



GLOBAL STATUS OF WIND POWER IN 2016

2016 was another strong year for the global wind industry with annual installations in excess of 50 GW. It did not match the record-breaking installations witnessed in 2015 when the annual market crossed the 60 GW mark for the first time.

In 2016 new investment in clean energy fell to USD 287.5bn (EUR 267.8 bn¹), 18% lower than the record investment of USD 348.5bn (EUR 324.6 bn) in 2015. According to BNEF, Asia-Pacific and China alone accounted for USD 135bn (EUR 125.7 bn) or almost 47% of the total global investments in clean energy during 2016².

The new global total at the end of 2016 was 486.8 GW, representing cumulative market growth of more than 12 percent. The 23.4 GW in new installations figure in China powered this growth in large part; overall, the global wind power industry installed 54.6 GW in 2016.

While still robust, the 2016 market did not meet the expectations we had set for it early last year, primarily due to the fact that China 'only' installed 23 GW in 2016, but also due to smaller than expected markets in Brazil, Mexico, Canada, and Africa – South Africa in particular. However, most of these issues are cyclical and we expect recovery in all those markets in 2017.

China, the largest overall market for wind power since 2009, retained the top spot in 2016. Installations in Asia once again led global markets, with Europe in the second spot, and North America closing the gap with Europe, in third place.

A result of this was that in 2016, the majority of wind installations globally were outside the OECD once again. This has been the case since 2010, with the exception of 2012. We expect this trend to continue.

By the end of last year the number of countries with more than 1,000 MW installed capacity was 29: including 17 in Europe; 5 in Asia-Pacific (China, India, Japan, South Korea & Australia); 3 in North America (Canada, Mexico, US), 3 in Latin America (Brazil, Chile, Uruguay) and 1 in Africa (South Africa).

By the end of last year nine countries had more than 10,000 MW of installed capacity including China (168,732 MW), the US (82,184 MW), Germany (50,018 MW), India (28,700 MW), Spain (23,074 MW), UK (14,543 MW), France (12,066 MW), Canada (11,900 MW) and Brazil (10,740 MW).

China should cross the 200,000 MW mark in 2018, adding another milestone to its already exceptional history of renewable energy development since 2005. This year it strengthened its position on the leaderboard.

ASIA: RECORD YEAR FOR INDIA

For the eighth year in a row, Asia was the world's largest regional market for new wind power development, with capacity additions totaling just over 27.7 GW. China's wind market reached almost 169 GW by the end of 2016, reinforcing China's lead in terms of cumulative installed wind power capacity.

In terms of annual installations **China** maintained its leadership position, although annual grid-connected capacity in China dropped almost 24 percent year-on-year following a policy-induced rush in 2015.

China added 23.4 GW of new capacity in 2016, once again the highest annual number globally. In 2016, wind power generation reached 241 billion kWh (241 TWh)³, an increase of almost 30 percent compared to 2015 levels accounting for 4 percent share of total electricity generation⁴.

This follows a pattern of steady increase in wind based electricity generation despite heavy curtailment. In 2012, wind-generated electricity in China was just over 100 TWh, accounting for 2 percent of the country's total electricity output. Wind provided almost 135 TWh of electricity in 2013, contributing 2.6 percent of the country's total electricity generation⁵. Total wind power generation reached over 153 TWh in 2014, 2.78 percent of total electricity generation⁶. In 2015, wind power generation reached over 186 TWh, 3.3 percent of total electricity generation.

Curtailment on wind farms in China worsened in 2016 according to the National Energy Administration (NEA), averaging 17% across the country for the year, up from 15% in 2015. On-going curtailment of electricity generation is a challenge for wind power projects. However, the NEA and State Grid are working to solve the transmission bottlenecks and other grid issues, and the situation is expected to improve.

India continued to be the second largest wind market in Asia, offering ample prospects for both international and domestic players. The Indian wind sector has struggled over the years to repeat the strong market performance of 2011 when over 3 GW was installed. However 2016 saw India rise up to its potential given the government's desire to address some of the structural bottlenecks in the market.

India saw new wind energy installations reach 3.6 GW by the end of 2016, for a total of 28.7 GW, a record for the Indian market. It also kept the Indian wind power market firmly in the top five rankings globally. The total grid connected renewable energy installations in the country crossed the 50 GW⁷ mark at the end of the year.

The Indian government has committed to a target of 175 GW of renewables by 2022. The target includes achieving 100 GW of solar capacity and 60 GW of cumulative wind power capacity by 2022. The government has also indicated its support for rapidly growing the power sector, renewables being a core part of this strategy.

While the rest of Asia did not make much progress in 2015, there are some favourable signs on the horizon. The **Japanese** market saw new installations of over 196 MW in 2016 to reach a cumulative capacity of 3.2 GW. Japan is slowly moving towards a transformation of its energy system to allow for a more diverse energy mix including more wind power and other renewables. However, removing existing barriers will still take time. Offshore wind development, in particular floating turbines, is a promising prospect for the future.

South Korea still has "green growth" as one of its national development priorities, but wind power is still a relatively modest contributor, with just over 200 MW of new installations in 2016, bringing total installed capacity to just over 1 GW.

1 Exchange rate used for USD to EUR conversion (USD1 = EUR 0.93)
2 <https://www.bnef.com/core/clean-energy-investment>

3 <https://www.bloomberg.com/news/articles/2017-02-10/china-widens-wind-power-lead-over-u-s-world-with-another-23-gw>
4 <http://cenews.info/en/power-statistics-china-2016-huge-growth-of-renewables-amidst-thermal-based-generation/>
5 http://www.chinadaily.com.cn/bizchina/greenchina/2014-02/26/content_17306185.htm
6 <http://www.reuters.com/article/2015/02/12/china-power-windpower-idUSL4N0VM3XJ20150212>
7 <http://www.mnre.gov.in/mission-and-vision-2/achievements/>



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Pakistan added 282 MW, bringing total installed capacity up to 591 MW. **Taiwan** added over 35 MW of new capacity, bringing its total installed capacity to 682 MW. **Vietnam** added 24 MW of new capacity, bringing its total to 159 MW. As for the rest of Asia, we expect new projects to come online in Thailand, The Philippines and Indonesia in 2017.

NORTH AMERICA: STRONG GROWTH CONTINUES IN THE US

The **US** is the second largest market in terms of total installed capacity after China. At the close of 2016, American wind installations totaled over 82 GW, enough to power 24 million average American households. Wind surpassed conventional hydropower to become the largest source of renewable electric capacity in the US, and the fourth largest overall.

For the year, wind developers added 8,203 MW of wind power capacity representing more than USD 13.8 bn (EUR 12.8 bn) in new investment.

Wind supplied over 5.5 percent of electricity nationwide, up from 4.7 percent in 2015. Wind turbines operating in 40 states generated a record total of 226 million MWh during 2016⁸.

In Oklahoma, wind's share of total electricity generation grew from 18.4 percent in 2015 to 25.1 percent in 2016. In Iowa, wind grew from 31.5 percent to 36.6 percent – the highest in the country – and in Kansas, wind's share increased from 24.1 percent to 29.6 percent. The Dakotas also saw significant gains, with South Dakota becoming the second state in the country to generate over 30 percent of its electricity from wind energy, and North Dakota rising to 21.5 percent wind.

The US also saw its first commercial offshore wind farm come online in 2016. The Block Island wind farm off the coast

of Rhode Island consists of five 6 MW Haliade-150 machines. It was built for a total cost of USD 290 mn (EUR 270 mn).

US wind industry jobs grew nearly 17 percent during 2016, and now number more than 100,000, with 102,500 workers in all 50 states. This growth was made possible, in part, by the multi-year extension of the wind energy Production Tax Credit (PTC) in 2015. The credit has already begun phasing out on an 80-60-40 percent schedule starting in 2017. This, combined with a broader range of customers, and an on-going "wind rush" driven by technological improvements is setting the stage for more years like 2016 in the US. After 2019 wind will be the only major source of energy without a dedicated federal incentive⁹.

In **Canada** 702 MW of new wind capacity came online, making it the tenth largest annual market, and ended 2016 with just under 12 GW in total installed capacity, making it the eighth largest market globally. Between 2012 and 2016, Canada's installed wind energy capacity has grown by an average of 18 percent annually.

The new capacity added in 2016 represents 21 projects in Ontario, Quebec and Nova Scotia. Sixteen of these projects are owned, at least in part, by aboriginal or local communities, or municipal governments. This is a sign that local communities continue to take a keen interest in wind energy.

Canada's new wind energy projects in 2016 represent over CAD 1.5 bn (EUR 1.05 bn) in investment. At the end of 2016, wind power was supplying approximately 6 percent of Canada's electricity demand.

There are now 285 wind farms made up of 6,288 wind turbines operating in Canada, bringing economic development and diversification to well over 100 rural communities through land lease income, property tax payments, ownership revenue and community benefits agreements¹⁰.

8 <https://www.eia.gov/electricity/data/browser/>

9 <http://www.awea.org/MediaCenter/pressreleasev2.aspx?ItemNumber=10025>
10 <http://canwea.ca/wind-energy-continues-strong-growth-canada-2016/>

GLOBAL INSTALLED WIND POWER CAPACITY (MW) – REGIONAL DISTRIBUTION

		End 2015	New 2016	Total 2016
AFRICA & MIDDLE EAST				
	South Africa	1,053	418	1,471
	Egypt	810	-	810
	Morocco	787	-	787
	Ethiopia	324	-	324
	Tunisia	245	-	245
	Jordan	119	-	119
	Other ¹	150	-	150
	Total	3,488	418	3,906
ASIA				
	PR China	145,362	23,370	168,732
	India	25,088	3,612	28,700
	Japan	3,038	196	3,234
	South Korea	835	201	1,031
	Taiwan	647	35	682
	Pakistan	308	282	591
	Thailand	223	-	223
	Philippines	216	-	216
	Other ²	253	25	276
	Total	175,970	27,721	203,685
EUROPE				
	Germany	44,941	5,443	50,018
	Spain	23,025	49	23,074
	UK	13,809	736	14,543
	France	10,505	1,561	12,066
	Italy	8,975	282	9,257
	Sweden	6,029	493	6,520
	Turkey	4,694	1,387	6,081
	Poland	5,100	682	5,782
	Portugal	5,050	268	5,316
	Denmark	5,064	220	5,228
	Netherlands	3,443	887	4,328
	Romania	2,976	52	3,028
	Ireland	2,446	384	2,830
	Austria	2,404	228	2,632
	Belgium	2,218	177	2,386
	Rest of Europe ³	7,220	1,077	8,241
	Total Europe	147,899	13,926	161,330
	of which EU-28 ⁴	141,721	12,491	153,729
LATIN AMERICA & CARIBBEAN				
	Brazil*	8,726	2,014	10,740
	Chile	911	513	1,424
	Uruguay	845	365	1,210
	Argentina	279	-	279
	Costa Rica	278	20	298
	Panama	270	-	270
	Peru	148	93	241
	Honduras	176	-	176
	Dominican Republic	86	50	135
	Caribbean ⁵	164	-	164
	Others ⁶	335	24	359
	Total	12,218	3,079	15,296
NORTH AMERICA				
	USA	73,991	8,203	82,184
	Canada	11,219	702	11,900
	Mexico	3,073	454	3,527
	Total	88,283	9,359	97,611
PACIFIC REGION				
	Australia	4,187	140	4,327
	New Zealand	623	-	623
	Pacific Islands	13	-	13
	Total	4,823	140	4,963
	World total	432,680	54,642	486,790

Source: GWEC

1 Algeria, Cape Verde, Iran, Israel, Kenya, Libya, Nigeria

2 Bangladesh, Mongolia, Sri Lanka, Vietnam

3 Bulgaria, Cyprus, Czech Republic, Estonia, Finland, Faroe Islands, FYROM, Hungary, Iceland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Norway, Romania, Russia, Switzerland, Slovakia, Slovenia, Ukraine

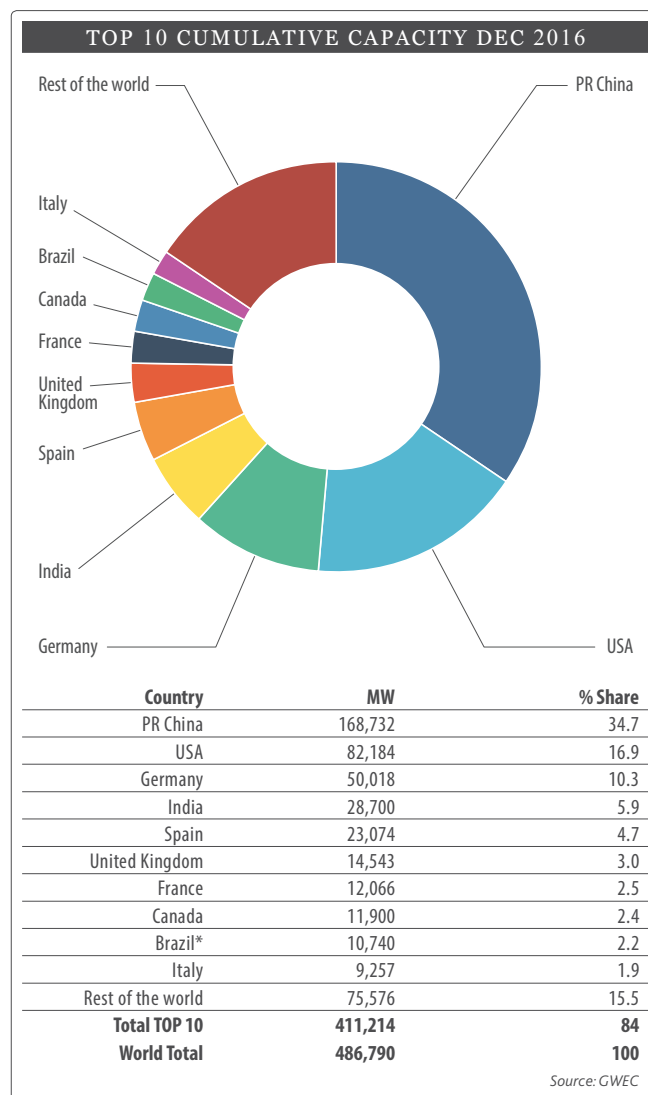
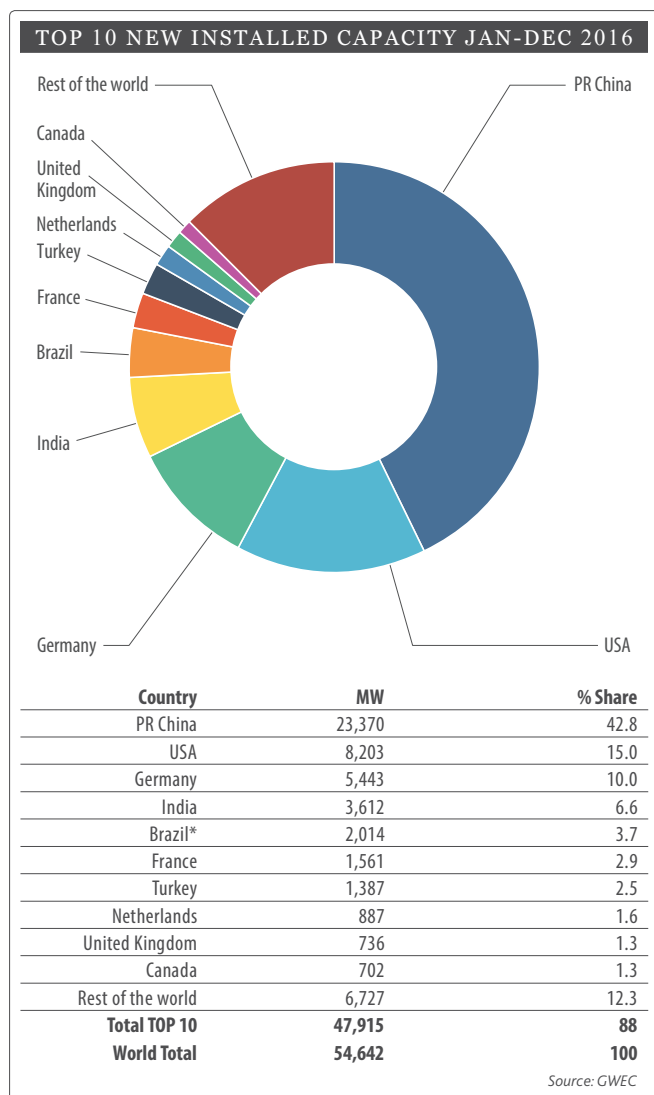
4 Austria, Belgium, Bulgaria, Cyprus, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, UK

5 Caribbean: Aruba, Bonaire, Curacao, Cuba, Dominica, Guadalupe, Jamaica, Martinica, Granada, St. Kitts and Nevis

6 Bolivia, Colombia, Ecuador, Guatemala, Nicaragua, Venezuela

Note: Project decommissioning of approximately 520 MW and rounding affect the final sums

* Projects fully commissioned, grid connections pending in some cases



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Mexico installed 454 MW of new capacity to reach a total of 3,527 MW by the end of 2016. Mexico has set an ambitious annual target of 2,000 MW per year until 2023. The ongoing market reforms for the electricity sector are expected to have a significant impact on the future of wind power in the country. 2017 will be another strong year for Mexican wind power installations.

EUROPE: TURKEY SETS NEW RECORD

The European Union installed 12.5 GW of gross additional wind capacity in 2016. This was 3 percent less than the new installations in 2015, although the total European market was marginally larger in 2016. With a total installed capacity of 153.7 GW, wind power has overtaken coal as the second largest form of power generation capacity in the EU.

Renewable energy accounted for 86 percent of all new EU power installations in 2016: 21.1 GW of a total 24.5 GW of new power capacity. Wind power installed more than any other form of power generation in Europe in 2016, accounting for 51% of total power capacity installations. With almost 300 TWh generated in 2016, wind power covered 10.4 percent of the EU's electricity demand.

In 2016 USD 29.7 bn (EUR 27.5 bn) were invested to finance wind power, 5 percent more than the total investment in 2015. This is largely due to investments in offshore wind, which increased by 39 percent compared to 2015. Onshore wind investments dropped to USD 10bn (EUR 9.3bn), their first decrease in the last five years.

There are now 153.7 GW of installed wind power capacity in the EU: 141.1 GW onshore and 12.6 GW offshore. Germany (50 GW) and Spain (23.1 GW) have the largest cumulative installed wind energy capacity in Europe. Together they represent 48 percent of total EU capacity. The UK, France and Italy follow with 14.5 GW (9.5 percent of total EU capacity), 12.1 GW (7.8 percent) and 9.3 GW (6.0 percent) respectively.

Wind energy now accounts for 17 percent of Europe's total installed power generation capacity. 16 EU Member States have more than 1 GW wind power installed, and nine of these have more than 5 GW installed. The overall EU installation levels once again mask significant volatility across Europe. 75 percent of the total installations took place in just five markets, a similar trend as in 2015.

Germany was the largest market in new wind power installations, with 44 percent of the total EU market. Germany remains the EU country with the largest installed wind power capacity, followed by Spain, the UK and France.



Five EU Member States had record years for 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. Beyond the EU member states, Turkey is the largest market, crossing the 6 GW mark in terms of total installed capacity. Looking ahead, Turkey's wind sector looks promising.

Offshore wind represented 13% of the annual EU wind energy market with 1,558 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 installations due to grid-connection delays in Germany being resolved. Offshore wind projects alone were responsible for more than half of the investment activity in the renewable energy sector. Investment in offshore wind in Europe reached USD 14.4 bn (EUR 13.3 bn).

The UK still has the largest offshore wind capacity globally at 5,156 MW, accounting for 36 percent of total offshore installations. Germany had a stellar year and kept its second spot in 2016 with new offshore installations of 813 MW. Germany saw total installation rise to 4,108 MW. With 1,271 MW Denmark is fourth spot. The Netherlands saw 691 MW in new installations to reach a cumulative installed capacity of 1,118 MW to move into the fourth spot.

A volatile legislative and regulatory environment and ongoing economic problems in some member states continue to hinder growth of the wind power industry. The year ahead is likely to be difficult but the broader investment shift away from fossil fuels could boost the European renewables sector.

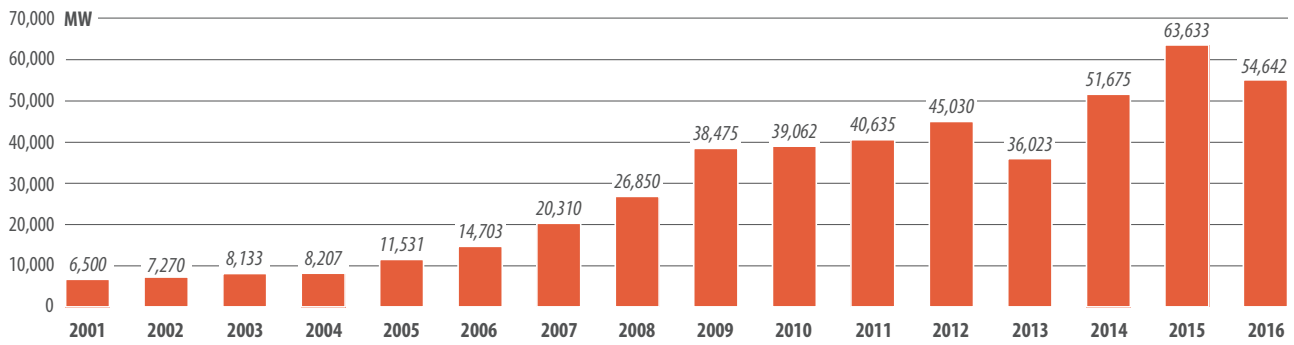
LATIN AMERICA AND THE CARIBBEAN: BRAZIL CONTINUES TO LEAD

The Latin America and Caribbean region saw 3,079 MW of new capacity come online in 2016, bringing total installations to 15.3 GW. Latin America has begun developing a substantial wind power industry to complement its rich hydro, biomass and solar resources.

Post the Paris Agreement at COP21¹¹, the demand for clean energy, bolstered by concerns for energy security and diversity of supply, promote the growth of wind power in Latin America and the Caribbean.

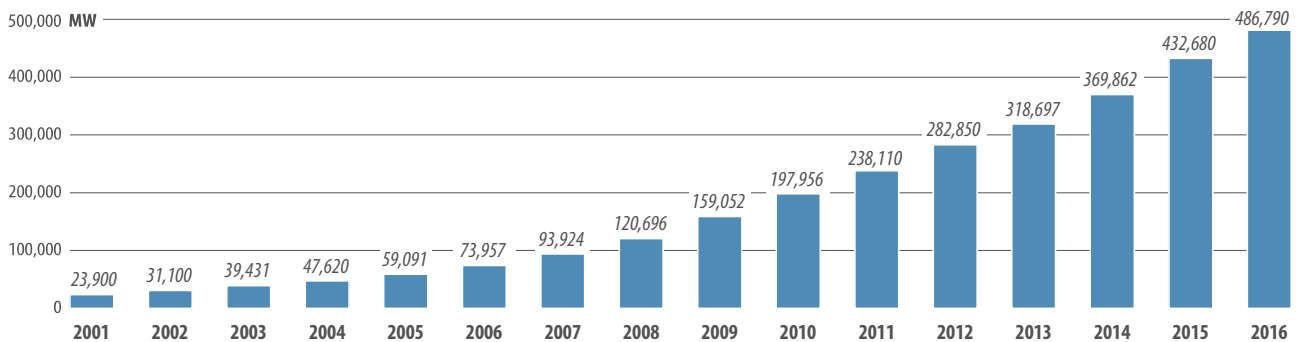
¹¹ http://unfccc.int/files/meetings/parisnov2015/application/pdf/parisagreementenglish_.pdf

GLOBAL ANNUAL INSTALLED WIND CAPACITY 2001-2016



Source: GWEC

GLOBAL CUMULATIVE INSTALLED WIND CAPACITY 2001-2016



Source: GWEC

For the fourth year in a row the Latin American market installed over 1 GW of new capacity. In 2012, six markets in the region installed 1,225 MW of new wind capacity for a total installed capacity of just over 3.5 GW. In 2013, just five markets including Argentina, Brazil, Chile, Dominican Republic and Uruguay accounted for 1,219 MW of new wind power capacity for a total installed capacity of 4.7 GW. In 2014, ten markets added new capacity. These included Argentina, Brazil, Chile, Costa Rica, Ecuador, Peru, Honduras, Nicaragua, Venezuela and Uruguay. In 2015, eight markets added new capacity. These included Argentina, Brazil, Chile, Costa Rica, Guatemala, Honduras, Panama and Uruguay. In 2016, seven markets added new capacity. These included Brazil, Bolivia, Chile, Costa Rica, Dominican Republic, Peru and Uruguay.

Brazil led Latin America with installations of 2,014 MW; although the projects were fully commissioned not all of them could be given a grid connection before the end of the year. Brazil continues to be the most promising onshore market for wind energy in the region out to 2020 despite the recent concerns with upcoming auctions.

Chile added 513 MW of new capacity to reach total installations of almost 1.5 GW. **Uruguay** has a goal to generate as much as 40 percent of its power from wind by the end of 2017. Uruguay added almost 365 MW of new capacity, bringing its total installations up to 1,214 MW.

Costa Rica added 20 MW of new capacity to reach a total of 298 MW. **Peru** saw its total installed capacity reach 241 MW, adding 92.7 MW of new capacity in 2016. **Bolivia** added new wind power capacity to its energy mix for the first time since 2014, with a 24 MW project, to reach a total installed capacity of 27 MW.

The Dominican Republic added 49.5 MW of new capacity to bring its total installations up to 135 MW last year.

PACIFIC

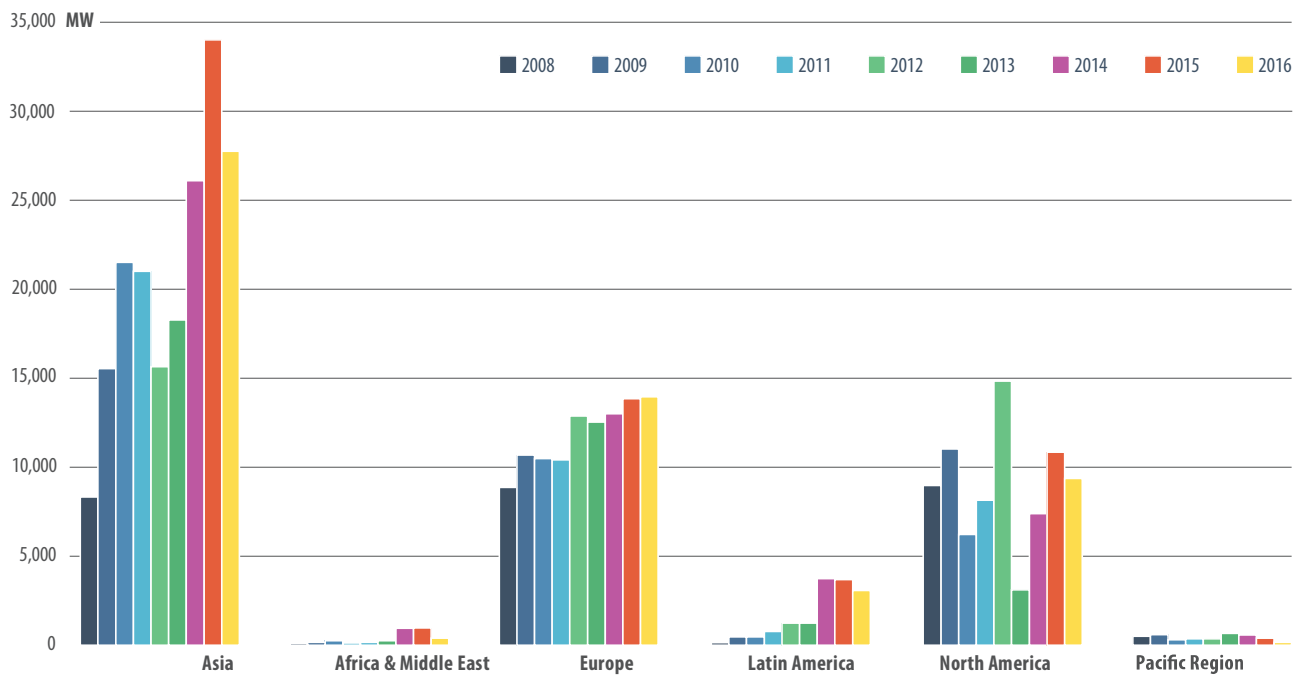
The region saw its total installed capacity rise to just over 4.9 GW last year. The **Australian** market added 140 MW in 2015, bringing its total installed capacity up to 4,327 MW.

New Zealand and the rest of the Pacific did not add any new wind power capacity in 2016, just like 2015.

AFRICA AND THE MIDDLE EAST

The Africa and Middle East region saw 418 MW of new capacity additions last year, bringing cumulative capacity for the region up to 3.9 GW. Africa's wind resource is best around the coasts and in the eastern highlands, but until 2014 it was in North

ANNUAL INSTALLED CAPACITY BY REGION 2008-2016



	2008	2009	2010	2011	2012	2013	2014	2015	2016
Asia	8,320	15,507	21,481	20,981	15,624	18,252	26,058	33,962	27,721
Africa & Middle East	96	251	153	8	131	240	934	953	418
Europe	8,851	10,660	10,466	10,393	12,862	12,524	12,988	13,831	13,926
Latin America	128	471	459	771	1,248	1,240	3,744	3,678	3,079
North America	8,969	11,008	6,208	8,137	14,807	3,112	7,382	10,829	9,359
Pacific Region	482	578	294	345	358	655	568	381	140
	28,854	38,475	39,061	40,635	45,030	36,023	51,674	63,634	54,642

Source: GWEC

and East Africa that wind power had been developed at scale. **South Africa** installed 418 MW of new capacity, for a cumulative total of 1,471 MW.

At the end of 2016, over 99 percent of the region’s total wind installations were spread across ten countries – South Africa, Morocco (787 MW), Egypt (810 MW), Tunisia (245 MW), Ethiopia (171 MW), Jordan (119 MW), Iran (91 MW), Cape Verde (24 MW), Kenya (19 MW), Israel (6.25 MW) and Algeria (10 MW). New projects are expected to come online in Egypt, Ethiopia, Kenya, Morocco, Tanzania and South Africa in 2017. Kenya’s Lake Turkana project has now completed construction and commissioning is expected in the coming months. The 310 MW project will account for almost 18% of Kenya’s total installed power generation capacity.

2016: ANOTHER GOOD YEAR FOR WIND

In 2016, the global wind industry kept annual installations above the 50 GW mark. After a slowdown in 2013, the wind industry set a new record for annual installations in 2014, and then again in 2015. Total cumulative installations stand at about 500 GW at the time of writing this report.

Wind power is a mature technology, with proven reliability and cost competitiveness across an ever-increasing number of markets today. The cost-stability of wind power makes it a very attractive option for utilities, independent power producers and companies who are looking for a hedge against the wildly fluctuating prices of fossil fuels while at the same time reducing their carbon footprint.

Wind power remains the most competitive way of adding new power generation capacity to the grid in large number of markets around the world, even when competing against heavily subsidized conventional generation technologies.

2016 was a big year for the big markets – China, the US, Germany and India, which set a new record. But there is a lot of activity in new markets around the world and in 2017 the installations are likely to see a broader distribution.

There is still an acute need around the world for new power generation, which is clean, affordable, indigenous, reliable and quick to install. Wind power is leading the charge in the transition away from fossil fuels; and continues to blow away the competition on price, performance and reliability.