3	23 025.3	0.0	
United Kingdom	12 987.5	13 855.0	867.5	
France**	9 313.0	10 312.0	999.0	
Italy	8 638.0	8 933.0	295.0	
Sweden	5 425.0	6 029.1	614.5	10.4
Poland	3 836.0	5 100.0	1 264.0	
Portugal	4 947.0	5 079.0	132.0	
Denmark	4 887.0	5 013.0	160.0	34.0
Netherlands	2 865.0	3 390.0	535.0	10.0
Romania	2 952.9	2 975.9	23.0	
Ireland	2 262.3	2 486.3	224.0	
Austria	2 086.0	2 409.0	323.0	
Belgium	1 958.7	2 228.8	274.3	4.2
Greece	1 979.0	2 150.8	171.8	
Finland	632.0	1 005.0	379.0	6.0
Bulgaria	691.2	691.2	0.0	
Lithuania	282.0	424.3	142.3	
Croatia	339.5	420.5	81.1	
Estonia	334.0	334.0	0.0	
Hungary	329.0	329.0	0.0	
Czech Republic	278.1	282.1	4.0	
Cyprus	146.7	157.5	10.8	
Latvia	69.0	69.0	0.0	
Luxembourg	58.3	63.0	4.7	
Slovakia	5.0	5.0	0.0	
Slovenia	4.0	4.0	0.0	
Malta	0.0	0.0	0.0	
Total EU 28	**129 459.6**	**141 718.2**	**12 518.3**	**259.8**

*Estimate. **Overseas departments not included for France. **Source: EurObserv'ER 2016.**

statistics body data generally released in the middle of the year and the more responsive data published by the grid managers or national wind energy promotion associations at the beginning of the year. For this reason the indicators published in this thematic barometer, which is representative of the sector's momentum, will be revised at the end of the year in our The State of Renewable Energies in Europe publication.
If we examine the European Union markets in detail, we can confirm that over the last two years the same trends have applied. Growth in certain national markets is much more restrained than in the past. The number of countries installing more than 1 000 MW in a year is much lower, for in 2015 we can only name Germany, Poland and France (which just made the threshold). However we should point out that the UK data is incomplete, because the Department of Energy & Climate Change (DECC) had, at the time this study was carried out, only published the datas of the third quarter. What is more of concern is that many EU countries, the markets have slowed or even ground to a halt. Italy only installed 295 MW, Portugal 132 MW while Spain scored zero. Growth was sluggish in most of Eastern Europe apart from Poland and Lithuania.

Graph. n° 3

Wind power capacity per 1,000 inhabitants in the EU in 2015 (kW/1,000 inhab.)*



*Estimate. **Overseas departments not included for France. **Source: EurObserv'ER 2016.***

AN OVERVIEW OF THE OFFSHORE FLEETS THAT WENT ON-GRID IN 2015

In Northern Europe offshore waters, there was a flurry of wind turbine connections in 2015 **(table 3),** with more than double the number of grid connections than in the previous year. Three countries increased their offshore capacity, namely Germany, the UK and the Netherlands, which connected a combined total of 3 014.6 MW to the grid, and took the European Union breezing through the 10 GW threshold with 11 001.6 MW connected at the end of 2015.
Between them, they managed to connect 14 new offshore wind farms to the grid (9 in Germany, 4 in the UK and 1 in the Netherlands), 12 of them are in the North Sea, and one each in the Baltic and Irish Seas. **See table 3 bis** for details on the number of wind turbines, types of machines used and their developers.
The Netherlands connected the Luchterduinen wind farm (129 MW) to the grid, which when added to the capacities of the Egmond aan Zee (108 MW) and Princess Amalia (120 MW) wind farms, gave the country 357 MW of offshore wind energy capacity in service at the end of 2015.
In the UK, full connection of the Gwynt y Môr wind farm off the Welsh coast (576 MW, or the world's second largest offshore wind farm after London Array), was completed along with those of the Humber Gateway (219 MW) and Westermost Rough (210 MW), both in North-West England, and Kentish Flats II (49.5 MW) in the Thames Estuary, in the Southeast. The Renewable UK association counted 28 fully operational offshore wind farms (including 3 demonstration farms) totalling 1 465 turbines and 5 098 MW of capacity. These figures tally with DECC's figures, which identified 5 104.5 MW of combined offshore capacity in the third quarter of 2015.
While the UK still dominates the offshore wind power rankings, Germany made up for its late start in 2015, by fully commissioning nine offshore wind farms in 2015: Amrumbank West I (302 MW), Baltic II (288 MW), Borkum Riffgrund 1 (312 MW), Butendiek (288 MW), DanTysk (288 MW), Global Tech I (400 MW), Meerwind Süd/Ost (288 MW), Nordsee Ost (295.2 MW) and Trianel Windpark Borkum (200 MW). If we add the four existing operations (Riffgat, Baltic 1, Alpha Ventus and Bard 1), the country had 13 offshore wind farms operating with 3 294.9 MW of combined capacity on 31 December 2015, according to the Deutsche Windguard offshore wind energy report count. The same report indicates that Germany hooked up 546 offshore wind turbines to the grid, with a total capacity of 2 282.4 MW. The connection hike came about in the

Tabl. n° 3

Installed offshore wind power capacities* in European Union at the end of 2015 (MW)

	2 014	2 015
United Kingdom	4 501.3	5 104.5
Germany	1 012.5	3 294.9
Denmark	1 271.1	1 271.1
Belgium	712.2	712.2
Netherlands	228.0	357.0
Sweden	211.7	201.7
Finland	28.0	28.0
Ireland	25.2	25.2
Spain	5.0	5.0
Portugal	2.0	2.0
Total EU 28	7 997.0	11 001.6

** and connected to the electric grid.* ***Source: EurObserv'ER 2016.***

Tabl. n° 3 bis

List of the offshore wind parks entirely connected to the grid during 2015 in the European Union.

Name	Country	Capacity (MW)	Number of turbines	Type of turbines	Developer
Luchterduinen	Netherlands (North Sea)	129	43	Vestas V112/3000	Eneco
Gwynt y Mor	United Kingdom (Irish Sea, North Wales)	576	160	Siemens SWT 3,6-107	RWE Innogy / SWM / Siemens
Humber Gateway	United Kingdom (North Sea, Yorkshire & Humber)	219	73	Vestas V112 3.0 MW	E.ON UK Renewables
Kentish Flats II	United Kingdom (North Sea, Thames Estuary)	49,5	15	Vestas V112 3.3MW	Vattenfall
Westermost Rough	United Kingdom (North Sea, Yorkshire & Humber)	210	35	Siemens SWT 6.0-154	DONG Energy
Amrumbank West I	Germany (North Sea)	302	80	Siemens SWT 3.6-120 (boosting 3.77 MW)	Amrumbank West GmbH (E.ON Climate &Renewables GmbH)
Baltic II	Germany (Baltic sea)	288	80	Siemens SWT 3.6-120	EnBW Baltic 2 GmbH
Borkum Riffgrund 1	Germany (North Sea)	312	78	Siemens SWT 4.0-120	DONG Energy
Butendiek	Germany (North Sea)	288	80	Siemens SWT 3.6-120	WPD Offshore GmbH
DanTysk	Germany (North Sea)	288	80	Siemens SWT 3.6-120	DanTysk Offshore Wind GmbH (Vattenfall Europe Windkraft GmbH)
Global Tech I	Germany (North Sea)	400	80	M5000-116 (AREVA Wind)*	Global Tech I Offshore Wind GmbH
Meerwind Süd/Ost	Germany (North Sea)	288	80	Siemens SWT 3.6-120	WindMW GmbH (Blackstone Group)
Nordsee Ost	Germany (North Sea)	295,2	48	6.2M 126 (Senvion)	RWE Innogy Windpower Hannover
Trianel Windpark Borkum	Germany (North Sea)	200	40	M5000-116 (AREVA Wind)*	Trianel Windkraftwerk borkum GmbH & Co. KG

** Now know as AD 5-116 (Adwen).* ***Source: EurObserv'ER 2016.***

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Gwynt y Môr , offshore wind farm in the Irish Sea off the coast of the UK, was commissioned on 18 June. It is the second largest the world, with 576 MW and 160 Siemens 3.6-107 turbines.

2015 because 297 towers (equating to 1 339.8 MW of capacity) that were installed in 2013 and 2014 were included in the annual connection count. At the end of the year, construction was underway on another four wind farms (Gode Wind 1, Gode Wind 2, Nordsee One and Sandbank), with 41 turbines (for 246 MW) already installed but not yet connected, and the foundation work on 122 wind turbines completed.

EWEA (the European Wind Energy Association) expects the newly-connected MW figure to fall in 2016, as it says that the six wind farms currently under construction are likely to increase European wind energy capacity to 12.9 GW. It has also identified 26.4 GW worth of projects to be constructed over the forthcoming decade and a further 63.5 GW in the development phase. Dong Energy's management board announced the biggest project on 3 February, after approving the final investment decision to construct the Hornsea One offshore farm off the coast of Grimsby, in the North of England. The wind farm has a design capacity of 1 200 MW and will supply one million British households by 2020.

MORE THAN 300 TWH GENERATED IN 2015

In 2015, many countries in Northern Europe, the UK and Germany enjoyed particularly good wind power-generating climate conditions, which combined with the newly-installed capacity explains the high increase in European Union output. This is contrasted by Southern Europe's poor climate conditions. Output in Spain, Italy and Portugal, for example, declined. All in all the production trend across the European Union was positive and according to the data collected by EurObserv'ER, increased by 20.6% to reach 303.5 TWh. Many countries' wind power output and contribution to the electricity mix broke records. The most outstanding growth was delivered in Germany. Preliminary estimates from AGEE-Stat point to 88 TWh of output, which is 53.4% more than in 2014 (57.4 TWh including 1.7 TWh offshore). In Denmark, a particularly windy year and the addition of 160 MW of capacity resulted in 14.1 TWh of output (13.1 TWh in 2014), which according to energinet.dk, thus accounted for 42.1% of the country's electricity generation. This outstrips its previous record, when 39% of the country's electricity demand was covered by the wind power. The UK also had a particularly windy year. Data from the National Grid shows that wind energy contributed 11% of the UK's power production, as against 9.5% in 2014, and was enough to meet the needs of 8.25 million British households. Winter conditions were especially conducive to offshore wind farm production. The UK has the largest offshore wind farm in service, London Array (630 MW), which alone generated 369 GWh during the month of December, equating to a load factor of 78.9%.

NEWS FROM AROUND THE MAIN EUROPEAN MARKETS

The German market is at its peak

According to two Deutsche Windguard reports (one on onshore and the other on offshore wind energy), Germany installed more than 6 GW in 2015 (6 013.4 MW to be precise), which is almost half the European Union market's size. The new wind power capacity connected to the grid breaks down into 3 731 MW of onshore and 2 282.4 MW of offshore wind energy. It is the highest annual connection figure ever reached in the country, for although Germany had a better year for onshore wind energy in 2014; full connection of its nine offshore wind farms took the annual connection figure to new heights.

The year 2014 had been exceptional for onshore wind energy, and a possible reason is that its developers hastened to connect their wind farms before August 1, the date when the new Renewable Energy Act, EEG, came into force, slashing wind energy remuneration. Despite the lower prices for wind power, the onshore wind energy market remained above the target construction level defined by the law (2400–2600 MW). The result will be that the quarterly price reduction will be more severe in 2016. The law had set it at 0.4% if the construction target was met, but in the event of an overrun of more than 800 MW, which is what happened, the price paid for wind power would be reduced by 1.2%. The continued drop in production costs has made it easier to set up projects. The "Kostensituation der Windenergie an Land" study conducted by the BWE (German Wind Energy Association) and VDMA (the German Engineering Federation), made public at the end of 2015, shows that onshore wind energy production costs have plummeted. It claims that the average costs calculated for a 20-year service life for 2016/2017 are 12% lower than for 2012/2013, which equates to a cost of € 0.053– 0.096/kWh depending on the sites. The primary reasons for this drop are higher yield turbines are being used, lower installation costs and also plummeting interest rates.

Downgrading of the rates paid for wind power must be viewed in the new context established by the 2014 EEG act, which also made it mandatory to adopt the direct market sales system for any new >500-MW installation from 1 August 2014. In Germany, it is the operator (or aggregator whose profession it is) to sell its electricity output on to the market, receiving an additional "sliding" market premium (Marktprämie). At the end of every month, this premium makes up the difference between the average market electricity price and the reference Feed-in Tariff for onshore wind power.

From 2017 onwards, the regulations will change again. The German government plans to modify the renewable energy funding support system, by abandoning the top-up remuneration system under mandatory direct electricity sales and replacing it with a tendering system. The aim of the tender is to regulate the development of renewable energies, while allowing cheaper projects to come through. In the new system, the reference value (used to calculate the amount of the market premium market), will be covered by the tender. The only selection criterion will be the proposed price, therefore environmental, industrial and innovation criteria will no longer be taken into account. In December 2015, the Federal Ministry for Economic Affairs and Energy (BMWi) defined the outlines of the new 2016 EEG Act, which should be adopted in the summer of 2016. As regards onshore wind energy, the initial tender should cover 2 900 MW of installation capacity, with minimum bidding volume planned at 2 000 MW.

Poland questions its renewable law

Poland certainly confounded all market expectations in 2015, when it increased its installation level by a factor of three over 2014 (adding 1 266 MW). Poland's developers were keen to make the most of the green certificate incentive system before the new contracts for difference system (CfD) that were suppose to come into force on 1 January. The Polish wind energy sector had welcomed the CfD system (auctioning), which was to accept its first bids at the end of April, because it was intended to encourage the development of renewable energies

Tabl. n° 4

Electricity production from wind power in European Union in 2013 et 2014* (TWh)

	2014	2015
Germany	57,357	87,975
Spain	52,013	48,380
United Kingdom	32,016	38,010
France	17,249	21,100
Sweden	11,234	16,500
Italy	15,178	14,589
Denmark	13,079	14,100
Portugal	12,111	11,878
Poland	7,676	9,830
Netherlands	5,797	7,237
Belgium	4,614	5,752
Romania	4,724	5,632
Ireland	5,140	5,500
Austria	3,846	5,200
Greece	3,689	4,130
Finland	1,107	2,329
Bulgaria	1,304	1,313
Croatia	0,730	0,786
Lithuania	0,636	0,777
Hungary	0,657	0,724
Estonia	0,604	0,693
Czech Republic	0,477	0,610
Cyprus	0,182	0,230
Latvia	0,141	0,145
Luxembourg	0,080	0,081
Slovenia	0,004	0,007
Slovakia	0,006	0,006
Malta	0,000	0,000
EU 28	**251,650**	**303,513**

Estimate. **Overseas department not included.* ***Source: EurObserv'ER 2016.*

WIND ENERGY BAROMETER – **EUROBSERV'ER** – FEBRUARY 2016

with the most competitive production costs. The participation in the system, which is securing warranted income for 15 years since start of operation, is possible also for existing installations. This (even though a deep crisis of the Polich green certificate market) should put the onshore wind energy sector in the front line. Under the new system, all the RES technologies have to compete in the auction, having however technology specific cap price. The winners income is warranted on the level bidded for 15 years since start of plant operation. A pre-qualification system for implementing this new system was set up from May 2015 onwards, so that the system could be up and running as early as 2016. Last October, the Polish Minister of the Economy published a draft list of reference prices for the various renewable electricity production technologies that will form the basis for the first round of bidding. It has been set at 385 PLN/MWh (about € 0.0921/kWh) for >1-MW onshore wind facilities, and for <1-MW onshore wind facilities at 415 PLN/MWh (€ 0.0992/kWh). The reference price for offshore wind energy has been set at 470 PLN/MWh (€ 0.1123/kWh). For existing installations (commissioned before 1/01/2016), there was reference price fixed at 410 PLN/MWh. Analysts suggest that the reference price chosen would be more lucrative than the current green certificate financing mechanism. In 2015, according to the data provided by Polish Power Exchange, renewable power plant operators got about € 0.066/kWh for their electricity by selling their green certificates (electricity purchase prices set at 163.58 PLN/MWh in 2015 + the average price for green certificate on spot market). However, still over 80% of the green certificates is sold in off-session transactions (bilateral contracts), where prices are significantly higher. This level has been perceived as insufficient by the wind power plants owner and is a result of a deep crisis in the market.

Despite this, the new Polish government, which was formed in November 2015, has decided that the new law on renewable energy, which had been approved by the previous parliament, would not come into force on the 1st January 2016 as was initially foreseen. In December 2015, there was an amendment of the RES Act introduced since 1/01/2016. It is actually keeping the status quo of the green certificates system (in deep crisis) and delaying the introduction of the new auctioning system until July 2016. Also, the previously announced reference prices might be changed by the newly established Ministry of Economy and the further changes of RES Act are expected before 1/07/2016.

The French market is poised to rebound

According to data from the Bilan électrique 2015, Electricity Report, produced by the transmission system operator (RTE), wind energy capacity connected to the electricity grid was 10 312 MW on 31 December. The study's indicators suggest that this data points to 10.7% growth of the wind turbine fleet compared to 2014, or 999 MW of newly connected turbine capacity in 2015, compared to 1 154 MW in 2014.

This performance is lower than expected for the sector, and amounts to only 62% of the required annual volume to attain the investment planning target by 2020. Nonetheless the sector's prospects developed well throughout 2015. Since 1 January 2016, a new State support mechanism has applied to the electricity sectors, based on top-up remuneration added to the price obtained from the sale of energy on the market. However, it has been agreed that the wind energy sector would be temporarily released from the system, so that new wind energy projects can continue to benefit from the purchasing obligation arrangement and allow the wind power producers to choose between top-up remuneration and the guaranteed purchase rate until at least 2018. The regulatory framework is the other plus point for the sector. A number of administrative simplification measures have been adopted for the energy transition law. The first awaited measure, the single authorisation, has made itself felt all over France since 1 November 2015. This authorisation gives a single go-ahead for a series of previously distinct procedures (authorisation in terms of classified installations, construction permit and energy code authorisation and also authorisation to clear land and waiving the ban on destroying protected species). This simplification is bound to accelerate application processing and streamline project set-up.

Tabl. n° 5

Main European wind farm developpers and operators 2015

Name of company	Country	Wind capacity developped or operated (in MW including offshore)* 2015	Annual turnover 2015 (in M€)**	Employees 2015
Iberdrola Renewables	Spain	13.703 **	2.083 **	3 000
EDP Renováveis	Portugal	8.878 ***	1.079**	< 900
Acciona Energy	Spain	7.208**	2.097 **	3 000
Gamesa	Spain	7 000	2.533** 3.400 (guidance)	6 350
EDF énergies nouvelles	France	6 875	1 085	3 009
Enel Green Power	Italy	3.819 (EU only) 6.628 (all wind farms)	2.242 **	3 600
E.ON Climate Renewables	Germany	4 000	1.806 **	1 661
WPD AG	Germany	3 048	n.a.	1 200
RWE Innogy	Germany	2 190	828**	889
Dong Energy	Denmark	6 500	597 **	2 358
Vattenfall	Sweden	4 000	497	550
Juwi AG	Germany	1 800	1 000	1 000

Large energy companies are well represented in this ranking because of their size and their ability to raise capital, but outside of this type of players, there is a large number of private developers specialized in renewable energy with substantial portfolios near or above the GW. Some wind manufacturers like Gamesa, Enercon or Nordex also chose to develop projects with their own machines.
** Operated and owned. ** 9 months/2015 only. *** Total renewable capacity - not only wind.* ***Source: EurObserv'ER 2016.***

Lifting and installation system for blades, specially designed by Siemens to handle the 75-meters-long blades of its offshore turbines.

INDUSTRY GOING THROUGH TURMOIL

The two major wind power market segments differ in their competitive situations. In the onshore segment, competition is fragmented because of the high number of major players, yet no manufacturer dominates the world market. Most of the major players can draw strength from their active home market, which gives them a solid base from which to contend for and win market shares abroad. Examples of this are GE Wind of the USA, Enercon, Senvion and Nordex in Germany, Suzlon in India and Goldwind, United Power and Mingyang in China. Some actors, who no longer have strong national bases and can only rely on export development strategy to survive, are now weakened and bearing the brunt of new sector consolidation **(see further on).**

The offshore segment is different, because it is much more limited than the onshore segment and so far has not been subject to international expansion. For the time being it is still mainly confined to a few markets in the North Sea, the Baltic Sea and off the British Isles and is in the hands of a handful or experienced top ranking actors including the world number one, Siemens Wind Power, that holds 80% of the market segment and MHI Vestas, the joint subsidiary formed by Vestas of Denmark, currently world number one in the onshore segment and Japan's Mitsubishi in 2013. Other manufacturers are positioned on this market and have already delivered their first turbines, but for the time being growth prospects are disappointing, and creating problems for them. For three years the dearth of fast growth prospects in the offshore sector has led to consolidations. It started with the merger of Vestas and Mitsubishi in 2013 which created the joint subsidiary MHI Vestas Offshore Wind Energy and was followed by the creation of Adwen in 2014, another joint subsidiary created by merging the offshore activities of Areva and Gamesa, resulting in a definitive merger in March 2015. Adwen now has a 2.8-GW portfolio of projects. In 2015, another consolidation took place in the offshore segment: France's Alstom, which is developing the Haliade 150 offshore wind turbine, was taken over by GE of America.

Industry consolidation is not an offshore market segment prerogative, as major manoeuvres have also been launched in the onshore segment, resulting in changes in the global market's power structure. Nordex of Germany and Spain's Acciona set the ball in motion with their October 2015 announcement that they would be joining forces to become a new major international wind energy player and enter the world top 5. The financial terms are that Nordex will take control of Acciona for 785 million euros while the Acciona Group takes a 29.9% share in Nordex. Under the terms of the union, Nordex make a cash contribution of 366 million euros and 16.6 million Nordex actions worth about 419 million euros. This new

entity will be totally focussed on the onshore market and aims to be making 4.2 billion euros' worth of sales as early as 2018. The two manufacturers complement each other as the German company was essentially positioned on the European market and medium-size projects of ≤30 MW, while Acciona was more oriented to large-scale wind farms of ≥100 MW, with the majority – 90% of its order book – for projects on the American continent (USA, Canada and Latin America). Merger of the two companies will also create technological synergies, such as Nordex's carbon fibre blade development and Acciona's expertise in constructing concrete towers. The companies await the antitrust authorisations due in March 2016 before they can seal the deal.

Consolidation in the wind energy sector could enter a new phase, with the creation of a new world number one at stake. On 29 January 2016 Gamesa's board announced that it had entered into discussions with Siemens with a view to merge their wind power businesses, after the Spanish company that submitted to the regulatory authority (CNMC) an information sheet in this direction. The deal is likely to create the world's biggest turbine maker with a market share of roughly 15%, ahead of General Electric (11%) and Vestas (10%).

Just like Acciona, Gamesa was weakened by its government's moratorium on the Spanish market, but it was successful in developing its export business to the emerging Latin American markets such as Brazil, Mexico, and also to the US, India and China. This international presence complements that of Siemens, which wishes to diversify its markets. Siemens is also interested in the offshore projects being developed by Adwen in France and Germany. If this deal comes off, Siemens will become a joint shareholder of Adwen and finally gain a foothold in the promising French offshore wind energy market, which has so far evaded it. In April 2015, Siemens had already stated its interest in buying up Areva's offshore assets in Adwen, 91% of which were held by the French state. These assets have been particularly targeted since Areva got into dire financial straits over its nuclear business woes. However this takeover would be anything but smooth sailing because the Siemens group's offshore wind power market share is already about 80%. The European competition authorities may have difficulty endorsing the asset buyout and furthermore it raises competition authority issues with regard to the buyout of Gamesa's shares in Adwen.

LOW-WIND SITES OFFER TREMENDOUS GROWTH OPPORTUNITIES

The onshore segment has a new growth vector in wind turbines adapted for low-wind sites complying with the international IEC-61400-1 standard, class III models (specially adapted for mean wind speeds over 12 months of up to 7.5 metres per second). Spectacular technological progress has been made on new generation class III wind turbines, and they offer 10–25% higher yields than the previous generation. These new wind turbines are generally taller and have much longer blades, which enables them to reduce the generator rating to swept area ratio. The main effect of this feat is that their load factor can be significantly increased and their production is also more regular, which reduces the capacity peak management issues for the electricity networks. A further advantage is that these wind towers can be installed as close as possible to consumption areas, near urban centres, which keeps transmission network investment levels down. Low-wind sites are also much more widespread and often much easier to access than class I (high wind speed) and class II (medium wind speed) sites. All of this opens up new prospects on international markets.

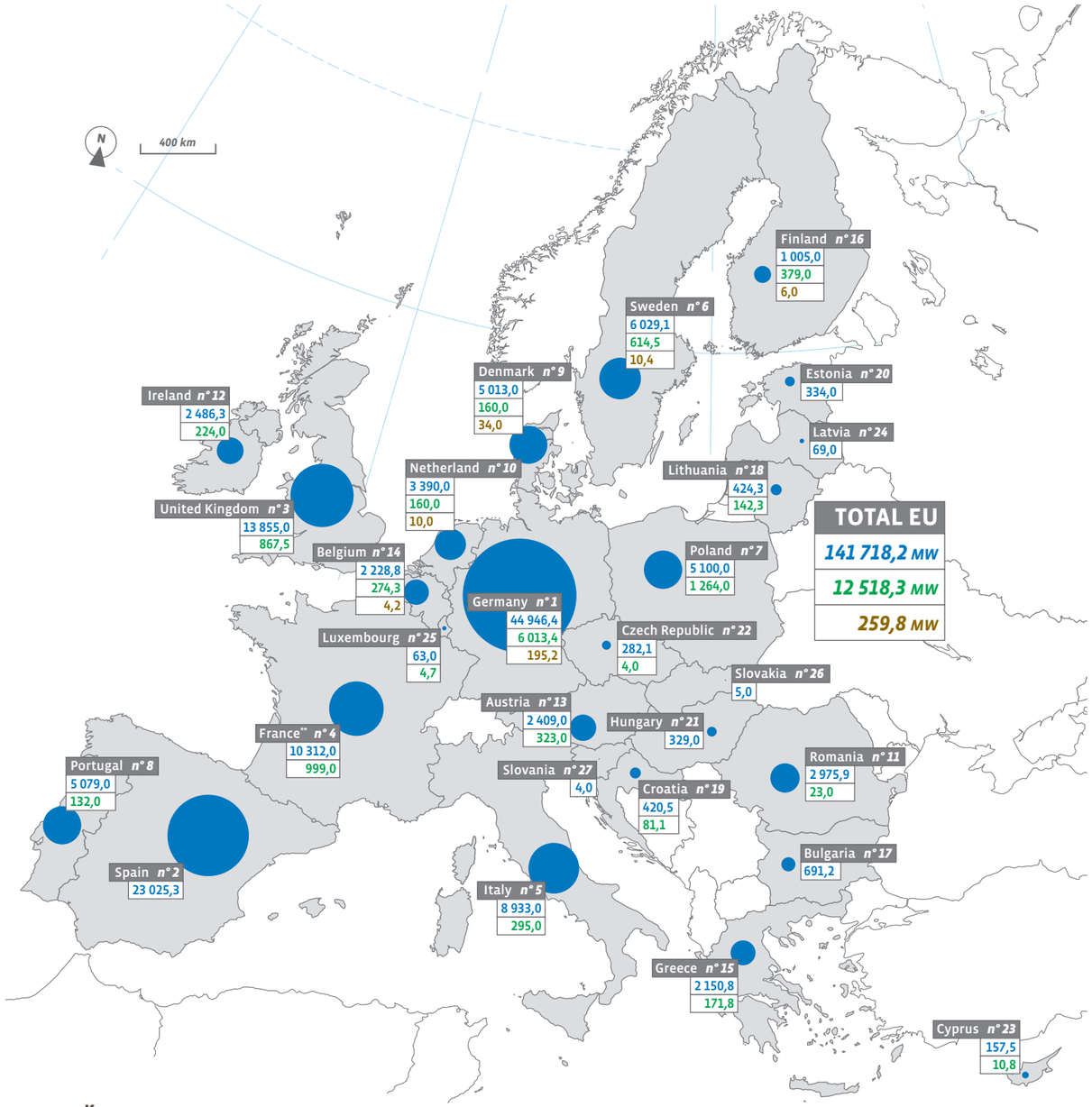
The industry is now primarily interested in selling class III turbines of this type, and in the next two years many new models will be offered for sale. Without attempting to be exhaustive, we can quote the December 2015 launch of the N131/3300 by Nordex (the turbines' names generally describe the blade diameter and turbine capacity); Gamesa will launch the G126-2.5 MW in 2017 and the manufacturer claims that it will yield 25% more than its G114-2.0 MW turbine; Enercon will roll out mass production of the E-141 EP4 (4.2 MW) and E-103-EP2 (2.35 MW) in 2017. At Husum Wind Fair Vestas unveiled its new low-wind class III turbine, the V136-3.45 MW. It outperforms its V126-3.3 MW turbine by 10% with mass production scheduled for the second half of 2017. In 2015, Siemens erected two prototypes of its SWT-3.3-130 MW, with sales due to kick off early in 2017, announcing 17–20% higher yield than delivered by its previous generation of wind turbines. To round up, the American manufacturer GE also took the wraps off its new class III turbine, the GE 3.4-137, as of November 2015, which will come in five tower heights from 85 to 155 metres, and as its name suggests, will have 137-metre diameter blades.

A EUROPEAN SCENARIO OF ABOUT 1 000 TWH FOR 2030

The 2020 targets being pursued by the Member States under the Renewable Energy Directive provide for a minimum of opportunities for the wind energy industry. Since 2009, European Union wind energy capacity has increased fairly steadily, rarely dropping below 10 GW per year and has been pitched more often than not around 11–12 GW, at least since 2012. For the time being the sector's financial investment indicators look good and have been improving for the past three years. EWEA data for 2015 points to a very good year. Financial commitments to new wind energy assets amounted to a total of 26.4 billion euros, which is a 40% year-on-year increase. New investments in offshore wind energy are the main underlying reason for this upturn, which slightly overtook investments in onshore wind energy (13.25 to 13.12 billion euros). The UK is by far the most attractive country, as it concentrates 48% (12.6 billion euros) of the investments made in 2015, ahead of Germany with 5.3 billion euros. The association claims that this explains how 9.7 GW of new wind turbine capacity managed to be funded in 2015.

In the medium term, wind energy market expansion should be a little slower as it still rolling out in the very strained context of the electricity market fraught with increasingly sensitive public reactions to electricity price hikes. No doubt some of the surcharges generated on the bill come from the production subsidies awarded to renewables, but the major operators' financial woes also have a hand in this as they struggle to make a return on their past investments. They have

Installed* wind power capacity in the European Union at the end of 2015 (in MW)**



Key

141 718,2 Installed capacity to date in the countries of the European Union at the end of 2015 (MW)

12 518,3 Capacity installed in the countries of the European Union 2015 (MW)

259,8 Capacities decommissioned during 2015 (MW)

** Connected to the grid. **Estimate. ***Overseas departments not included for France.* ***Source: EurObserv'ER 2016.***

Tabl. n° 6

Main Wind turbine Suppliers in 2015

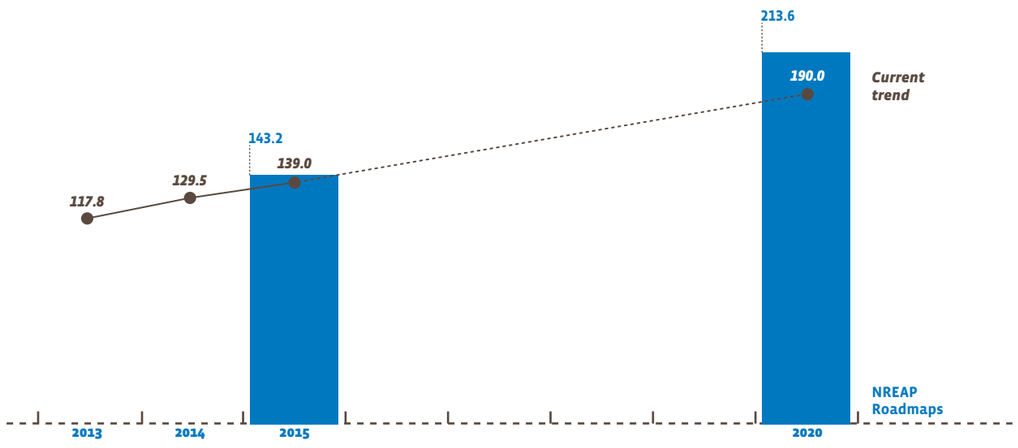
Company	Country	MW supplied in 2015	Turnover 2015 (in M€)	Employees 2015
Goldwind	China	7 800	4 180	5 000
Vestas	Denmark	7 486	8 400	19 600
GE Wind	USA	5 900	n.a.	3 200
Siemens	Germany	3 100	5 660	9 000
Gamesa	Spain	3 100	3 504	6 400
Enercon	Germany	3 000	n.a.	13 000
Guodian United Power	China	2 800	n.a.	n.a.
Mingyang	China	2 700	684*	2 100
Envision	China	2 700	n.a.	700
CSIC (Chongqing) Haizhuang Windpower Equipment	China	2 000	n.a.	1 000
Nordex	Germany	1 700	2 430	3 300

** 9 months/2015 only.* ***Sources: EurObserv'ER 2016, BNEF Bloomberg New Energy Finance / Sun& Wind Energy.***

suffered in particular from overcapacity problems which affect the profitability of their production facilities (unamortized fixed costs) and furthermore suffer the significant and continuous decline in electricity's wholesale market price. Accordingly, they are opposed to rapid new growth of installed renewable energy capacity, and are putting pressure on the decision makers to ensure that new capacity is integrated more gradually. There are several other reasons for the European market's overcapacity crisis. It is also down to the recession, which since 2009 has led to a sustained drop in the industrial demand for electricity. The EU's electricity output has dropped since 2009, from about 3 378 to 3 175 TWh in 2014. The third explanatory factor is better and ongoing interconnection between the European grids. Pooling production infrastructures curbs the need for individual country overcapacity.

Graph. n° 4

Comparison of the current trend against the NREAP (National Renewable Energy Action Plans) roadmaps (in GW)



Source: EurObserv'ER 2016.

Not all of Europe's countries react in the same way to this situation, but the installation level variations witnessed in 2015 compared to those of 2014 and 2013 show that some countries have obviously altered course. As a result, it is likely that the European Union market will slow down a little in the next few years with thresholds closer to 10 GW, or even less, which EurObserv'ER feels would at best result in European wind energy capacity in 2020 being at around 190 GW.

Looking at the longer term, current changes to the production system can only increase and wind energy will certainly have a major role to play. The framework has already been set for 2030, as in October 2014, the European Union heads of state and Parliament agreed that the renewable energy share of final consumption would increase to 27%, which in the European Commission's reference scenario could take the form of a 46% share of renewable electricity. To show what wind energy could achieve, the EWEA undertakes an annual forecasting exercise publishing its three scenarios for 2030.

In the first, "low" scenario, the European Union does not achieve its aims, as the European electricity market reform has stymied renewable energy integration, which has also been limited by the lack of significant progress in European grid interconnections. In this pessimistic vision, reforming the CO_2 emissions trading scheme has inconclusive results and the offshore wind power product cost reduction aims are not met. This low scenario would lead to 251 GW of wind turbine capacity in 2030, including 45 GW offshore. There would be 604 TWh of associated electricity output or the equivalent of 19% of European electricity demand.

The high scenario relies on outstripping Europe's 27% target. The new electricity market and CO_2 emissions trading scheme reform are successful, and enable the wind energy market to surge in all the European Union countries. Wind turbine capacity would reach 392 GW in 2030, including 98 GW offshore. By that time wind energy would be generating 988 TWh, namely 31% of European demand.

Finally in the central scenario, the European Union would fulfil its commitments, primarily through the effective implementation of regional cooperation mechanisms and a suitably interconnected European market to integrate a high level of renewable energy input. The CO_2 emissions trading scheme is reformed and capable of giving investors sufficiently attractive "price" signals. The offshore wind power cost reduction targets for 2020 are achieved and continue to fall through to 2030. In this scenario, wind turbine capacity rises to 320 GW, including 66 GW offshore. Wind energy produces 778 TWh of electricity, or 24.4% of European demand.

Tracking the route taken by the sector over the past 15 years, the technical progress made by the industry, we feel that EWEA's "central" and "high" scenarios for the next 15 years are probably the most realistic. □

Sources: IG Windkraft (Austria), Apere (Belgium), FER (Croatia), Ministry of Industry and Trade (Czech Republic), ENS (Denmark), Tuuleenergia (Estonia), VTT (Finland), SER (France), Deutsche wind guard (Germany), AGEE-Stat (Germany), HWEA (Greece), IWEA (Ireland Republic), ANEV (Italy), STATEC (Luxembourg), windstats.nl (Netherlands), IJS (Slovenia), IEO (Poland), AEE (Spain), Svensk Vindenergi (Sweden), DECC (United Kingdom), EWEA.

The topic of the next barometer will be photovoltaics

Download

EurObserv'ER is posting an interactive database of the barometer indicators on the www.energies-renouvelables.org (French-language) and www.eurobserv-er.org (English-language) sites. Click the "Interactive EurObserv'ER Database" banner to download the barometer data in spreadsheet format.

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