GLOBAL WIND REPORT

ANNUAL MARKET UPDATE

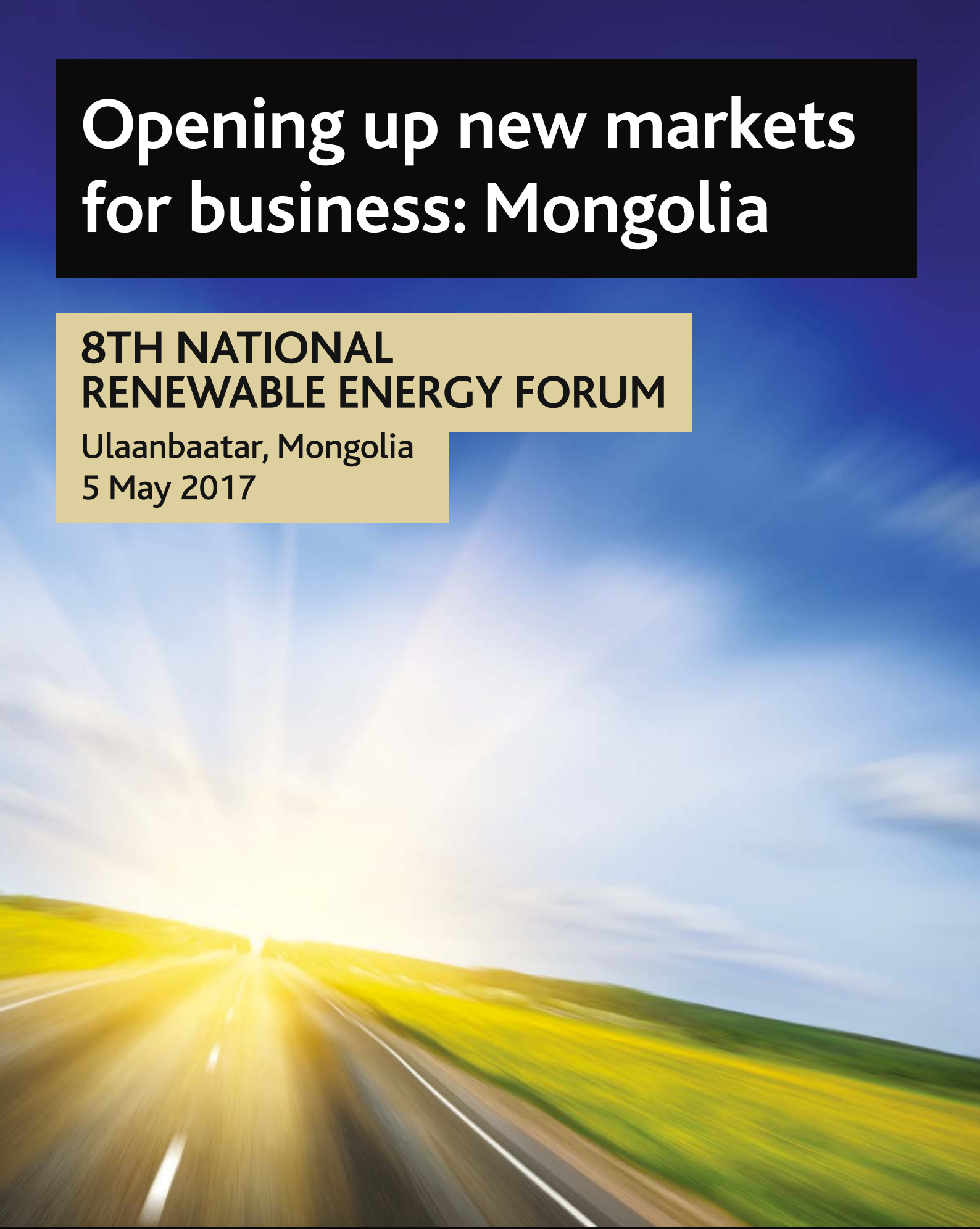
2016

GWEC
GLOBAL WIND ENERGY COUNCIL

Opening up new markets for business: Mongolia

8TH NATIONAL RENEWABLE ENERGY FORUM

Ulaanbaatar, Mongolia
5 May 2017



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PREFACE

Overall, the wind industry finished up 2016 in good shape, with solid prospects for 2017 and beyond. The economics of the industry continue to improve, with record low prices for the winning tender in Morocco last year of about $30/MWh, and very competitive prices in auctions around the world, while more and more companies' P&Ls have come out of the red and into the black.

Despite some uncertainty in the market due to the US election results in November, we seem to be on track for continuing to enjoy the longest period of policy stability ever in the critical US market; and despite slumps in some key emerging markets, we believe these are largely cyclical and will rebound in 2017.

Although we didn't reach the 60 GW mark in 2016, largely because China 'only' installed 23 GW instead of last year's phenomenal 30 GW, the industry chalked up 12.6% growth in cumulative capacity; with a 54.6 GW market leading to a total cumulative capacity at the end of the year of 486.8 GW, which will have by now (March 2017) have passed 500 GW in total.

India set a new national record with 3,612 MW of new installations, pushing it into fourth place in terms of annual capacity growth, and cementing it's fourth place position in cumulative terms, behind China, the US and Germany. Germany passed the 50 GW mark in 2016 with installations of 5,443 MW, and US installations of 8,203 MW were about the same as 2015's, and despite the political goings-on, seem to be on track for a strong 2017, with 18+ GW either under construction or in advanced stages of development. So far so good – fingers crossed!

Europe's numbers were surprisingly strong, actually surpassing 2015 for Europe as a whole on the strength of Turkey's 1,387 MW, the first time that country has broken the 1 GW barrier in a single year. The EU 28 was down by just a few percent, led by Germany, France (1,561 MW) and the Netherlands (887 MW – most of which was offshore).

Brazil once again led markets in Latin America, installing 2,014 MW, despite the country's political and economic woes. Chile had a record year with installations of 543 MW, and Uruguay installed 365 MW, pushing both countries over the 1 GW mark in terms of cumulative installations. But the big news in Latin America this year was Argentina, which started the year with a new government and a moribund industry, but ended the year with a solid 1.4 GW pipeline and more to come.

We expect China's market to return to growth in 2017, in anticipation of yet another cut in the feed-in tariff scheduled for the beginning of 2018. We expect strong repeat years from the US, Germany, and India, and there is hope that the Brazilian economy will start to recover and put some demand back in the market. In South Africa, there are strong indications that the

impasse between ESKOM and the industry, which has held up more than 2 GW of renewable energy projects for more than a year and a half, is coming to an end. Again, fingers crossed.

Elsewhere in Africa, the 850 MW auctioned in Morocco in 2016 at record low prices will start to be built out, and the pioneering Lake Turkana project in Kenya, which will be Africa's largest wind project as well as the largest private investment ever in Kenya, has now completed construction, and will be commissioned very soon.

But the big story that developed in 2016 and promises to begin to bear fruit in 2017, is the cratering of offshore prices. It started with the Dutch tender for Borssele 1 & 2 in June coming in at EUR 72/MWh, well below expectations; followed by a Danish nearshore tender in September at EUR 64/MWh. This was followed in November with the winning bid for the Danish Krieger's Flak project coming in at an astonishing EUR 49.90/MWh; and then Borssele 3 & 4 in the Netherlands coming in at EUR 54.50/MWh in December.

Record low prices for offshore wind, as well as for onshore wind in major markets in both the OECD and emerging markets, will be the primary drivers for development of wind power in the short to medium term; and the evolution of the Paris Agreement, with or without the US, will only add to the industry's momentum.

This is the 12th annual report on the status of the global wind industry by the Global Wind Energy Council. It provides a comprehensive overview of the global industry at a moment in time; an industry now present in more than 80 countries, 29 of which have more than 1,000 MW installed, and 9 with more than 10,000. The information contained in this report – market data, profiles and analysis, have been collected primarily through GWEC's member associations and companies around the world, as well as from governments and independent analysts. We thank all our contributors and look forward to continuing our collaboration in the future.

Steve Sawyer
Secretary General
GWEC

Morten Dyrholm
Chairman
Global Wind Energy Council

> We want a better world for our sons and daughters. We believe there is a better way to generate energy, a clean one, based significantly on renewable sources. There must be a future and we will fight for it <

Foreword from our sponsor

THE FUTURE WILL BE RENEWABLE-BASED OR THERE WON´T BE A FUTURE

Adolfo Rebollo
CEO of Ingeteam

Energy is one of the main concerns in the world today. Everybody is talking about energy, but from very different perspectives. One year after the Paris Agreement, renewable energy was again a central topic at the Marrakech Climate Change Conference. The recently published Energy Union Winter Package by the European Commission comes with a new push towards a better environment, towards new ways to produce energy, in a way that is also respectful to the environment, to Mother Nature, and to human well-being.

Technological corporations face the challenge of developing better technology, based on innovative solutions to reach those goals.

Technology is our DNA. Changing the way energy is generated and consumed, being able to make a difference here, is our driving force. It is so important for Ingeteam that it's included in our Mission Statement. The founders, owners, executives, employees, we all live this Mission Statement. We believe Ingeteam is contributing to the change in the way energy is produced; over 24,000 wind turbines, 36 GW are spinning day in and day out around the world, using Ingeteam's proprietary Power Conversion Technology (generators, converters and control systems). The technological evolution of the solutions applied to renewable energy, the ability to predict the available resource, the cost battle, has been fierce, making renewable energy sustainable, predictable and competitive.

The range of solutions is vast and reaches every kind of renewable energy. In the case of wind energy, the progression from the first small asynchronous fixed-speed generator wind turbines through multi-megawatt high efficiency variable-speed generator machines has been a big leap… In the year 1995, Ingeteam started working on the development of variable-speed machines, which led to the successful installation of a first prototype of doubly-fed induction generation (DFIG) in the summer of 1996, a technology that was to become the golden standard in the wind industry to this date. Since then, the company has developed power converters for DFIG and Full Conversion (FC) topologies, achieving industry-leading efficiency and reliability, compliance with the most demanding grid codes, as well as helping with the wind turbine LCoE, which at the end of the day, matters most to utilities and IPPs: efficient, reliable, sustainable, predictable and cost competitive energy.

The conquest of the sea, a reality today due to the use of marine natural resources by the machines whose power density is getting bigger every year.

This evolution is not only based on the wind turbines themselves. A big new array of innovations related to the electric grid is helping to manage the excellent available wind resource and making it every day more "user-friendly" to the power distribution corporations. Systems based on power electronics performing energy storage, DC links, and power flow controllers.

Technology is here to help renewable energy grow, to make it easier to achieve the very demanding goals in terms of percentage of the energy generated from clean sources vs those contributing to the greenhouse effect. We want a better world for our sons and daughters. We believe there is a better way to generate energy, a clean one, based significantly on renewable sources. At least from this side of the table, there is no reason why the race for reaching those goals should be slowed down. There must be a future and we will fight for it.

In addition, this development is a driver of the global economy; it is bringing wealth to many families around the world. For example, according to IRENA, the renewable energy industry employs a total of 9.4 million people around the world, from technical personnel working in the different parts of a renewable energy project, to the people living in areas where the energy plants are located. The places where these kinds of projects are developed are usually areas where industrial development is poor. Fortunately, the need to operate and maintain the installations is helping local people to keep on living there and contribute to the development of such areas.

As can be seen throughout the text, the words development and sustainability have been used repeatedly. This is because we are convinced the future will be renewable-based or there won´t be a future…

Adolfo Rebollo
CEO of Ingeteam

Ingeteam

One of the more fascinating aspects of the UNFCCC COP 21 that gave birth to the Paris Agreement at the end of 2015 was the plethora of business conferences that surrounded the event. These conferences have been a 'side feature' of climate COPs for more than a decade, but Paris marked a turning point, both in terms of the volume and the tone of these gatherings. In the past, they have been characterized primarily by companies and businesses keeping an eye on a potential long term downside business risk from carbon regulation, but in Paris, it was all about *opportunity*.

As negotiators haggled about details up the road at the conference center, the emerging consensus was that now at least the direction of travel was clear, and renewable energy was the future. Smart companies would be getting ahead of the game. Plummeting prices for wind and solar were driving the business case, and while there was a healthy dose of skepticism for what governments could actually accomplish, there was a large majority of businesses anxious to move, and to move much faster than governments. They have learned (as have we all) the hard way that a consensus process involving 190+ governments isn't going to get us to where we need to go fast enough to safeguard our children's future, never mind the long-term viability of the business concern in question.

Steve Sawyer

CORPORATE SOURCING OF RENEWABLES – A NEW MARKET DRIVER FOR WIND

There was an initially skeptical reaction from some, being reminded of the emergence of various business groupings around the first Earth Summit in Rio back in 1992, which contained a very large degree of 'greenwashing', i.e., companies painting themselves green for public relations purposes while carrying on pretty much business as usual. It is true that some of the new initiatives that have grown up around the idea of corporate sourcing of renewables lack standards and/or accounting rigor. "Additionality", that was central to the Kyoto Protocol's Clean Development Mechanism, is difficult to measure in this case. Maybe the projects that arise from corporate sourcing might have happened anyway. However, corporate off takers and/or investors the projects can usually happen more quickly and more profitably for all concerned, so it's a win-win, even if the net benefit is hard to quantify in terms of specific numbers of TWh or tons of CO_2 equivalent.

Depending on how you look at it, corporate sourcing of renewable power is nothing new. Starting in about 1880, small to medium size businesses throughout the United States as well as in parts of Europe were building their own power plants (usually small hydro dams) to generate electricity to power their mills and workshops, often selling their surpluses to local communities. These small plants continued to expand until about 1930, when municipal public utilities began to take over the task of supplying electricity.

The birth of the wind power industry in India came about in the 1990s as a result of business owners frustrated with unreliable power and rising prices. In Mexico, up until the Electricity Reform which was enacted in late 2015 which is still being rolled out, 'self-supply', another type of corporate sourcing was all that was available for wind power developers, and you could say corporate sourcing is responsible for all of the 3.5 GW of wind power installed in the country. This would also hold true for the 2 GW or so which will be built out over the next couple of years, before the projects which were auctioned in 2016 start to be built.

Direct corporate purchases of wind power plant, or the power from them, have also played a role in the development of the market in Chile particularly in the mining sector; and has resulted in a few projects in the so-called 'free market' in Brazil, perhaps most notably a wind project in Rio Grande do Sul supplying the total power needs of a Honda factory near Sao Paulo, more than 1,000 kilometers to the north.

The latest boom in corporate sourcing has been centered in the United States, which started a few years ago, but reached a new peak in 2015, when about 4 GW of corporate PPAs were signed by such household names as Google, Apple, Proctor and Gamble, and General Motors. Driven by the increasing competitiveness of wind power pricing along with the expected expiration of the Production Tax Credit (PTC) at the end of 2015, this push attracted significant public attention, and represented the high point of a 'new wave' of corporate purchasing, which certainly contributed to the optimism around the Paris climate summit.

This coincided with the rise of a number of corporate sourcing initiatives, such as the Climate Group's RE 100 campaign[1], the NGO 100% Renewables campaign[2], the Rescale initiative from the WBCSD[3], and Corporate Sourcing of Renewables[4] campaign launched by governments at the Clean Energy Ministerial in San Francisco in June of 2016.

1 http://there100.org/re100
2 http://www.go100re.net
3 http://www.wbcsd.org/Clusters/Climate-Energy/REscale
4 http://www.cleanenergyministerial.org/Our-Work/CEM-Campaigns/Corporate-Sourcing-of-Renewables

The numbers slacked off a bit in the US in 2016, partly due to the lack of urgency due to the unforeseen extension and phase-out of the PTC passed by the US Congress and signed by President Obama at the 11th hour at the end of 2015. Still:

- Corporates signed 1,574 MW, or 39%, of the MW contracted through PPAs in 2016
- More than 50 corporates have procured more than 5,600 MW through PPAs to date, and more than 6,600 MW when also considering direct ownership and large-scale REC purchases
- 3M, Johnson & Johnson and Target executed their first wind PPAs in 2016
- Amazon was the largest purchaser in 2016, followed by Google, Microsoft, Dow Chemical and 3M
- 24% of the 8,203 MW installed in 2016 has a PPA with a corporate buyer

Indeed, the appetite for such PPAs seems quite healthy, and the latest major announcement comes from Anheuser-Busch (AB) InBev, the world's largest brewer, which has joined the RE 100 campaign as a result of an investor and shareholder driven initiative. Anheuser-Bush has pledged to source 100% of its power for its operations from renewable sources by 2025, with three quarters or more of this coming from direct purchasing through PPAs, while the balance will come from on-site installations at its major facilities[5]. Having new buyers of that size in the market can't be a bad thing.

So what form do these deals take? There are many. Some of the most common are: 1) building your own plant on-site; 2) purchasing from an on-site or near-site project that is managed by someone else; 3) investing directly in an on-site or near site project, without assuming full ownership; 4) buying or investing in an off-site generation plant; 5) a corporate PPA with an offsite project; 6) buying renewable certificates from an existing project; 7) buying 'green' electricity from a power company.

As usual, the extra work and extra risk associated with having your own plant can potentially reap much greater rewards, but it depends upon whether the company in question is capable of managing the asset, is sufficiently capitalized, and/or is willing to take the risk. Each business will be different.

WHAT MOTIVATES A COMPANY TO DECIDE TO SOURCE RENEWABLES?

First and foremost, is the economics. Not only are wind and increasingly, solar, competitively priced, but they are immune from the fluctuations in fossil fuel prices and hence electricity price variability, and eliminate the potential substantial risk from carbon regulation in the future. Companies can either opt to take the risk associated with owning and operating their own assets, or eliminate those risks (and potential benefits) by going with a PPA for some or all of the power production from an existing or newly built facility.

> Smart companies would be getting ahead of the game. Plummeting prices for wind and solar were driving the business case, and while there was a healthy dose of skepticism for what governments could actually accomplish, there was a large majority of businesses anxious to move, and to move much faster than governments

Secondly, an increasing number of companies, either through their own volition or through shareholder or public pressure, have sustainability plans that involve reducing their carbon footprint. So after doing what they can to reduce their emissions through energy efficiency, direct sourcing of renewables is the next logical step, and is now increasingly a cost effective measure as well.

Thirdly, there is the undeniable benefit of brand name recognition and credibility in terms of sustainability. In most markets, a 'green' profile is of great benefit, particularly for companies with direct exposure to the consumer market, and especially those that consider themselves leading edge and/or trendsetting.

The advantages for the developer are clear: risk reduction through a secure PPA with a company can lead to lower financing costs, diversifies their revenue stream and leaves them an option other than the usual utility buyers. It makes the project more 'bankable', it's good for the brand name of the company as well as potentially helping its stock price, and of course, if the deal works out well, can lead to more business with other companies.

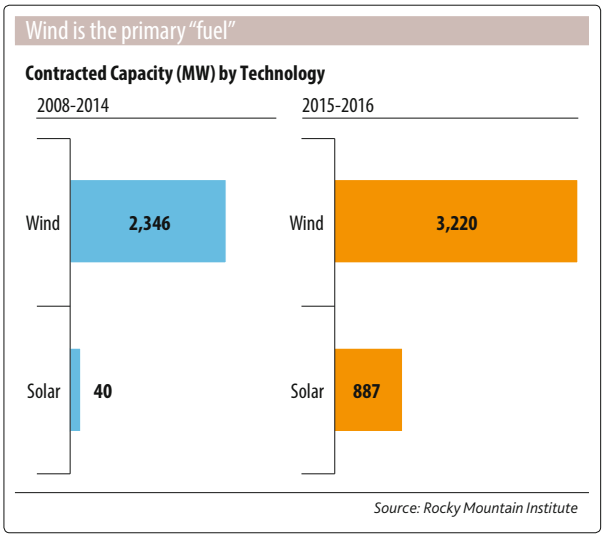
There are of course downsides. Companies are going to be in most instances venturing into areas outside their core business, which could prove a distraction, and quite a substantial one if they're looking at owning and/or operating their own assets; which would also require the use of the company's capital, which will not be available to be deployed elsewhere in pursuit of its core business.

While in general terms a long term contract at a stable and predictable price is very valuable, it may prove burdensome if the company hits hard times and its electricity demand shrinks. Furthermore, understanding and assessing the current state of, and forecasts for power, markets is not something that most companies are set up to do. It can also require extra resources in terms of internal governance and approval procedures, extra accounting requirements, not to mention the risks associated with power market regulation, and the possibility of political meddling which could leave the company exposed.

On the whole, however, in many markets corporate sourcing of renewables makes good business sense, especially for larger companies and those with consumer exposure and with clear growth prospects.

5 http://www.cnbc.com/2017/03/29/beer-giant-anheuser-busch-inbev-commits-to-100-percent-renewable-energy.html

> The undeniable benefit of brand name recognition and credibility in terms of sustainability. In most markets, a 'green' profile is of great benefit, particularly for companies with direct exposure to the consumer market, and especially those that consider themselves leading edge and/or trendsetting <



WHAT ARE THE OBSTACLES?

This is assuming that direct purchase of renewably sourced power is even an option. There are still many countries in the world where you buy your power from 'the power company' and that's it. The trend of liberalization of electricity markets around the world, embraced with such fanfare a few decades ago still continues, although it has stalled in many places, leaving many consumers (and businesses) with little choice as to how they source their power.

Furthermore, the nature of the support schemes in place in various countries can either be a benefit or a significant hindrance to corporate sourcing of renewables. Feed-in tariffs (FIT), for instance, while they have been absolutely fundamental to developing technologies and markets, create a situation where there is not really any economic incentive on either side to conclude a corporate PPA, as the mere existence of the FIT assumes that the renewable power produced comes at a higher price than the wholesale market price. The same can be said of feed-in premiums, or indeed the Contracts for Difference scheme in the UK. Companies may still proceed in these markets, but there seems little economic incentive to do so.

Renewable Portfolio Standards (RPS), on the other hand, even when they are not mandated for large power users, can lead to utilities actively searching for renewables certificates, which can support the efforts leading to corporate sourcing. Furthermore, in a number of markets such as Mexico, Argentina and India, there is a direct requirement for large consumers to meet an RPS, and serves as a self-evident driver for companies to own and operate renewables assets, to conclude a PPA with renewable generators, or to source renewable energy in some other way.

As for the Production Tax Credit and Investment Tax Credit currently operational in the United States, they are very well suited to encouraging corporate sourcing of renewables. Particularly in this case the company can take direct advantage of the tax credit if it is the owner or invests directly in a project, or otherwise get a very favorably priced tariff if the tax credit is being monetized by the developer/operator. This explains why there was such a boom in corporate sourcing boom in 2015 when it was thought that the PTC was going to expire at the end of the year. It also raises a question about the future of the corporate sourcing market as the phase-out of the PTC is completed at the end of 2019, and the Investment Tax Credit for solar a few years later.

REGULATORY REFORM NEEDED

As always, government regulation plays a significant role in determining whether corporate purchasing of renewable energy will flourish. While the problems and potential solutions are different in each market, there are some general principles which will apply to most markets, assuming they have chosen for any substantial degree of electricity market liberalisation..

Where there are direct prohibitions on third party PPAs, or prohibitions from purchasing power from anyone other than the centralized (usually state-owned) utility, they should be removed.

Corporate PPAs and direct sourcing should be included in general electricity market regulatory schemes.

Transmission system wheeling (and banking, if appropriate) should be facilitated at reasonable prices, rather than being made too difficult and expensive.

Governments could/should take an active role and encourage corporate buyers to assist in meeting government RE and emissions reduction targets.

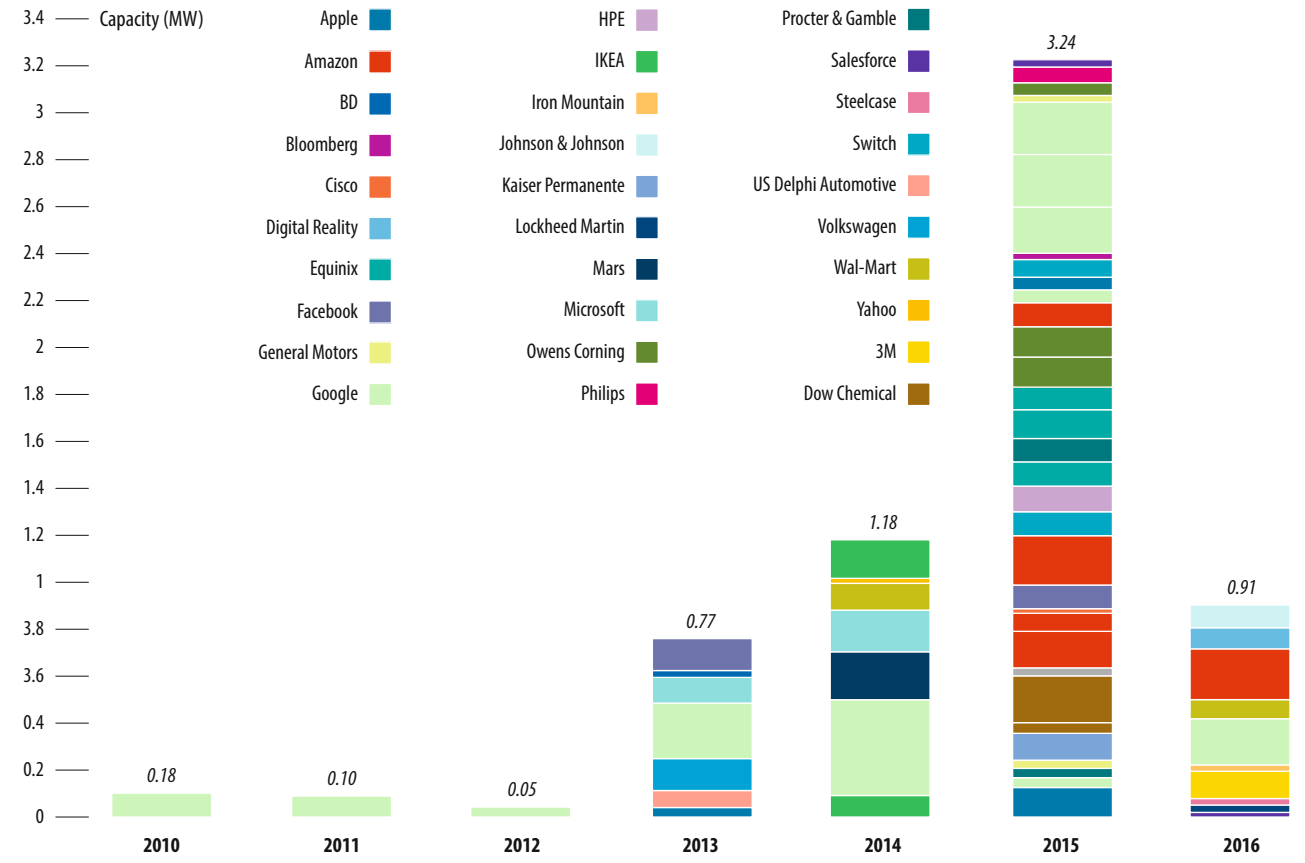
Competition regulators should engage and issue guidance to corporates seeking to enter the market, creating rules which support these efforts, while at the same time maintaining the integrity of the market.

Some governments have stepped up and created renewable power purchase procurements for themselves, and governments are often significant purchasers of power; more should be encouraged to do so.

Finally, as is always the case, policy stability is critical. Power sector investments are long term, and the policies that support them must be as well.

In conclusion, corporate sourcing of renewables is potentially a potent driver for the rapid uptake of renewables. The next few years will prove whether or not this is a short term phenomenon, or whether it continues to evolve as a key measure of corporate sustainability and a bellwether for a company's commitment to the energy revolution which is required in the next few decades. Whether the motivation is purely economic, a real commitment to sustainability, or motivated primarily by growing awareness of consumers in places where there is a real choice where you buy your power, hardly matters. What matters is what happens, and what needs to happen is a rapid transformation of our energy system, not only in the power sector, but for heating and transport as well.

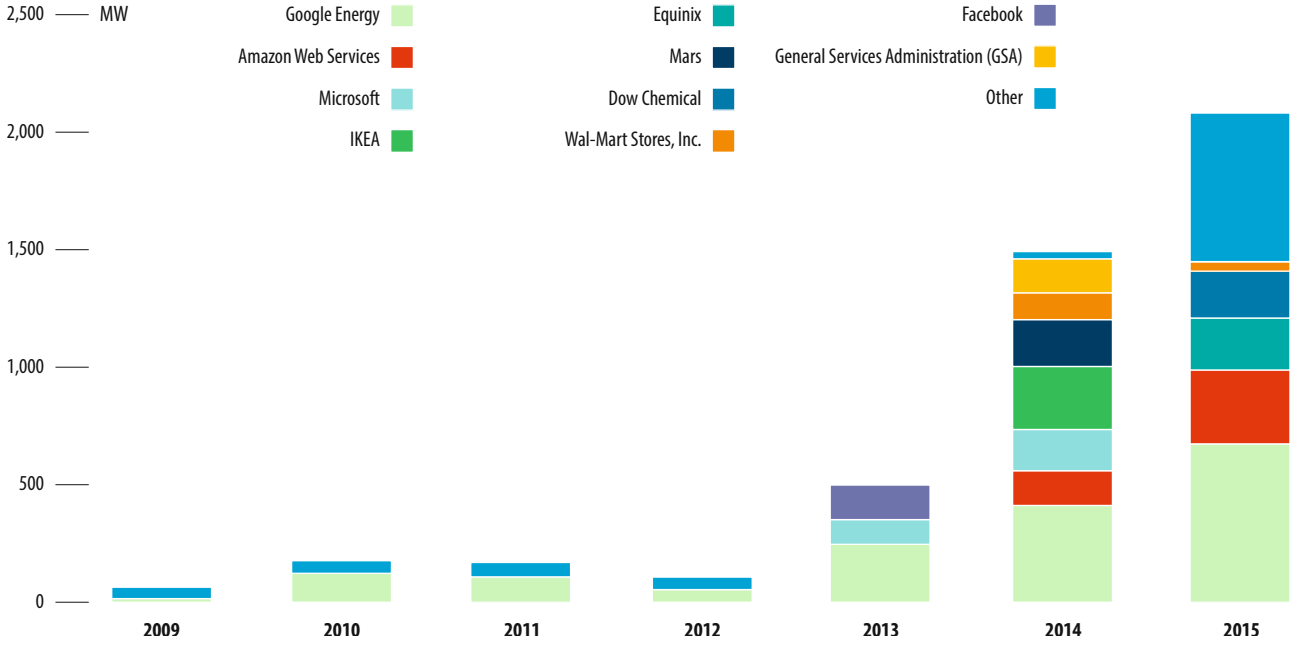
CORPORATE RENEWABLE DEALS 2010-2016



Publicly announced contracted capacity of corporate Power Purchase Agreements, Green Power Purchases, Green Tariffs, and Outright Project Ownership in the US and Mexico, 2012-2016. Excludes on-site generation such as rooftop solar PV and deals with operating plants. Last updated: August 8, 2016.

Source: Rocky Mountain Institute

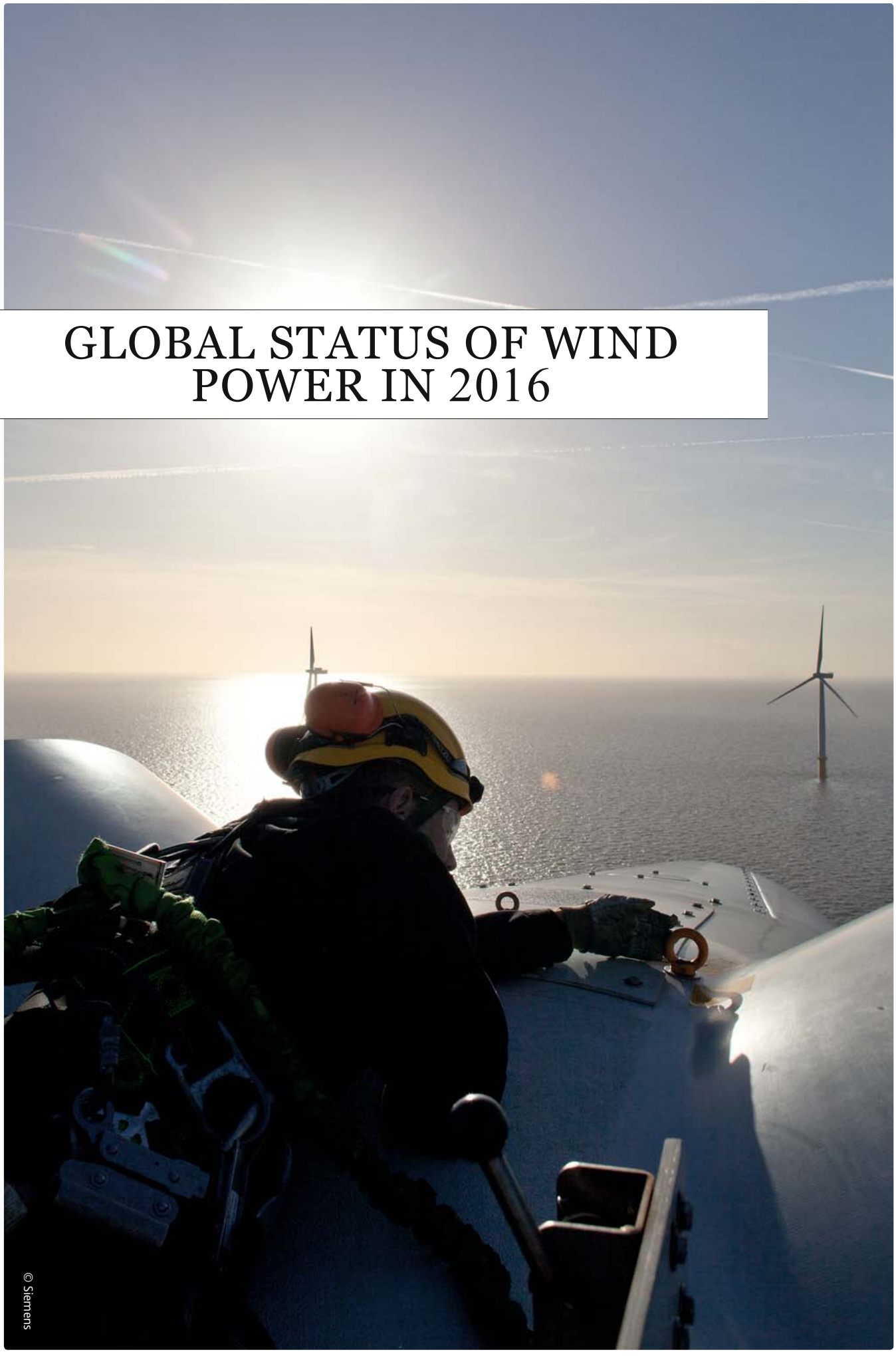
NON-UTILITY WIND POWER PURCHASES BY YEAR



Note: Data include publicly announced physical and virtual power purchase agreements (PPA), offsite wind projects announced under direct ownership, and offsite wind projects announced with a long-te rm, REC-only contract. Data is recorded at the time of announcement and does not indicate when the associated wind project is placed into operation.

Source: AWEA U.S. Wind Industry Annual Market Report Year Ending 2015. MW counted as of public announcement of contract

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 bn[1]), 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 2016[2].

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 generation[4].

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 generation[5]. Total wind power generation reached over 153 TWh in 2014, 2.78 percent of total electricity generation[6]. 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 GW[7] 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://ceenews.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/

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 2016[8].

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 incentive[9].

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 agreements[10].

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

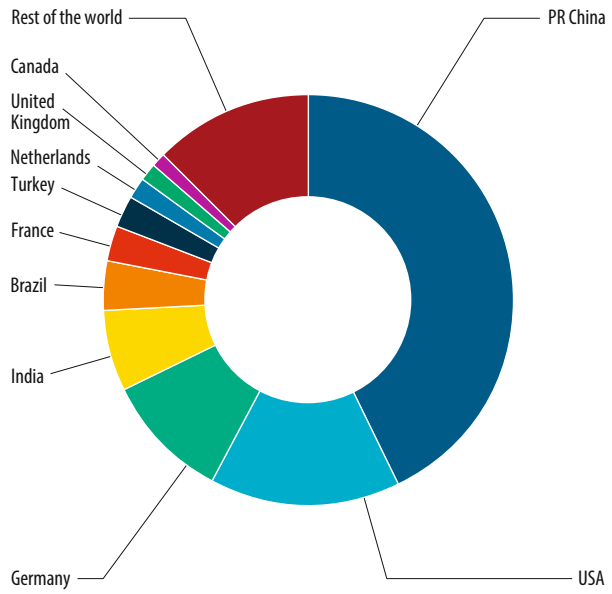
		End 2015	New 2016	Total 2016
AFRICA & MIDDLE EAST				
	South Africa	1,053	418	1,471
	Egypt	810	-	810
	Morocco	787	-	787
	Ethiopia	324	-	324
	Tunisia	245	-	245
	Jordan	119	-	119
	Other[1]	150	-	150
	Total	**3,488**	**418**	**3,906**
ASIA				
	PR China	145,362	23,370	168,732
	India	25,088	3,612	28,700
	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*

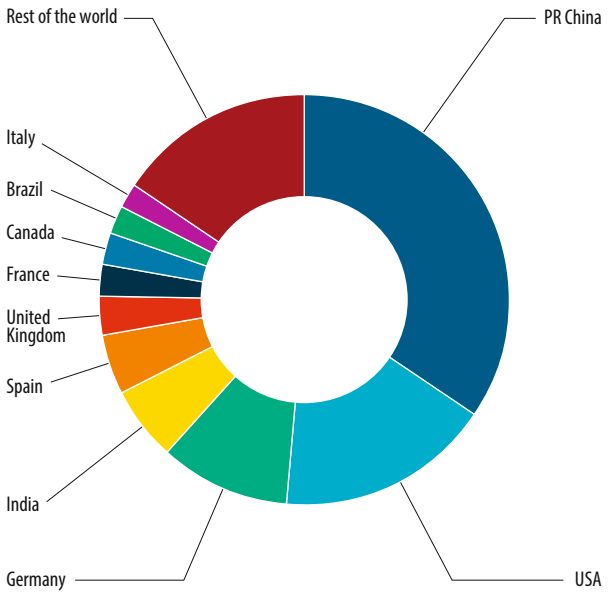
TOP 10 NEW INSTALLED CAPACITY JAN-DEC 2016



Country	MW	% Share
PR China	23,370	42.8
USA	8,203	15.0
Germany	5,443	10.0
India	3,612	6.6
Brazil*	2,014	3.7
France	1,561	2.9
Turkey	1,387	2.5
Netherlands	887	1.6
United Kingdom	736	1.3
Canada	702	1.3
Rest of the world	6,727	12.3
Total TOP 10	**47,915**	**88**
World Total	**54,642**	**100**

Source: GWEC

TOP 10 CUMULATIVE CAPACITY DEC 2016



Country	MW	% Share
PR China	168,732	34.7
USA	82,184	16.9
Germany	50,018	10.3
India	28,700	5.9
Spain	23,074	4.7
United Kingdom	14,543	3.0
France	12,066	2.5
Canada	11,900	2.4
Brazil*	10,740	2.2
Italy	9,257	1.9
Rest of the world	75,576	15.5
Total TOP 10	**411,214**	**84**
World Total	**486,790**	**100**

Source: GWEC

* *Projects fully commissioned, grid connections pending in some cases*

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.

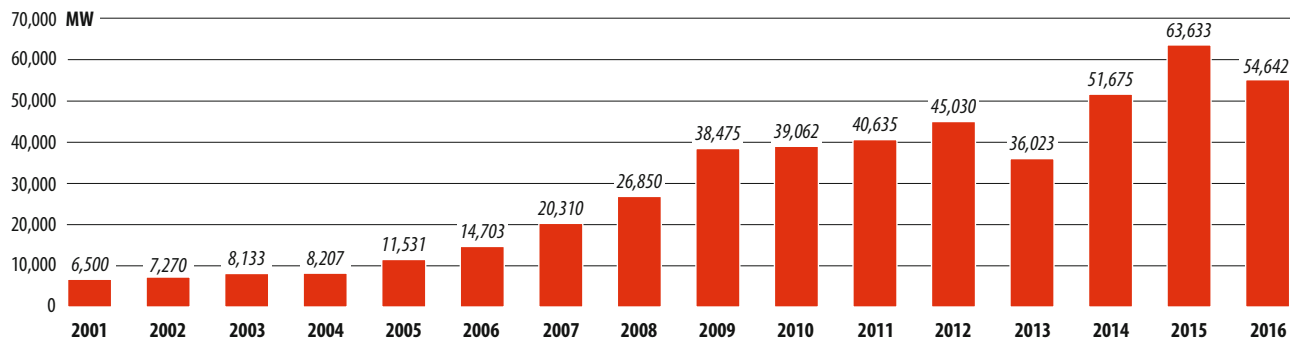
LATIN AMERICA AND THE CARIBBEAN: BRAZIL CONTINUES TO LEAD

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 COP21[11], 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.

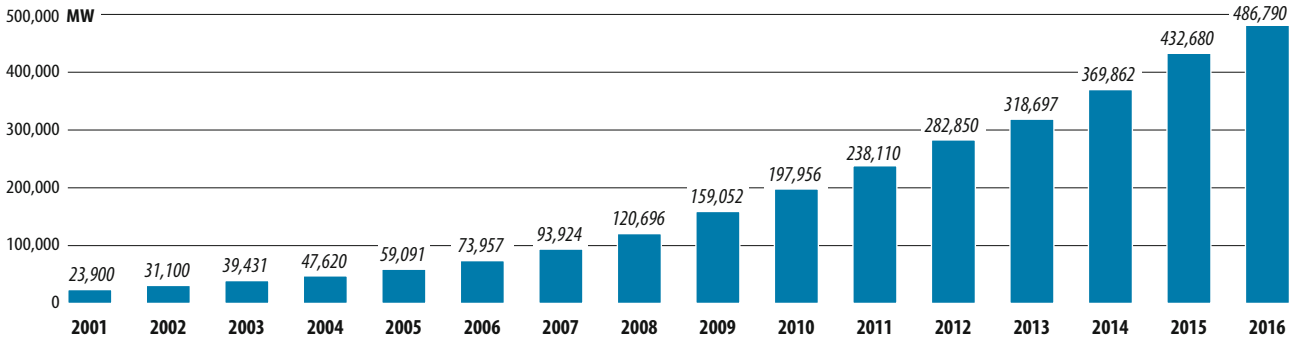
11 http://unfccc.int/files/meetings/parisnov2015/application/pdf/parisagreementenglish_.pdf

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

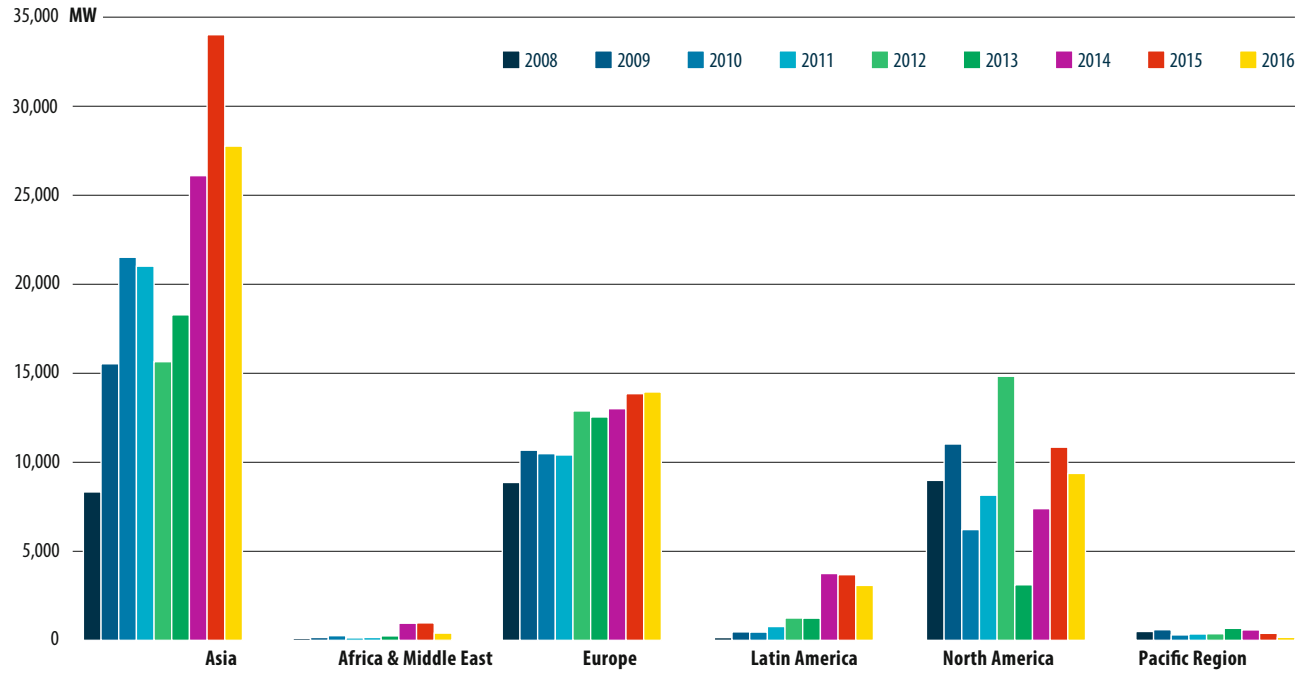
The region saw its total installed capacity rise to just over 4.9 GW last year. The **Australian** market added 140 MW in 2015, bringing its total installed capacity up to 4,327 MW.

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 a 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.

MARKET FORECAST 2017-2021

After setting a new record in 2014, passing 50 GW for the first time; and then again in 2015 passing 60 GW for the first time, the wind industry in 2016 had a year of consolidation. China 'only' installed 23 GW, and cyclical or policy related slowdowns in key markets such as Brazil, Mexico, South Africa and Canada meant that the industry was not able to set another record in 2016, but still installed 54.6 GW during the course of the year. A number of countries set records in 2016, most notably India, with its all-time high total of 3.6 GW. At the end of 2016, total global installed capacity was 486,790 MW.

We expect the annual market to return to growth in 2017: another policy-induced rush to install will drive market growth in China, although it is unlikely to reach the 30 GW record set in 2015; stable markets in Europe and North America; continued growth in India; a general pickup in Africa and Latin America; and some new markets putting up numbers for the first time.

MAJOR TRENDS IN 2016

Cratering of offshore prices

While the offshore industry was expecting prices to gradually decrease towards the target of EUR 100/MWh by 2020 that it had set itself, everyone was surprised at how quickly it has actually happened. Starting in July with the Dutch tender for the 700 MW Borssele 1&2 projects at EUR 72.7/MWh (USD 78.5), the action then moved to Denmark with their nearshore tender which came in in September at EUR 64/MWh (USD 69.1); followed in November by the Kriegers Flak project at EUR 49.9/MWh (USD 53.9), and returning to the Netherlands in December with the Borssele 3&4 project for another 700 MW at EUR 54.5/MWh (USD 58.9). A spectacular drop in price, by any measure, which has certainly defined a range for 'the new normal' in mature northern European offshore wind markets at well below EUR 100/MWh.

Now, it should be noted that these projects are exclusive of transmission costs, which would add another EUR 6-12/MWh, and that they are not in either very deep water or very far offshore. Regardless, it seems that the industry has exceeded its 2020 targets by a significant margin, and four years ahead of time. We have the remarkable situation where all of a sudden offshore is competitive with onshore wind, and the repercussions have been felt across the world, setting the stage for a round of large investments in offshore not only in Europe, but also in Asia and North America.

Corporate buyers playing a larger role in the market:

While direct purchasing of the output of wind farms by corporations has been a significant factor in a number of markets for the past decade, most notably in Mexico, during the past couple of years it has become a major factor in the US market, and it is spreading to Europe as well. While it seems that 2016 was a bit slower than the record year in 2015, it's another aspect of the major upheaval underway in the power sector.

Competition with solar

While most major indices of LCOE still have wind come in significantly cheaper than solar PV, the competition in emerging markets such as Mexico and Chile is fierce indeed, and even in such a windy place as Argentina, solar PV prices are catching up to wind quite quickly.

From a global point of view, of course, this is a very good thing: that in an increasing number of markets around the world, the cheapest way to add new capacity to the grid is wind power...except where it is solar PV. But this will be of little consolation to the project developer who loses out to solar PV in an auction in a new market.

In most cases, of course, the technologies are quite complementary, with solar providing the majority of its power on a relatively predictable curve during the middle of the day, whereas often wind is at its peak in the evenings or at night. However, every circumstance is different, and system needs and design, as well as the market arrangements to support them will increasingly be determining factors for technology selection as we move from electricity markets dominated by fossils to those dominated by wind and solar.

Looking ahead

The other major event, of course was the outcome of the US election in November. However, so far so good and it seems that the new Treasury Secretary as well as the new Energy Secretary are looking to keep the current arrangements in place. We (and everyone else) will be watching closely.

There have been rumblings in the two remaining sleeping giants – Russia and Saudi Arabia – but we've heard these before, and we'll keep a close eye but have no concrete expectations at this point.

Finally, good news from Argentina. Twelve months ago there was nothing but hopes founded on the election promises of a new government. Now we have a solid 1.4 GW pipeline of wind projects, with more to come as Argentina rolls out the second year of its RenovAR programme with another auction later this year.

So what does this mean for the short term? From where we sit here at the end of March 2017, it looks like solid if unspectacular growth in 2017, a flat 2018, then moderate growth through the rest of the decade and the beginnings of another growth spurt at that time. We don't expect the spectacular swings that led us to dramatically underestimate (in 2015) or overestimate (in 2016) the market; but we can only make our projections on the basis of what we know now...and there's a lot we don't know! To quote a phrase variously attributed to such diverse characters as Niels Bohr and Yogi Berra, "It's hard to make predictions, especially about the future!"

REGIONAL MARKET DEVELOPMENT

The Asia market continues to dominate, with India playing a stronger role alongside China's leading position, and with a number of new markets emerging. Europe continues to defy expectations and remain stable, and strong offshore buildout for the rest of the decade will keep it on track towards its 2020 goals. Pending an as yet unforeseen disaster in the US, the North American market should remain strong.

With Brazil's political and economic woes putting a damper on that market, Chile and Argentina in particular will be picking up some of the slack, along with contributions from Peru and smaller markets in Central America and the Caribbean. For the Middle East and Africa, the main drivers will continue to

Lake Turkana © Vestas

be South Africa, Morocco (and we hope) Egypt, with strong contributions from Kenya and Ethiopia as some of the smaller markets are just getting off the ground. Australia is poised to boom again, which will be the main driver in the Pacific.

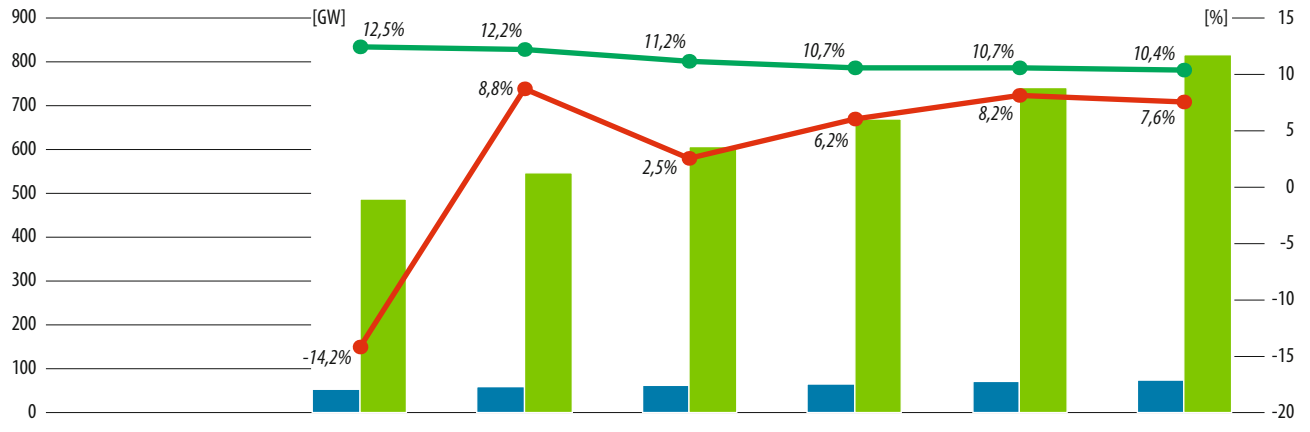
Asia

At 203.7 GW of installed capacity, the Asian region is the driver of the global industry, and we expect that to continue for the foreseeable future.

While falling back from its record breaking 30 GW market in 2015, China posted strong installations of 23.4 GW, just ahead of 2014's market. While we expect the market to increase a bit in 2017 due to the imminent feed-in-tariff reduction (and a spurt in offshore), it is unlikely to repeat its 2015 achievement in the medium term. This is due to: the heavy congestion and poor management of the overall power system which saw 17% of China's wind generated electricity curtailed in 2017; the flattening of demand growth in the country; and increasing solar installations. The Five-Year Plan for Energy (2016-2020) was finally published late last year, and calls for 210 GW of wind by 2020, which will almost certainly be surpassed, but not by as much as we had thought last year. While China has taken the political decision to transition away from a coal-based power system towards sustainable energy, it has some serious systemic and market issues to address before it can move much further forward.

India set a new record in 2016, and 2017 is likely to be another strong year, but after that things will probably slow a bit as the industry and markets adapt to the tendering system which is now being introduced, and then pick up again. Elsewhere in Asia, Japan and Korea will continue to grow slowly, but we're looking at increasing strength in the market in Pakistan, an impending surge in the Philippines, a new offshore market in Taiwan, and the 'next big thing' in Vietnam, pending critical regulatory changes which are expected during the course of 2017. Overall, we expect the Asian market to add 154 GW in the next five years, for a total of 357 GW by the end of 2021.

MARKET FORECAST FOR 2017-2021



	2016	2017	2018	2019	2020	2021
Cumulative [GW]	486.8	546.1	607.0	671.7	741.7	817.0
Cumulative capacity growth rate [%]	12.5%	12.2%	11.2%	10.7%	10.7%	10.4%
Annual installed capacity [GW]	54.6	59.4	60.9	64.7	70.0	75.3
Annual installed capacity growth rate [%]	-14.2%	8.8%	2.5%	6.2%	8.2%	7.6%

Source: GWEC

Europe

The expectations for a drop in the European market in recent years have not come to pass. Overall, the European market was up very slightly in 2016, despite a lull in offshore installations, and the EU-28 market was down only very slightly. Germany had another strong year, passing the 50,000 MW mark in cumulative installations, and 2017 is also expected to be strong, before the new auction system kicks in. France, Turkey and the Netherlands all had strong years in 2016, and are expected to repeat in 2017.

Offshore installations are expected to be up again in 2017, as well as in subsequent years, with much greater growth after 2020 given the price points which have now been reached. A number of countries have announced they are considering accelerating their offshore programmes in light of the price points which have been reached in the past year.

Overall, we expect Europe to proceed in line with its 2020 targets, and while it is not everything the industry would wish, the European Commission's proposals for the post 2020 renewables regime, along with a strengthening Euro-zone economy, give rise to cautious optimism. We expect Europe to install about 73 GW of new wind power in the period out to 2021.

North America

After the tax deal which was struck at the end of 2015 for the extension and phase out of the Production Tax Credit in the period up to 2020, the US wind industry entered its longest ever period of policy stability, and the 2016 market numbers bear this out. However, the results of the 2016 elections initially cast this expectation of policy stability into doubt. Although it's early days, it seems that those arrangements will most likely stay in place, due to strong bi-partisan support for wind power, continued support at the state level, wind power's increasingly competitive pricing and the more than 100,000 jobs (and growing) in the sector. This all bodes well for a strong US market for the next several years.

While the Canadian market is off its peak installation period of 1-1.5 GW/year from 2011-2015, we expect stable markets of.7-1 GW going forward. Mexico should have its first year installing more than 1,000 MW in 2017, and should proceed to take off from there, in line with the new energy reform and government targets. Overall, we expect 61.5 GW to be installed in the North American region over the next five years.

Latin America

The cancellation of all renewable energy auctions in Brazil in 2016 as a result of Brazil's political and economic woes was the major dark spot in an otherwise bright picture for Latin America. Brazil's market was down to just over 2 GW and although installations are expected to remain at least at that level through 2017, unless there are new auctions then the newly established supply chain in the country will be in trouble.

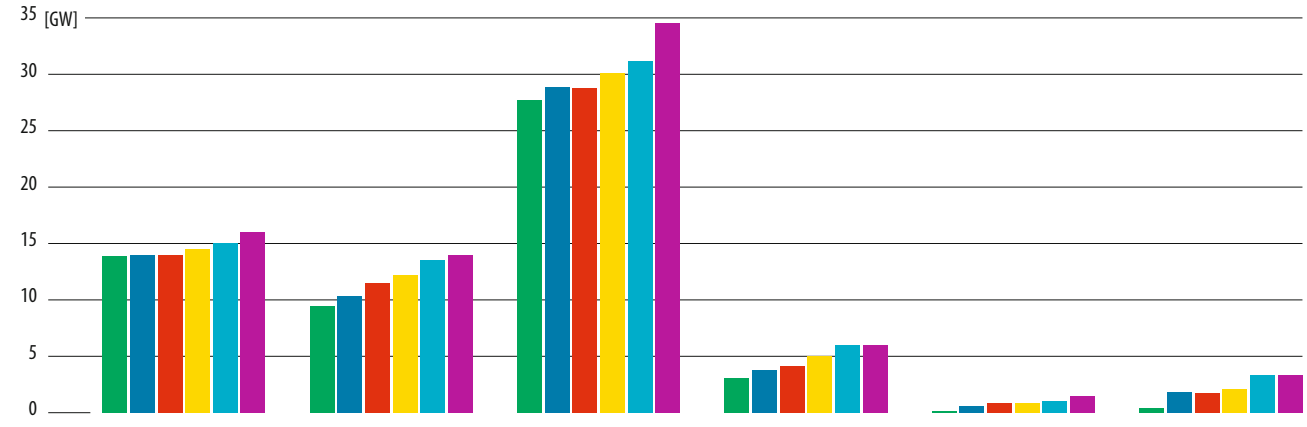
Elsewhere, we have a vibrant new market in Argentina, a dramatically strengthened Chilean market, the end of the big build-out in Uruguay and continued growth in Peru. Small markets in Central America will continue to make a contribution, and new climate and energy targets in the CARICOM countries mean that there will be significant activity there, although small in absolute terms. Overall, we expect just under 25 GW of new installations in the region in the period out to 2021.

Africa and the Middle East

After a relatively quiet 2016, we expect the Africa and Middle East region to start growing again in earnest this year. In South Africa, it seems that the stalemate is about to break with Eskom over the PPAs the state owned utility has refused to sign despite the government-run tender results and instructions to do so. If it does, this will unleash an enormous backlog of projects, with more to come in the next bidding rounds. South Africa's new Integrated Resource Plan, if it becomes policy, will facilitate this key African market's living up to its potential.

Elsewhere in the region, Kenya's 310 MW Lake Turkana project is now ready for commissioning in the next few months,

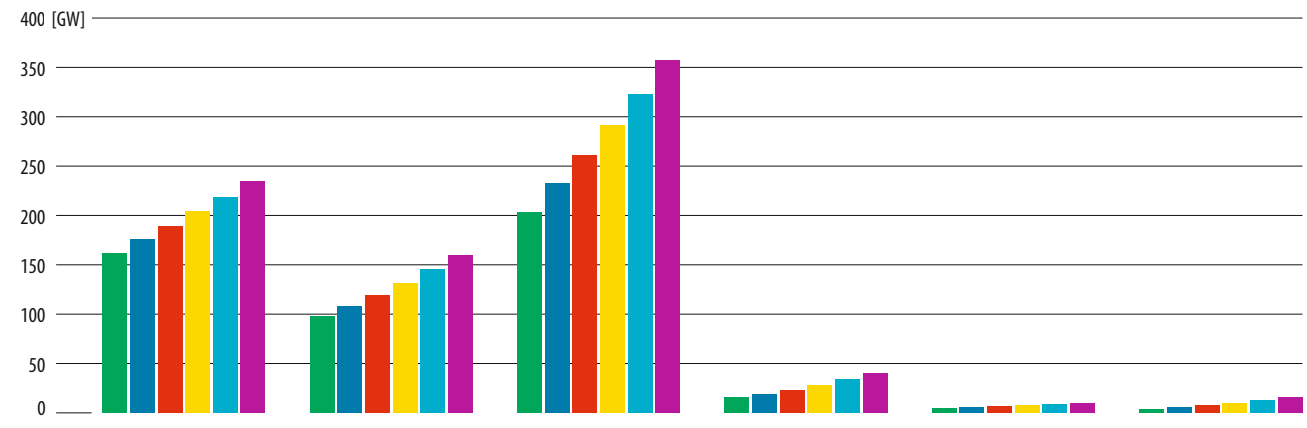
ANNUAL MARKET FORECAST BY REGION 2017-2021



	Europe	North America	Asia	Latin America	Pacific	Middle East & Africa
2016	13.9	9.4	27.7	3.1	0.1	0.4
2017	14.0	10.3	28.9	3.8	0.6	1.8
2018	14.0	11.5	28.8	4.1	0.8	1.7
2019	14.5	12.2	30.1	5.0	0.8	2.1
2020	15.0	13.5	31.2	6.0	1.0	3.3
2021	16.0	14.0	34.5	6.0	1.5	3.3
Total 2017-2021	**73.5**	**61.5**	**153.5**	**24.9**	**4.7**	**12.2**

Source: GWEC

CUMULATIVE MARKET FORECAST BY REGION 2017-2021



	Europe	North America	Asia	Latin America	Pacific	Middle East & Africa
2016	161.3	97.6	203.6	15.3	5.0	3.9
2017	175.3	107.9	232.5	19.1	5.6	5.7
2018	189.3	119.4	261.3	23.2	6.4	7.4
2019	203.8	131.6	291.4	28.2	7.2	9.5
2020	218.8	145.1	322.6	34.2	8.2	12.8
2021	234.8	159.1	357.1	40.2	9.7	16.1

Source: GWEC

and we expect the initial buildout from last year's auction in Morocco to begin this year, and carry on through 2020. There is also a pipeline of projects in Ethiopia which we expect to at least begin construction this year; and we hope that the bottlenecks will be removed in Egypt so that country can begin to fulfill its potential as well as government targets. Overall, we expect just over 12 GW to be installed in the Africa and Middle East region over the coming five years out to 2021.

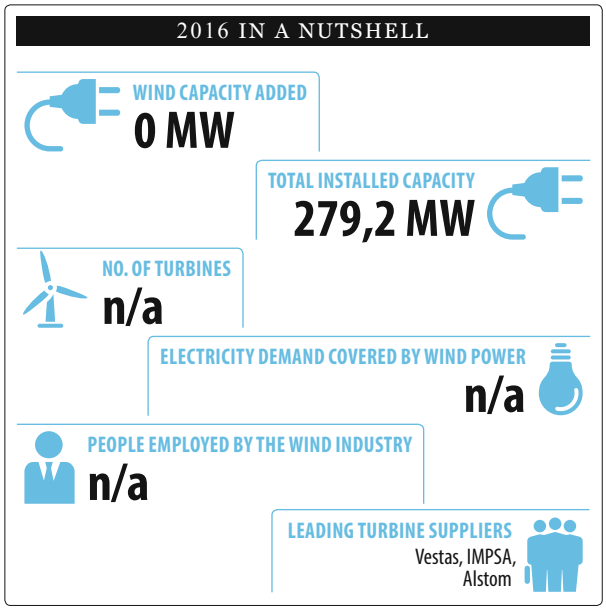
Pacific

After a very quiet 2016 where the only installations were 140 MW in Australia, we expect that an increase in policy stability in that major market will lead to an increase in the Pacific for the next several years. With the clarification of Australia's MRET (Mandatory Renewable Energy Target) in 2016, increased investment has led to a pipeline of more than 1,500 MW of new

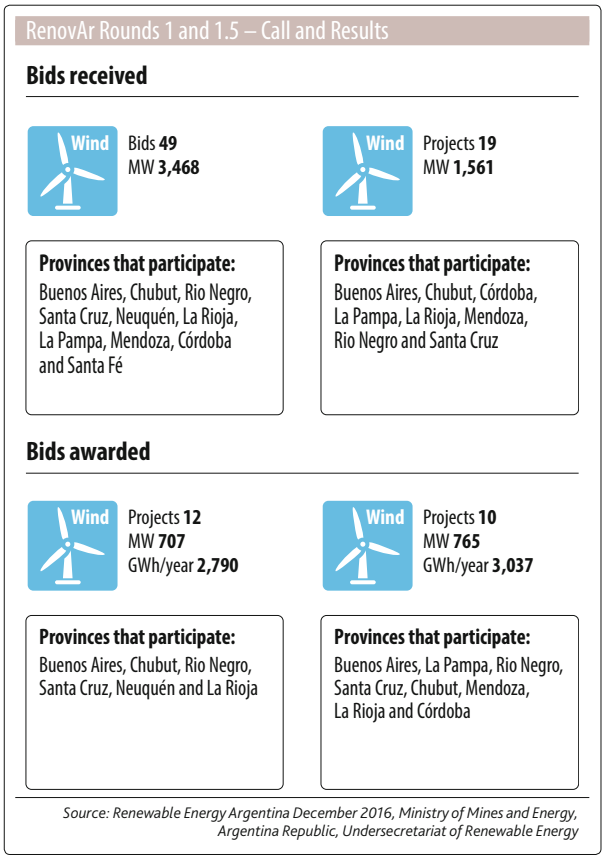
wind projects either under construction or with construction expected to begin this year.

We don't see much activity in the rest of the region in the near future, and Australia will be the main market driver leading to the installations of about 4.7 GW in the Pacific region in the period out to 2021.

In conclusion, these are our expectations for the next five years, as we see it at the end of March 2017. No doubt we will have both positive and negative surprises (there always are), but we have a lot of confidence in the wind power market going forward, as the technology continues to improve, prices continue to go down and the call for clean, renewable power to reduce emissions, clean our air and create new jobs and new industries only gets stronger with each passing year. We'll re-visit these numbers in 2018 to see how accurate we were (or not), and explore the reasons why.



ARGENTINA



After a number of false starts over the last two decades, Argentina stands out as the leading breakthrough market in 2016. At the beginning of the year, there was nothing but the promises of the newly elected government. By the end of the year there was a solid pipeline of more than 1.4 GW of new wind power, out of a total of more than 2.4 GW of winning bids for renewable power in two rounds of tenders in 2016. These projects will be built out over the next two years, with another auction to come later in 2017.

Argentina has huge wind power potential. Around 70 % of the country, the world's eighth largest by area, is suitable for wind power development. One estimate in the 1990s suggested that Argentinian wind could supply the power needs of the entire South American continent seven times over. The best sites are located in the southern part of the country, particularly in central and southern Patagonia.

Despite these excellent resources, previous attempts to develop Argentina's renewables sector have failed due to poor design, lack of political support, and investor wariness due the high-risk economic environment under previous governments. A law for the promotion of renewable energy was adopted in 2006 with a target set at 8% by 2016, but it took the government three years to publish the details of the law. In addition, in 2009 the GENREN programme was initiated, which called for the state utility ENARSA to contract at least 1 GW of renewable energy capacity to be sold into the grid at fixed rates for a period of 15 years. However, difficult macroeconomic conditions in Argentina left investors struggling to secure financing, and in the end international financial institutions declined to participate in the projects due to the high degree of risk.

Only 188 MW of wind was built under the 2006 law, bringing the country's current total installed capacity to 279 MW, compared with 1,424 MW in neighbouring Chile, 1,210 MW in Uruguay and more than 10.7 GW in Brazil.

But things are rapidly changing. From being a net energy exporter, mismanagement has turned the country into a large energy importer, costing the Treasury billions annually in foreign exchange. This has led the new government to establish a framework for the rapid scale-up of renewable energy as a matter of urgency.

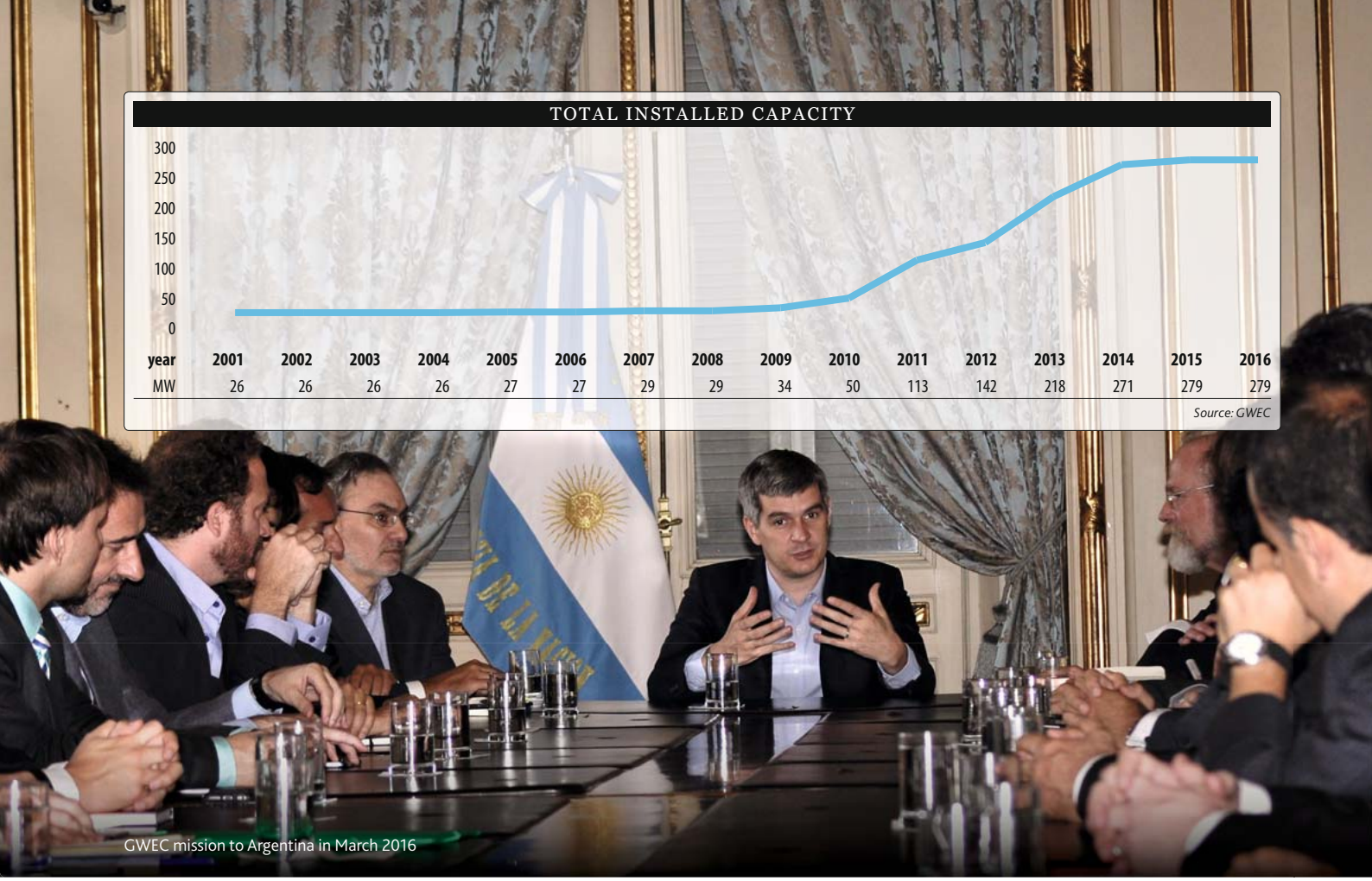
NEW POLICY DEVELOPMENTS

President Macri has made renewable energy one of his main priorities since taking office in December 2015. The stage was set with the passage of the law *Act 27,191* in late 2015, which sets targets for the use of renewables at 8% by 2017 and 20% by 2025. In order to meet the targets, installed renewable energy capacity must increase to at least 10 GW, up from 800 MW today. In terms of annual installations, this translates into 1 to 1.5 GW of new wind power capacity per year.

Furthermore, in 2016, the government passed secondary legislation, *Decree 531/16 and 882/16,* to facilitate meeting the targets by purchasing electricity from distribution utilities and/or directly from the wholesale electricity market administrator (CAMMESA). In the case of large users, this compliance can also be achieved through corporate PPAs in the private market (either directly with IPPs or with power traders) or through self-generation projects. Detailed regulations for PPAs and self-generation projects are expected to be released in the first half of 2017.

WIND MARKET IN 2016

In May 2016, the Argentinian government launched the RenovAr programme to boost investment in the renewable



GWEC mission to Argentina in March 2016

energy sector. RenovAr consists of a series of fiscal incentives and financial support mechanisms, along with regulatory and contractual rules aimed at overcoming some of the investment barriers that resulted in the failure of previous government attempts to kick-start the renewables market.

During 2016, 2.4 GW of renewable energy projects were awarded under Rounds 1 and 1.5 of the RenovAr programme. Additionally, 0.5 GW of legacy projects were reconverted to the new legal and contractual framework.

Under RenovAr round 1, twelve wind projects were awarded up to 707 MW at USD 59.4/MWh; and under the RenovAr round 1.5, ten wind projects adding up to 765.4 MW were awarded with an average price of USD 53.34/MWh.

The round 1.5 projects are expected to generate just over 4 TWh/year when they come on line in mid-2019, and combined with the 1,109 MW (700 MW of wind) from the round 1 auction, will generate about 7% of the country's electricity demand, well on the way towards meeting the 20% by 2025 target.

While no new wind capacity was installed in 2016, the bid-winning projects are expected come online over the next 18 to 36 months. The government continues preparing successive rounds of the RenovAr programme paving the way for a round 2 tender to be launched in 2017. The private PPA market as well as self-generation and distributed renewables are set to become important additional drivers to achieve the government's targets.

Projects are currently being developed in the proximity of the main nodes of the transmission system in the provinces of Buenos Aires, La Pampa, Río Negro, Santa Cruz, Chubut, Mendoza, La Rioja and Córdoba.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

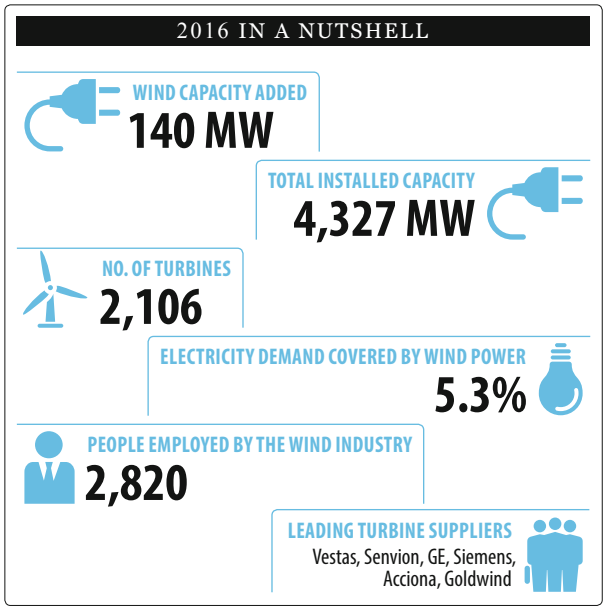
Financing and grid infrastructure development will be the challenges faced by the Argentinian wind market in the coming years. While the new government has made a good start at implementing (sometimes unpopular) structural economic reforms, there is still a long way to go to fully restore investor confidence in the market, and the electricity system is also in need of a complete economic overhaul. While the grid is probably sufficient to absorb the projects tendered so far, if progress is to continue, major infrastructure investments will be necessary. However, the government has moved rapidly to address these issues and the signs so far are very positive.

OUTLOOK FOR 2017 AND BEYOND

Argentina is the third largest power market in Latin America after Brazil and Mexico. More than 60% of Argentina's energy capacity comes from fossil fuels, with only 800 MW of renewables capacity. However, that is set to triple in the next 2 years, and proceed from there.

With a government strongly committed to renewable energy, if all goes to plan Argentina has what it takes to become a major wind and renewables market, strengthening its economy, lowering the cost of electricity and creating new industries and thousands of new jobs.

With input from Undersecretariat of Renewable Energy, Ministry of Mining and Energy, Argentina



AUSTRALIA

2016 began as a quiet year for wind energy in Australia, with past policy uncertainty impacting the industry and hampering new investment. However, the second half of 2016 proved far more promising.

The most significant policy development was the finalisation of the revisions to the federal *Renewable Energy Target* (RET), which faced a long period of uncertainty due to unfavourable government perspectives. With renewed confidence, the future of wind energy in Australia is encouraging, and the second half of 2016 saw investor interest return and grow.

State policy also encouraged growth in 2016, with state-based renewable energy targets being implemented in the Australian Capital Territory (ACT), Victoria and Queensland, sometimes building on the federal target. Increased efficiency and improved technology is also expanding the potential of sites that were previously considered on the margins.

WIND MARKET IN 2016

Only three wind farms were commissioned in 2016, adding 140 MW of new capacity to the existing fleet. Wind power contributed 5.3% of Australia's total generation for the year. The Australian Bureau of Statistics reported that the Australian wind industry created 620 new jobs in the year from July 2015 to July 2016.

Most of the electricity generation in Australia is connected to the National Electricity Market (NEM), which connects the eastern states of Australia, plus South Australia and Tasmania. Governance organisations for the NEM are the Australian Energy Market Commission (AEMC), which sets market rules, and the Australian Energy Market Operator (AEMO), which operates the market. The state of Western Australia has its own electricity market and grid, called the South West Interconnected System (SWIS).

Installed wind capacity by state

State	Installed capacity (MW)
South Australia	1,595
Victoria	1,250
New South Wales	668
Western Australia	491
Tasmania	310
Queensland	13
Total:	**4,327**

Source: Clean Energy Council

LATEST POLICY DEVELOPMENTS

The newly revised RET saw wind energy investment return in 2016, and strong growth is now expected in the coming years. The revised RET has legislated a target of 33,000 GWh per year to come from renewable energy from 2020 onwards. The target is not technology banded. While wind will be a large contributor to the target, large-scale solar has become more competitive and can deploy more rapidly. The competition between these technologies may limit the contribution of wind to the target.

There were several other significant policy developments from state governments in 2016 that reinforced support for the sector.

The Victorian Government established a state *Renewable Energy Target*, supported by an auction scheme to be implemented during 2017, which allows for potential new generators to compete for government finance by offering bids of low cost generation and greatest value for money. Its aim is to meet 25% and 40% capacity contributions from renewables by 2020 and 2025 respectively. It is expected that wind energy will be the dominant contributor to this scheme.

The ACT Government also has a goal of sourcing 100% of its electricity from renewables by 2020, with the Queensland Government announcing an aspirational target of 50% renewables by 2030. The policy leadership by these states is partly a result of the uncertainty created by a lack of Federal Government leadership on carbon pricing or a long-term energy policy, with the entire energy sector navigating a highly partisan federal political environment.

Changes to project planning requirements that clarify visual and noise amenity guidelines in New South Wales have also provided a major clarification for the sector to move forward.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

Assessing public support and acceptance of wind farms in Australia is still on the political radar, with the National Wind Farm Commissioner and Independent Scientific Panel having done work in 2016 to investigate community complaints around wind farm noise, health and planning processes. The Commissioner reports directly to the Minister for the Environment and Energy, and is expected to table a report for 2016 to a Senate Select Committee on Wind Farms in 2017.

year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MW	73	105	198	380	708	817	824	1,306	1,712	1,990	2,226	2,584	3,239	3,807	4,187	4,327

Source: GWEC

© Vestas

Wind farms have faced strong public scrutiny after a state-wide blackout event in September 2016 occurred in South Australia, the state with the highest wind energy penetration in Australia. The closure of its only coal plant in May 2016, and major failings in Australia's east coast gas market that have led to significant price increases, have thrown the wind and renewable energy sector into the political spotlight. Since then, several significant technical reviews have commenced to investigate varying components of the energy supply sector, each having an impact on wind and renewable energy.

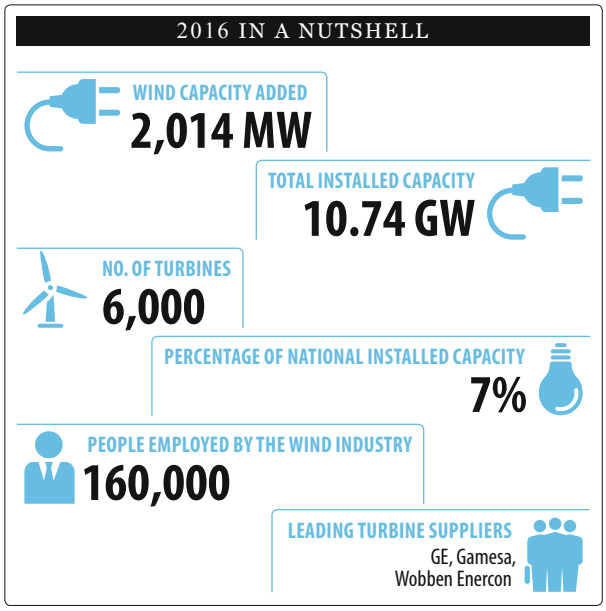
In the existing policy environment, another major concern is the lack of an incentive beyond the federal 2020 target (no increases in the years beyond 2020). There is an ongoing policy debate on the appropriate emission abatement mechanisms needed beyond 2020 in order to achieve Australia's 2030 Paris Treaty commitment of a 26-28% reduction from 2005 levels.

There has also been on-going discussion amongst generator operators, developers and governing bodies around the challenges Australian wind farms face when connecting to the National Electricity Market. This challenge will be emphasised as fossil fuel generators continue to age, face increased operating costs and possible carbon constraints, and close their operations in the coming years.

OUTLOOK FOR 2017 AND BEYOND

The Clean Energy Council is expecting a big year for the wind industry in 2017, with major announcements of new projects, projects commencing and finance flowing well. Policy certainty has resulted in a pipeline of more than 1,505 MW either under construction or starting in 2017, and is expected to create over 1,400 jobs. This activity, combined with significant cost reductions for both renewable technologies and deployment capability, shows the response of investors. Major policy and market reviews will be completed in 2017 with an aim to provide state and federal governments with guidance. The development of a long-term energy policy will be essential for maintaining these positive investment trends in future years.

With input from the Clean Energy Council, CEC, Australia



BRAZIL

2016 was an important year for the Brazilian wind industry, with installations passing the 10 GW milestone. Although the country was faced with political and economic crises, the wind industry maintained its solid growth thanks to installations and production coming from projects that were contracted in auctions and the free market during previous years. At the end of 2016, Brazil's cumulative wind power capacity totalled 10.74 GW, accounting for 7% of national generation capacity. The Brazilian electricity mix combines renewable and thermal power sources, with the lion's share (61.2%) coming from hydro power.

Brazil has some of the best wind resources in the world, exceeding the country's current electricity needs three times over. This year Brazil's wind generation record was broken by producing 11.8% of national electricity demand on 2 October, showing the excellent operational performance of wind power in Brazil.

WIND MARKET IN 2016

In 2016, Brazil added 2,014 MW of new wind power capacity, installing 947 wind turbines across 81 wind farms, and creating 30,000 new jobs, with multiple benefits for the Brazilian economy. This represented an investment of USD 5.4 billion, accounting for 78% of the total investment in clean energy in Brazil[1]. The key investors in the Brazilian wind market were Casa dos Ventos with 22% share, followed by CPFL Renováveis, Brazil Energy & Sequoia Capital, Rio Energy and EDP Renováveis Brasil.

Brazil's wind capacity stood at 10.74 GW at the end of 2016, representing a total investment of BRL 70 billion (EUR 21.5/ USD 22.8 bn). The sector employs 160 000 people, supplies electricity to about 17 million homes, and reduces CO_2 emissions by about 16 million tons per year.

1 Bloomberg New Energy Finance

Installed capacity by state at the end of 2016 (MW)

State	Installed capacity	Number of wind farms
Rio Grande do Norte	3,420	125
Bahia	1,898	73
Ceará	1,789	68
Rio Grande do Sul	1,695	72
Piauí	915	33
Pernambuco	651	29
Santa Catarina	239	14
Paraíba	69	13
Sergipe	35	1
Rio de Janeiro	28	1
Paraná	3	1
Total	**10,742**	**430**

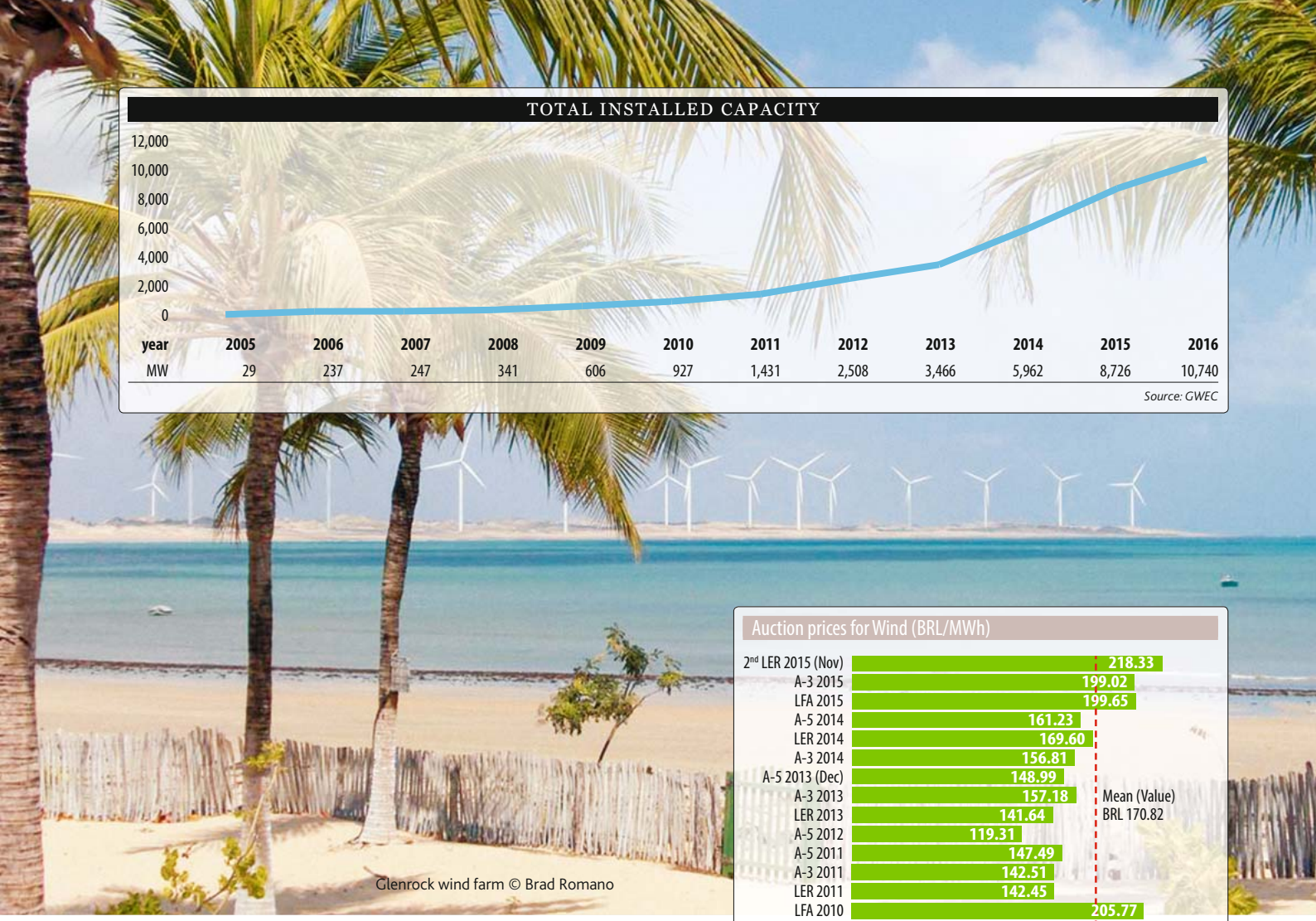
The leading market players in the Brazilian wind market are CPFL Renováveis, Eletrosul, Renova, Cubico and Contour Global, accounting for 37% (4 GW) of the total capacity. The top three manufacturers, accounting for over 50% of the total market share were GE, Gamesa and Wobben Enercon.

An important financing development occurred in 2016 when the National Development Bank (BNDES), responsible for financing practically all major infrastructure projects in Brazil, reinforced its position to give priority to renewable energy projects. For wind power, the bank maintained existing conditions; however, they were put on hold for a while due to the financial crisis in the country. Importantly, the bank has announced its intention to solve the delay in releasing funds, which has forced investors to look for short-term financing elsewhere.

While the Brazilian wind market continues to grow, the sector faces severe challenges due to the economic crisis and reduced electricity demand. 2016 was the first year without any auctions for wind power since 2009, and this will have an impact on the industry for years to come; and from 2019 to 2020 the annual goal of 2 GW will not be met. The wind industry was taken by surprise in December, when the 2nd Reserve Energy Auction (2nd LER 2016) was cancelled. The government justified the cancellation due to the lack of demand. However, the Brazilian Wind Energy Association (ABEEólica) disagrees with this for the following reasons:

- The cancellation of the auction means that no competitive energy reserves will be available when the economy starts growing again. This may require using more expensive thermal energy.
- Auctions for reserve energy are part of the government's strategic planning. The cancellation of the auction is not in line with the government's aim for getting the economy back on a growth track. Additionally, planning based on energy security is even more important now, while the government has an intense agenda to promote renewed growth, which involves new investments in infrastructure. The reserve auction for wind power is essential for the economic recovery of the country.

There is a problem with excess 'supply' within the system, i.e., capacity which has been contracted but which will not be built. To address this, the government is looking for ways to deal with this problem.



Glenrock wind farm © Brad Romano

TOTAL INSTALLED CAPACITY

year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MW	29	237	247	341	606	927	1,431	2,508	3,466	5,962	8,726	10,740

Source: GWEC

Auction prices for Wind (BRL/MWh)

Source: ABEEólica

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

Lack of demand, insufficient transmission lines and financing are the key barriers to wind energy development today in Brazil. Lack of demand is a direct consequence of the economic crisis and should be solved when the economy starts growing again. Overcoming these barriers is the core of ABEEólica's working agenda for 2017.

OUTLOOK FOR 2017 AND BEYOND

2017 will be a challenging year:

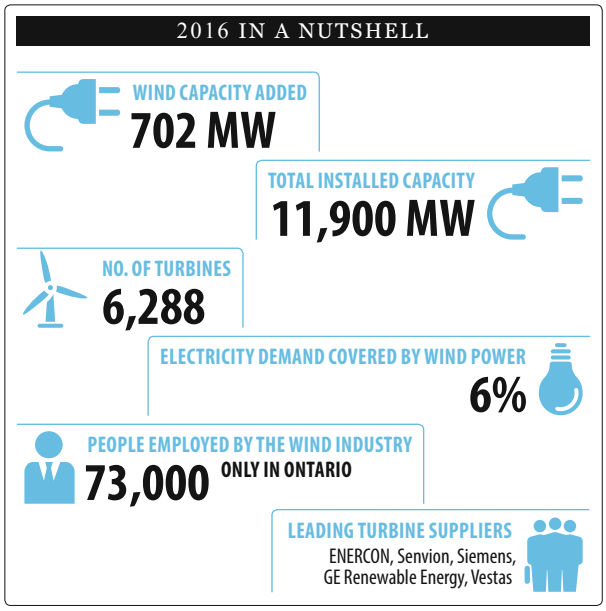
1. Demand - the situation with *excess energy* is overestimated and would rapidly disappear in the event of a poor year for hydropower, or even with a slight economic recovery. Wind energy has become a fundamental part of the Brazilian energy system during the past few years and the industry has put in place a mature supply chain which has attracted serious investments. Keeping up the volume of 2 GW of wind energy per year is fundamental for maintaining the newly installed supply chain. This is also essential for achieving the climate goals which Brazil committed to when signing the Paris Agreement.

2. Transmission - Lack of sufficient transmission lines in the areas with most wind power potential has become a severe problem in Brazil. Three states - Rio Grande do Norte, Rio Grande do Sul and Bahia – all big investors in wind power, would not have been able to participate in the cancelled Reserve Auction (2016) because of lack of transmission capacity. Additional transmission lines are urgently needed to strengthen the system. ABEEólica has contracted an in-depth study to analyse the transmission system in Brazil which is expected to be published during early 2017.

3. Financing - BNDES has announced new financing rules for the energy sector. It intends to support low-impact renewable energy and maintain the conditions for wind energy. While this is good news, Brazil needs to also develop new forms of financing, and there are ongoing discussions about private banks being more involved in financing the infrastructure sector.

Finally, the outlook for 2017 looks promising with expectations to install +2 GW by the end of the year. In 2017, the sector can still benefit from the results of auctions in previous years. The main concern is to overcome the current challenges to maintain a vibrant industry in the future.

With input from the Brazilian Wind Energy Association, ABEEólica



CANADA

WIND MARKET IN 2016

The Canadian wind energy industry added 702 MW of new wind energy capacity in three provinces in 2016. Ontario continued to lead the way in market size and growth, adding eight projects totalling 413 MW to bring its installed capacity to 4,781 MW. Quebec maintained its position as Canada's second largest wind market, adding three projects with a combined capacity of 249 MW to end 2016 with 3,510 MW of wind energy. Nova Scotia installed more projects than any other province in 2016, with ten new wind facilities totalling 39.5 MW coming on line.

Canada ended the year with 11,900 MW of installed wind energy capacity, supplying approximately 6% of the country's electricity demand, enough to power more than three million Canadian homes.

Source: CanWEA

More wind energy has been built in the last eleven years in Canada than any other source of new electricity supply, while over the past five years, the country's wind energy fleet has grown by an average of 18% a year. There are now 285 wind farms, made up of 6,288 turbines, operating across all ten provinces and two of the three northern territories.

There were five wind turbine manufacturers (OEMs) active in the 2016 market, led by Enercon with 35.6% of the total market, followed by Senvion with 35.3%. Siemens, GE Renewable Energy and Vestas also contributed. Ownership of new wind farms built in 2016 was marked by diversity. Major developers like Boralex, Invenergy Wind Canada, Capstone Infrastructure and Northland Power added to their operating portfolios, while the high level of local involvement in wind energy development that has been a feature of the Canadian market in recent years continued. Of the 21 projects completed last year, 16 had some degree of Aboriginal, municipal or local ownership.

NEW POLICY DEVELOPMENTS

Canada's wind industry saw important gains on the policy front in 2016 as federal and provincial governments took major steps down the path to a low-carbon future.

After unveiling its *Climate Leadership Plan* in late 2015, the Alberta government began implementing elements of the strategy in 2016. It passed the *Renewable Electricity Act* in December, which requires the province to supply 30% of its electricity needs from renewable energy sources by 2030 and establishes Alberta as the leading market for new wind energy investment in Canada. The target will drive installation of 5,000 MW of new renewable energy capacity – mostly wind – onto its grid over the next thirteen years, starting with a 400 MW request for proposals (RFP) in 2017.

In Saskatchewan, the government-owned utility SaskPower laid out its plan to add 1,600 MW of new wind to its grid by 2030, starting with a 200 MW RFP in 2017. The wind energy additions are part of a broader strategy that will double the percentage of renewable electricity generating capacity in the province within fifteen years, cutting electricity sector greenhouse gas emissions 40% below 2005 levels.

Quebec unveiled a new long-term energy policy in 2016 that sets the stage for wind energy to play a key role in the government's efforts to accelerate the transition to a decarbonised economy. Although it does not set specific targets for new wind energy development, the policy aims to increase renewable generation in the province by 25% and decrease fossil fuel use by 40% by 2030. An analysis by the Canadian Wind Energy Association (CanWEA) suggests that in order to meet these goals, Quebec will need at least 24 TWh a year of new renewable electricity supply by 2030 and will have to start procuring that energy as early as 2019. Quebec's new strategy also recognizes the opportunity to bundle wind with hydro for export, and with the US state of Massachusetts issuing an RFP for 9.45 TWh of new wind and hydro supply during the spring of 2017, producers in both Quebec and Atlantic Canada are positioning themselves to respond.

In Ontario, the government released a climate action plan in 2016 that charts a course towards the electrification of key sectors of the province's economy in order to meet its target of reducing greenhouse gas emissions 80% below 1990 levels by 2050.

TOTAL INSTALLED CAPACITY

year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MW	198	236	322	444	684	1,460	1,846	2,369	3,319	4,008	5,265	6,214	7,827	9,699	11,205	11,900

Source: GWEC

Turbines and Waterton Range west of Pincher Creek © BP

Although electricity policy falls largely under the jurisdiction of provincial governments in Canada, the federal government made a number of policy decisions in 2016 that will help carve out a growing role for zero-emissions energy sources like wind. It unveiled a plan for a national carbon price starting in 2018, and promised to phase out traditional coal-fired generation across the country by 2030. It also set a target of generating 90% of Canada's electricity from non-emitting sources by 2030, up from about 83% today, and committed to powering federal government operations with 100% renewable energy by 2025.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

Slow electricity demand growth, combined with electricity supply surpluses in the core markets of Ontario and Quebec, remains a near-term challenge as governments and utilities hold off on new procurement, despite the important role cost-effective wind energy can play in meeting their longer-term climate targets.

Transmission is becoming an increasingly important issue, especially as governments look to facilitate trade in clean electricity across provincial boundaries and into the US. New infrastructure spending needs to prioritize the capture of Canada's vast wind energy resource, and ensure it can be integrated in a way that maximizes its emissions reduction and cost benefits.

OUTLOOK FOR 2017 AND BEYOND

The Canadian wind energy industry is looking forward to another good year in 2017, with about 700 MW of new capacity expected to come online.

New wind energy procurement in Alberta and Saskatchewan in 2017, coupled with the renewed focus on actions to transition to a low-carbon economy, mean that wind energy's growth prospects will remain strong in Canada for many years to come.

With input from the Canadian Wind Energy Association, CanWea

2016 IN A NUTSHELL

WIND CAPACITY ADDED
513 MW

TOTAL INSTALLED CAPACITY
1,424 MW

NO. OF TURBINES
n/a

ELECTRICITY DEMAND COVERED BY WIND POWER
3.1%

PEOPLE EMPLOYED BY THE WIND INDUSTRY
n/a

LEADING TURBINE SUPPLIERS
n/a

CHILE

WIND MARKET IN 2016

2016 was an exciting year for the renewable energy sector in Chile. For the wind industry it was a record year not only because of doubling the 2015 market and adding 513 MW of new wind power capacity to the grid, but also for creating a strong pipeline of projects for the future.

The highlight of the year was the country's largest ever power auction[1] held by Chile's Energy Ministry on 16 August, awarding nearly 4 GW of wind, solar and small hydro power projects for 20-year power purchase agreements (PPAs). Chile's National Energy Commission (CNE) revised its tendering rules for electricity supply tenders to attract new investments with the aim of increasing the competitiveness of renewables against conventional sources, and of reducing electricity prices in the country.

The renewables bids won more than half of the energy awarded in the auction. The tender winners have until 2021-22 to begin supplying electricity, which ensures a solid growth outlook for the Chilean wind market for the coming years.

The tender was hailed as a great success in lowering electricity prices and raising competitiveness in the market, with an average price of USD 47.6/MWh (EUR 44.6/MWh), considering that only two years ago the country had some of the highest wholesale electricity prices, and PPAs awarded in previous tenders went for as much as USD 120/MWh (EUR 112.4 MWh). This massive reduction in prices is the result of large number of bids placed by new international market players, as opposed to previous tenders, which were dominated by a few domestic players.

Wind power projects won 39% of the energy contracts tendered in the auction. The wind industry is expecting an increase in efficiency due to improved performance of turbines, competitive prices and better financing opportunities, and is now in a better position to face some of the challenges which are likely to be brought by new regulatory changes affecting the sector.

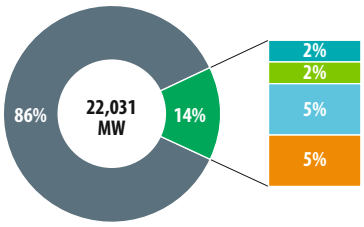
A new tender[2] to cover electricity demand in the country during the period of 2023-2032 was already announced by the National Energy Commission in December 2016. The tender will be held in the course of 2017 and about 4.2 TWh/annum is expected to be awarded for 20-year power purchase agreements beginning in 2023.

Additionally, another series of tenders was announced by the Ministry of Energy, to be carried out in 2017 for 7.2 TWh/annum

Installed capacity for electricity generation in Chile

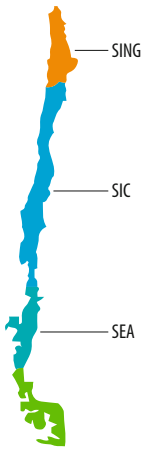
At the end of 2016, the Non-Conventional Renewable Energy (NCRE) installed capacity reached a total of 2,975MW, representing 14% of the total. Of this 89.4% are connected to the Central Energy System (SIC), 9.7% in the Northern Energy System (SING) and the remaining 0.9% in the the Aysen Energy System (SEA) in southern Chile.

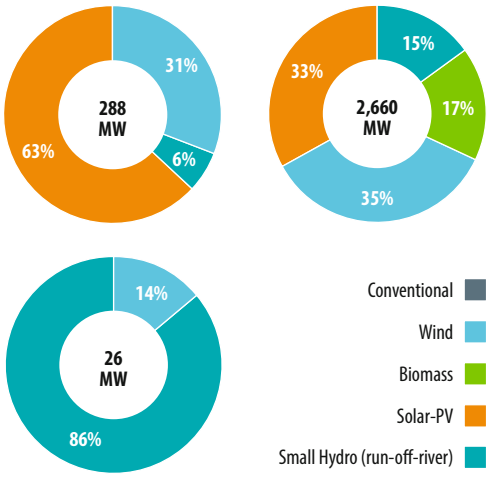
NCRE Break Down by Technology



*There are additionally 27 power plants in test phase – all synchorinised with their own electricity system, reaching a total of 824MW.

NCRE installed capacity





Source: CDEC-SIC/CDED-SING, CNE

1 Licitación Pública Nacional e Internacional para el Suministro de Potencia y Energía Eléctrica para abastecer los consumos de clientes sometidos a regulación de precios (Licitación de Suministro 2015/01)

2 Licitatión de Suministro 2017/01

with delivery dates in 2024, and in 2018 for 8.9 TWh/annum for delivery in 2025.

NEW POLICY DEVELOPMENTS

Chile has a target to generate 20% of its electricity from renewable sources by 2025, up from about 14% today. This target was set by *Law 20/25* which was adopted in 2013 and replaced a previous target of 10% of RE electricity by 2024. The government has not set any technology specific targets.

Since the adoption of the 20/25 Energy Law, Chile's energy agenda has shifted: The government's new regulation establishing the necessary conditions for renewables uptake allows variable energy sources to compete on a level playing field with conventional technologies.

Chile's main support scheme for renewable electricity is a quota obligation. The 2008 Non-Conventional Renewable Energy Law *(Law 20257)* set an initial quota of 5% renewable electricity in 2014 to be increased by 0.5% yearly increments until 2024. The quota applies to all electricity sales and has a non-compliance penalty of USD 32/MWh (EUR 30.2/MWh), which can go up to USD 47/MWh (EUR 44.3/MWh) after three years of non-compliance. In 2013, the new *Law 20/25* increased the quota (for contracts signed after July 2013) to 5% in 2013, with yearly increments of 1% until reaching 12% in 2020. Thereafter, yearly increments of 1.5% would bring the quota up to 18% in 2024, followed by a 2% increase to reach 20% in 2025.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

An inadequate national transmission system is currently one of the key challenges for wind power development in Chile. Although the government is working to address this issue and some new grid capacity is being built, the country urgently needs a long-term national expansion plan to eliminate increasing restrictions in the energy injection and transmission capabilities of the grid.

The lack of an efficient carbon tax is another barrier for the sector. The current carbon tax is set at USD 5/ton CO_2 (EUR 4.7/ton CO_2). While this price is too low, there are also cases where thermoelectric generators are allowed to pass the future increases of this tax on to their customers, making the system ineffective in reducing emissions.

OUTLOOK FOR 2017 AND BEYOND

In 2016, the wind industry obtained strong results from the 2015/1 energy auction, winning contracts for 6000 GWh/year under PPAs for the period of 20 years, beginning in 2021. Considering the strong pipeline of projects of 6,893 MW already approved and 2,117 MW under approval by the environmental authoriy, the Chilean wind industry expects a steady annual growth of 400-500 MW for the coming years.

With input from the Chilean Renewable Energy Association, ACERA

2016 IN A NUTSHELL

WIND CAPACITY ADDED
23,370 MW

TOTAL INSTALLED CAPACITY
168,732 MW

NO. OF TURBINES
104,934

ELECTRICITY DEMAND COVERED BY WIND POWER
4%

PEOPLE EMPLOYED BY THE WIND INDUSTRY
507,000

LEADING TURBINE SUPPLIERS
Goldwind, Envision, Ming Yang

PR CHINA

WIND MARKET IN 2016

China led the global wind market for the eighth consecutive year by adding 23,370 MW of new capacity to the country's electricity grid. This brings China's cumulative installations to 168,732 MW, representing 35% of the global total. Electricity produced from wind power reached 241 TWh, a 30% increase from the previous year, enough to produce 4% of the national electricity supply.

China's installations were down 24% from 2015's spectacular 30 GW, which was driven by impending feed-in tariff reductions. Also, Chinese electricity demand growth is slackening, and the grid is unable to handle the volume of new wind capacity additions. However, the market is expected to pick up again in 2017. The Chinese offshore market also began what many hope is the sector's long awaited take-off in 2016, with China passing Denmark to achieve 3rd place in the global offshore rankings, after the UK and Germany.

Goldwind continued to dominate the Chinese market with 27% of the total annual market, followed by Envision and Mingyang. The top three manufacturers accounted for 44.1% of the total market.

Key players in the Chinese wind market in 2016

	Manufacturer	MW	Market share
1	Goldwind	6,343	27.1%
2	Envision	2,003	8.6%
3	Mingyang	1,959	8.4%
4	Guodian United Power	1,908	8.2%
5	CSIC	1,827	7.8%
6	Shanghai Electric	1,727	7.4%
7	XEMC	1,236	5.3%
8	DongFang	1,227	5.2%
9	Windey	724	3.1%
10	Huachuang	715	3.1%
Total		**19,669**	**83%**

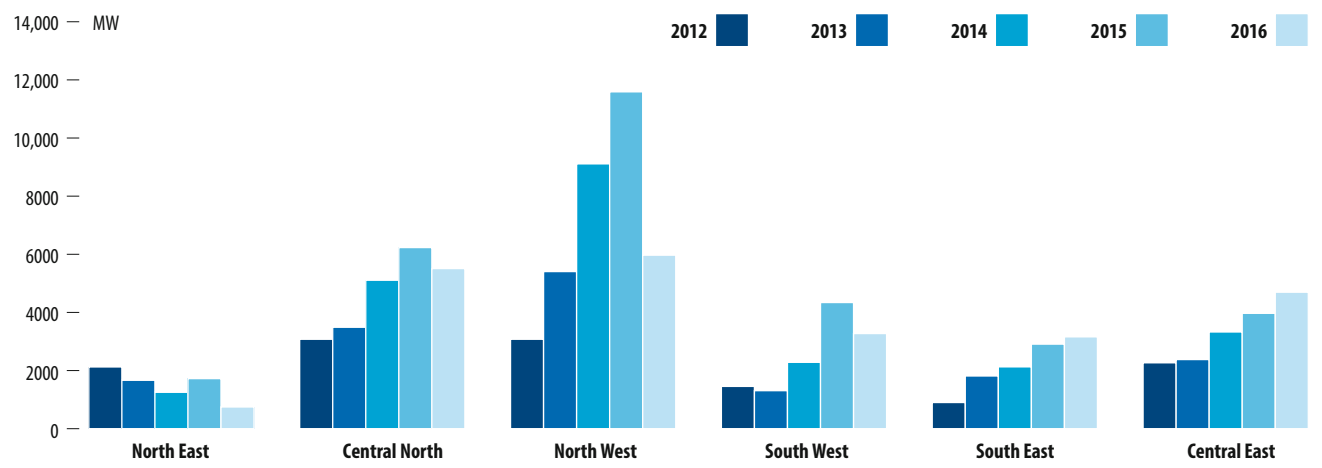
The leading foreign manufacturers were Vestas with 610 MW, followed by Gamesa with 498 MW and GE with 205 MW, ranking 12th, 13th and 19th with a market share of 2.2%, 2.1% and 0.9% respectively.

LATEST POLICY DEVELOPMENTS

The 13th Five-Year Plan

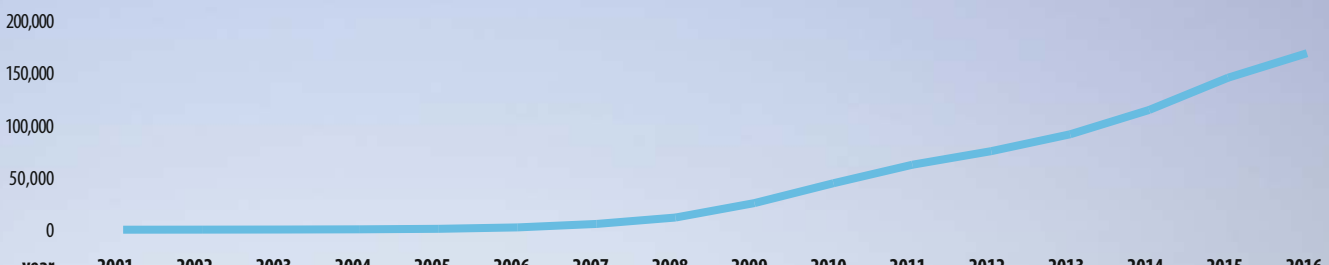
The 13th Five-Year Energy Plan (FYP) was released by the National Energy Administration (NEA) towards the end of 2016. This is the framework legislation defining energy development in China for the period from 2016-2020.

Installed capacity by region 2012-2016



Source: Chinese Wind Energy Association, CWEA

TOTAL INSTALLED CAPACITY



year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MW	404	470	568	765	1,250	2,599	5,910	12,020	25,805	44,733	62,364	75,324	91,413	114,609	145,362	168,732

Source: GWEC

In the new Energy FYP, the major change is the contrast between promotion of renewables and the control over coal development. Non-fossil energy sources will account for over 15% of the total energy consumption, while coal consumption will be lowered to below 55%, down from 65% in 2015. To reach the 15% target, the share of renewables will need to go up by 3% during the five year period to 2020. In the previous FYP, the increase was 2.6% to bring the total from 9.4% in 2010 to 12% in 2015. This is the backbone for renewables development in China, reflecting the commitment made in the Paris Agreement.

According to the 13th FYP, by 2020, total RE electricity installations will reach 770 GW, up 250 GW from 2015, representing an increase of 31%. The target for wind power is at least 210 GW by 2020, with electricity production of 420 TWh and 6% of total power production. Offshore has a target of 5 GW by 2020. This translates into at least 79 GW of new wind power, representing about 30% of all installations planned for the renewables sector.

Solving the curtailment issue is also a prime focus of the FYP. Solutions include increasing the share of natural gas, increasing HV DC/AC long distance lines, and increasing the use of RE heating systems and pumped storage.

Regional development

A significant change in the regional distribution of wind projects took place in 2016. For the first time, wind installations in the Southern and Eastern regions increased substantially, reaching almost the level of the Three Northern regions, which have traditionally led wind development, accounting for 72% of installations in the past decade.

The decline was most dramatic in the Northwest region, which only accounted for 26% of 2016's installations, down from 38% in 2015, and from nearly 40% in 2014.

To better address the curtailment issue, the development of wind in the Central and Eastern regions is prioritized in the

13th FYP over that in the Northern and Western regions. Newly added capacity in the Central Southern regions, with generally lower levels of curtailment, have a target of an additional 42 GW by 2020, larger than the additional 35 GW target for the Three Northern regions. This will make the Central and Southern regions the new engines of wind development in the next five years, which is opposite to the development path in the past decade. The Three Northern regions will have the next five years to find a solution to their curtailment problems.

Feed-in tariff or the green certificate system?

The feed-in tariff, which was introduced in 2009, has been the key driver for wind development in China. The four-category FIT structure is based on four levels of wind resources and is paid for 20 years to ensure a long-term, steady revenue stream.

The FIT has been financed through an RE surcharge, which is added to each kWh of electricity produced. The surcharge is then put into an RE Fund dedicated to finance the FIT and other activities related to renewables. According to the law, all RE project owners are entitled to the feed-in tariff. In practice, however, when electricity is fed into the grid, project developers usually get only part of the FIT, equivalent to the local coal tariff, and the rest of the FIT is reimbursed at a later stage, usually in a lump-sum.

This was not an issue earlier, when the level of wind development was still modest and the RE Fund was big enough to support the nascent wind industry; the delays in payments were expected and were built into the industry's planning. However, since 2012, the delays have become longer, and the premiums (difference between the FIT and local coal fire tariff) were paid only on an annual basis, and sometimes not at all due to the depletion of the RE Fund and the unprecedented growth of the wind and solar power sectors.

The surcharge has been increased several times in the past ten years, from RMB 0.2 cents/kWh (EUR 0.027/USD 0.029 cents/kWh) in 2009 to RMB 19 cents/kWh (EUR 2.56/USD 2.75 cents/ kWh) in 2016. However, according to the Ministry of Finance, the accumulated deficit of the RE Fund was estimated at 5.5 billion RMB (EUR 740/USD 800 mn) in mid-2016.

With wind installations topping 23 GW along with solar PV's record-breaking 34 GW in 2016, the RE fund is under increasing pressure to sort out the feed-in tariff payments. Meanwhile, the National Energy Administration (NEA) has planned to introduce green certificates as a solution, and finally as a replacement for the FIT.

However, an aggressive Renewable Energy Portfolio (RPS) is a prerequisite for a nation-wide green certificate market, and it must be stringently enforced to ensure sufficient demand for the certificates. In China, the RPS has been discussed for a long time and is still not resolved, despite four years of negotiations with the various stakeholders.

Currently, the NEA is promoting the concept of green certificates, acknowledging that without an RPS it won't be a powerful tool, and trying to call for voluntary buyers among the industrial emitters and potential buyers from the public. If a critical mass of voluntary buyers can be gathered in this demonstration phase and enough experience is gained, it might be used as a showcase to prove that RPS enforcement can be achieved cost-effectively.

Overall, replacement of the FIT is being prepared and this has become the new consensus, despite the reluctance of the wind industry. This is also a signal for the industry to improve their technology and to further lower costs to reduce the reliance on subsidies and ultimately to reach grid parity. With the *energy transition* in the background, the RE industry has the opportunity to play a more significant role in the national energy system. At the same time, the challenges are also getting bigger, with the changes in the FIT system and uncertainty over if and how the new green certificate system will work.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

Grid curtailment remains the most critical challenge facing the wind industry in China. According to NEA, 49.7 TWh of wind electricity was curtailed in 2016, up 15.8 TWh from 2015. Curtailment remains shockingly high in Gansu (43%), Xinjiang (38%), Jilin (30%) and Inner Mongolia (21%), while the national average was at 17%. The high curtailment rate is eating up the profits that wind operators have gained from the decline of turbine prices. The electricity curtailed is almost equivalent to the electricity produced from all of the new installations in 2016.

© Vestas

The future of wind, and solar PV, largely depend on solving the problem with curtailment.

Another issue is the future of the feed-in tariff. The current proposal with the green certificate system replacing the FIT will only function if there is an aggressive and strictly enforced RPS along with a robust green certificate market.

OFFSHORE WIND POWER

New offshore wind installations accounted for 592 MW in 2016, up 64% from 2015, bringing the total to 1,627 MW. All new installations were near shore projects, not the inter-tidal projects that have previously dominated offshore development in China. The 13th Five-Year Plan sets a target of 5 GW by 2020 for offshore wind, together with a FIT of RMB 0.85/kWh (EUR 0.11/USD 0.12) for offshore/nearshore and RMB 0.75/kWh (EUR 0.10/USD 0.11) for intertidal projects. These tariffs are expected to provide the major driving force for the sector for the next five years.

Limited potential for onshore wind in the Northern and Western regions also helps push developers to move offshore, while the technology has steadily improved in the past few years, with some of the domestic manufacturers now developing bigger turbines to harness the wind offshore.

OUTLOOK FOR 2017 AND BEYOND

The industry has been trying to install as much as they could in the past two years, due to the FIT adjustments at the beginning of 2016 and 2018. However, a decline is expected after 2017.

Looking out to 2020, the major drivers for wind development are still in place. Nevertheless, curtailment puts a physical limit on installations in the most promising wind regions. This is expected to cause a definite slowdown for the industry in the next few years, which is maybe not such a bad thing, after so many hectic years of development. It remains to be seen how the industry will evolve with the shrinking market and increased competition, both in terms of domestic strategies and global expansion plans.

With input from the Chinese Wind Energy Association, CWEA and Chinese Renewable Energy Industry Association, CREIA

2016 IN A NUTSHELL

WIND CAPACITY ADDED
220 MW

TOTAL INSTALLED CAPACITY
5,228 MW

NO. OF TURBINES
6,131

ELECTRICITY DEMAND COVERED BY WIND POWER
37.6%

PEOPLE EMPLOYED BY THE WIND INDUSTRY
31,250

LEADING TURBINE SUPPLIERS
Vestas,
Siemens

DENMARK

WIND MARKET IN 2016

2016 was an average year for the wind power market in Denmark: 220 MW of new capacity was added onshore. This brought Denmark's cumulative wind capacity to 5,228 MW, of which 1,271 MW is offshore, accounting for 37.6% of Denmark's electricity needs. No new offshore wind was installed during the year.

However, the big story in 2016 was the cratering of offshore prices: the winning bid for the Danish Near Shore tender came in at DKK 475/MWh (EUR 64/USD 69 MWh), followed by the world's record low offshore price for the Krieger's Flak project at DKK 372 /MWh (EUR 49.90/USD 53 MWh).

An important political agreement was also concluded in 2016, scrapping the *Public Service Obligation* (PSO) tariff that has been financing renewable energy development in Denmark since 1998 and was tacked on to Danish resident's electricity bills. Now the government has published a memorandum, outlining a new finance plan for sustainable energy projects which is currently pending approval from the European Commission.

The Danish wind industry employs more than 30,000 people today. There are more than 6,000 wind turbines in Denmark and they are located in 78 out of 98 Danish municipalities. The top two players in terms of installed capacity in the Danish wind market in 2016 were: Vestas (81%) and Siemens (14%).

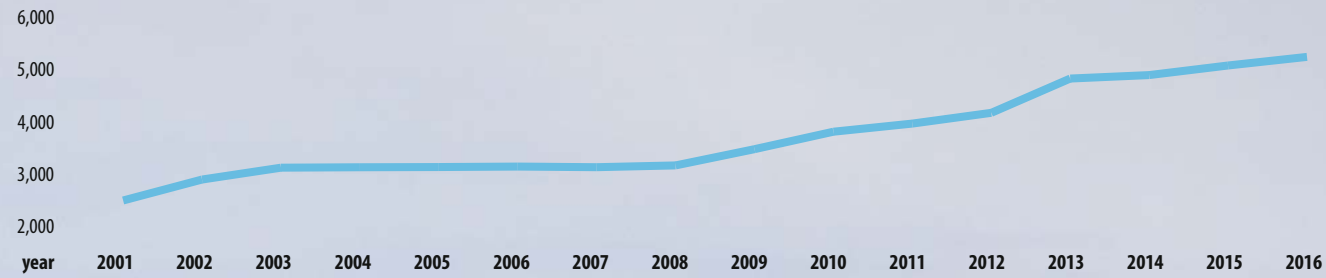
NEW POLICY DEVELOPMENTS

Denmark was one of the first countries to install wind turbines and has been a first mover in the wind industry for decades. Today, onshore and offshore wind turbines provide more than 37% of Denmark's electricity consumption – the highest level of wind energy integration in the world. The Danish government has set a goal to generate 50% of the country's electricity consumption by wind energy by 2021 and Denmark has an overall goal to be fully independent of fossil fuels by 2050.

An independent Energy Commission was established by the Danish government in 2016 to investigate how this vision can be realized in the long term. The Energy Commission will analyse the new developments in the energy sector and make recommendations for Danish energy policy from 2020 to 2030. The goal is to maintain Denmark's position as one of the leading countries in the green transition. The Energy Commission is expected to publish recommendations for Danish energy policy in early 2017.

Denmark's large-scale wind energy integration is made possible by a well-developed transmission infrastructure, capable of handling fluctuations. The Danish grid is connected to the neighbouring countries, allowing for the import and export of energy during peak periods. As Denmark continues to develop and expand a flexible and intelligent national power grid it will be possible to integrate even more wind energy in the system. In 2016, the annual record was broken on 15 October when 139% of Denmark's electricity needs were covered by wind power.

TOTAL INSTALLED CAPACITY



year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MW	2,489	2,889	3,115	3,123	3,127	3,136	3,124	3,158	3,468	3,801	3,956	4,161	4,815	4,881	5,064	5,228

Source: GWEC

Middelgrunden offshore wind farm in the Øresund 3.5 km outside Copenhagen, Denmark © GWEC

Offshore wind

The Danish ambition to cover 50% of the country's electricity consumption by wind by 2020 entails an offshore wind target of 1,500 MW. This includes the two tenders which were carried out in 2016 for the 600 MW Krieger's Flak offshore wind farm located in the Baltic Sea and the near shore tenders of 350 MW, which are split up into Vesterhav Syd and Vesterhav Nord, located in the North Sea. Additionally, the installation of the 400 MW Horns Rev 3 also located in the North Sea, will begin in 2017. Overall, Denmark is planning to install nearly 1,400 MW of offshore wind by 2021, more than doubling current capacity.

In 2017, the world's first offshore wind farm, Vindeby (5 MW) will be decommissioned. The Vindeby wind farm has played a crucial role in proving the case for offshore wind since it was installed in 1991.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

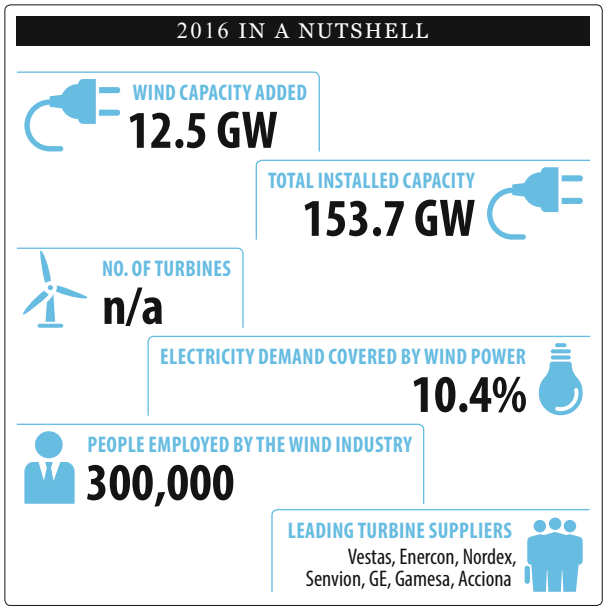
For onshore wind the time before 21 February 2018 when the current support scheme ends is pivotal. A new model for onshore wind needs to be approved by the EU Commission as well as by the Danish government before this date. A lot will also depend what the new energy agreement, including policy goals and measures out 2030, will mean for the sector.

From around 2018-2020 onwards, when the next wave of offshore wind farms will be grid connected and 50% of the Danish electricity consumption will be supplied by wind power, a new challenge will be to establish an adequate technical and regulatory framework for the continuation of the successful integration of wind power in the energy system, including the need for additional transmission lines to neighbouring countries and increased use of wind electricity in the district heating system.

OUTLOOK FOR 2017 AND BEYOND

Offshore wind development is expected to continue running smoothly with the target to install nearly 1,400 MW by 2021. For onshore wind power a lot will depend on the new support system taking effect in 2018.

With input from the Danish Wind Industry Association, DWIA



THE EUROPEAN UNION

WIND MARKET IN 2016

A total of 12.5 GW of new wind power capacity was installed and grid-connected in the EU during 2016, a decrease of 3% compared to 2015 annual installations. 10,923 MW were installed onshore, and 1,558 MW offshore. Germany was the largest market for new power capacity installations (44% of the total EU installations), with 5,443 MW of new capacity, 818 MW of which was offshore. France took second place with record installations of 1,560 MW, an increase of 45% on 2015. The Netherlands came third, also breaking its annual record, with 887 MW. The UK and Poland followed with 736 MW and 682 MW respectively. Overall, five EU countries had record years: France, the Netherlands, Finland, Ireland and Lithuania. Turkey also broke its record for annual new installation with 1.4 GW. Wind power installed more than any other form of power generation in Europe in 2016, accounting for 51% of total power capacity installations.

Cumulatively, there are now 153.7 GW of wind power capacity in the EU: 141.1 GW onshore and 12.6 GW offshore. With about 300 TWh of energy generated in 2016, wind power covered 10.4% of the EU's electricity demand.

Europe invested a total of EUR 27.5bn (USD 29bn) in wind energy, a 5% increase from 2015. This is largely due to investments in offshore wind, which increased by 39% on 2015. Onshore wind investments dropped to EUR 9.3bn (USD 9.8bn), the first decrease in the last five years. In total, there were 10.3 GW of new wind capacity financed in 2016.

Regulatory framework for wind energy

Within the European Union, the European Commission *Guidelines on State Aid for Environmental Protection and Energy* establish competitive market-based support schemes for Member States to meet their 2020 energy and climate targets. For wind energy, this means more exposure to wholesale power prices; for example, through feed-in-premiums rather than feed-in tariffs, and the roll out of competitive auctions.

In 2016, competitive auctions were already held in a number of EU Member States, including Denmark, Italy, Spain, UK and the Netherlands. While France and Germany should have their first auctions in 2017, some countries will maintain their old support schemes: green certificates will remain in Sweden and Belgium, and Finland will keep its feed-in-premium system until 2018.

NEW POLICY DEVELOPMENTS

The European Commission released its *Clean Energy Package* on 30 November 2016, outlining the post-2020 EU regulatory framework for renewable energy, the internal energy market, security of supply and energy efficiency. One of the key elements is the binding obligation of Member States to submit their 2030 national energy plans to meet the *at least* 27% RES target in final energy demand by January 2019. This includes linear national renewable energy deployment trajectories that will give good visibility on the upcoming pipeline of projects. For the first time, Member States will have to define at least a 3-year schedule (timing, capacity and budget) for the allocation of support to renewable energy.

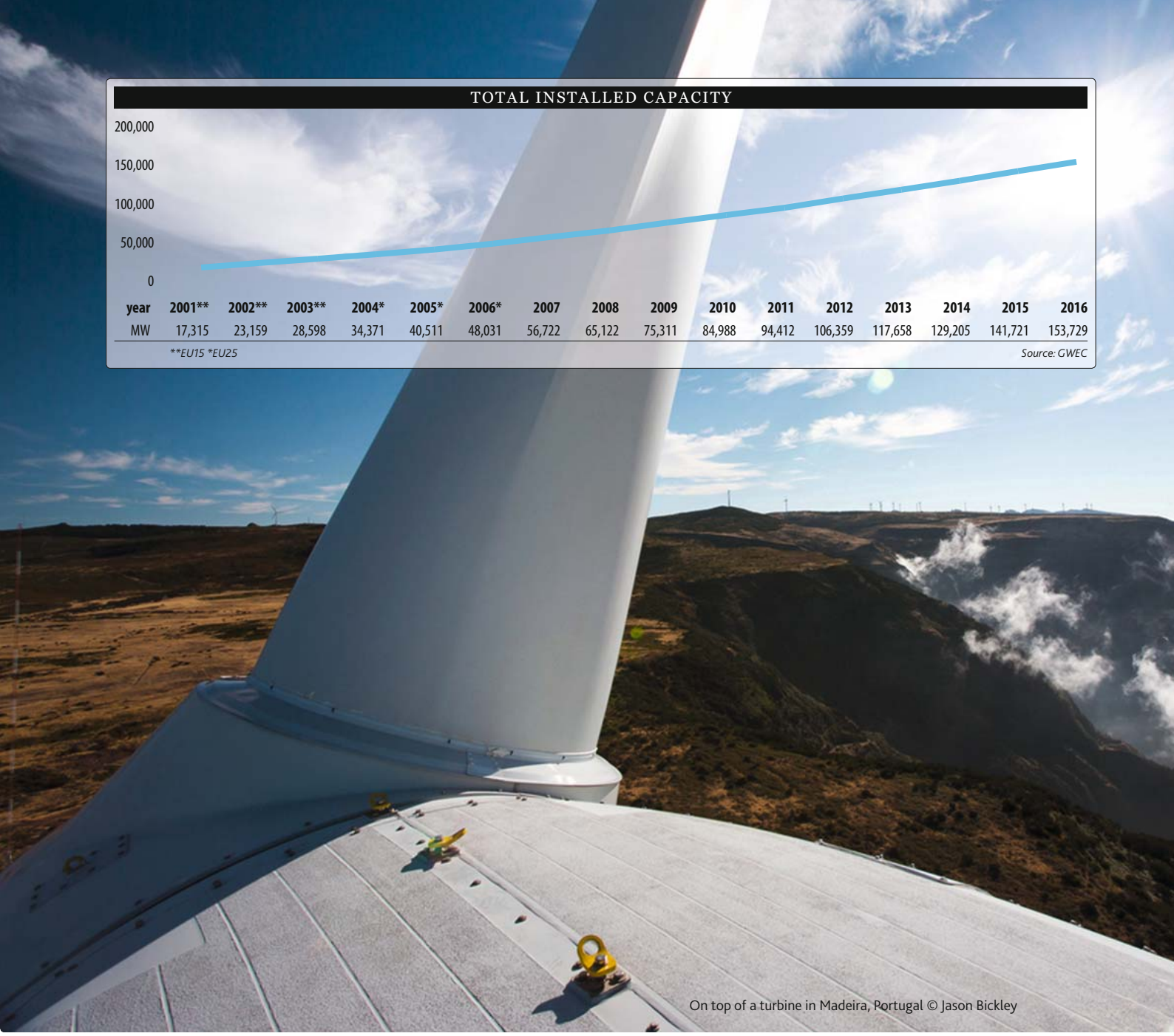
KEY BARRIERS TO WIND ENERGY DEVELOPMENT

Instability in legislation and retroactive changes are the main barriers to wind energy deployment in Europe. The lack of commitment in the post-2020 period for an even deployment of installations across Europe is particularly challenging. There are only 7 out 28 Member States with commitments and policies in place beyond 2020. The Clean Energy Package proposed by the European Commission is geared towards addressing these issues. However, until the package is adopted by the European Council and the European Parliament, the regulatory framework post-2020 remains uncertain. Negotiations on the legislation are foreseen to be finished by 2019 at the earliest.

The EU wind energy sector also suffers from long permitting and siting procedures in some countries due to potentially adverse interaction with civil and military aviation, environmental constraints both on and offshore, and burdensome administrative procedures.

OFFSHORE WIND POWER

The European offshore wind industry added 1,558 MW of new capacity - 338 turbines in six wind farms in 2016, representing



year	2001**	2002**	2003**	2004*	2005*	2006*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MW	17,315	23,159	28,598	34,371	40,511	48,031	56,722	65,122	75,311	84,988	94,412	106,359	117,658	129,205	141,721	153,729

***EU15 *EU25*

Source: GWEC

On top of a turbine in Madeira, Portugal © Jason Bickley

a decrease of 48% compared to 2015. However, eleven projects accounting for 4,948 MW, worth EUR 18.2bn (USD 19.3), reached Final Investment Decision (FID) and are expected to become operational by 2018 or 2019 depending on the project.

Overall, there are now 12,631 MW of installed offshore wind power capacity in the offshore waters of the EU. Including sites with partial grid-connected turbines, there are now 81 offshore wind farms in ten European countries.

The UK has the largest offshore wind capacity in Europe, representing 40.8% of all installations, followed by Germany (32.5%) and Denmark (10.1%). The Netherlands took the fourth place in 2016 with 8.8% of the installations, with Belgium in the fifth spot (5.6%).

Combined, the top five EU countries represent 97% of all grid-connected installations in Europe and 86% of worldwide capacity.

OUTLOOK FOR 2017 AND BEYOND

2017 and 2018 are expected to be transition years for the European wind energy sector. While the support systems are undergoing dramatic changes, the phase out period should take at least a year. This means that there will be installed capacity under both the old and new support schemes. Onshore wind is likely to follow its current 10 GW/year level, continuing the market plateau. However, the installation rate could start decreasing from 2019 onwards if legislation does not provide post-2020 certainty.

For offshore wind, a strong pipeline of projects ensures over 3 GW of installed capacity in 2017. A slight decrease is expected for annual installations between 2018 and 2020. Nevertheless, offshore wind is on track to reach at least 24 GW of cumulative installed capacity by 2020.

With input from WindEurope

2016 IN A NUTSHELL

WIND CAPACITY ADDED
570 MW

TOTAL INSTALLED CAPACITY
1,538 MW

NO. OF TURBINES
552

ELECTRICITY DEMAND COVERED BY WIND POWER
3.6%

PEOPLE EMPLOYED BY THE WIND INDUSTRY
5,000 IN 2015

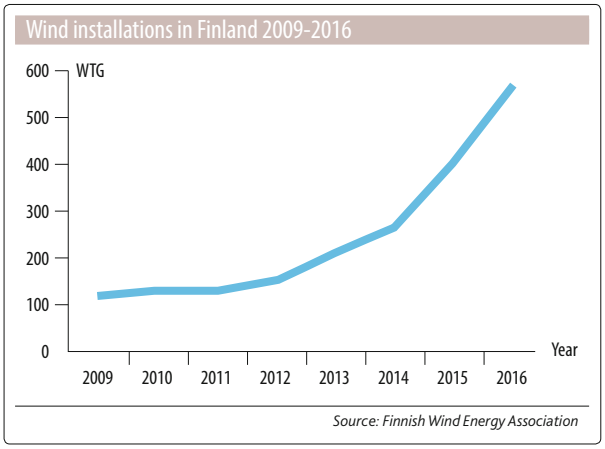
LEADING TURBINE SUPPLIERS
Vestas, Nordex, Gamesa

FINLAND

WIND MARKET IN 2016

2016 was a record-breaking year for the Finnish wind industry, as have been all years since 2012. 2016 was also a year for big political decisions with the release of the *Climate and Energy Strategy for 2030*[1]. The main change impacting wind development was the introduction of technology neutral auctions for renewables for 2 TWh per year for the period 2018-2020.

In 2016, Finland added 570 MW of new wind power capacity, bringing the total to 1,538 MW. This is enough to supply 3.6% of Finland's electricity needs with an annual production of 3.1 TWh.



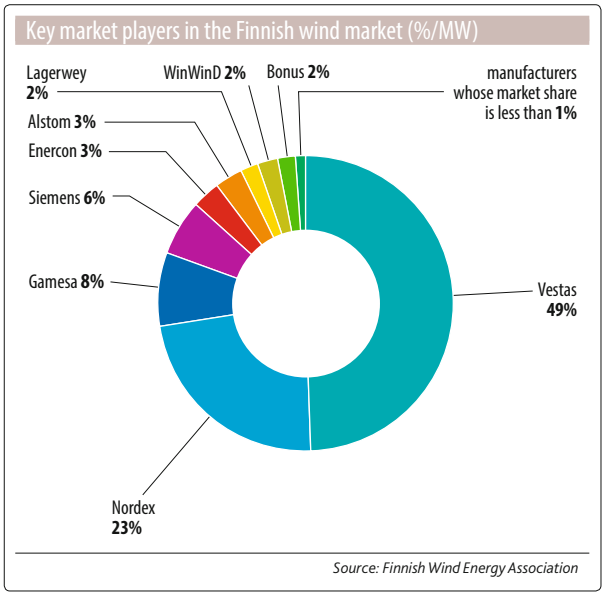
Finland is a sparsely populated northern country with a long coastline and good wind resources. Roughly the size of Germany, Finland has only 5.5 million inhabitants. Despite favourable wind conditions, wind power development in Finland began later than in many other European countries. The introduction of a comprehensive feed-in premium in 2011 made it possible to establish a wind industry in Finland. Wind power capacity remained at modest levels for some time, but recent years have seen impressive growth.

In forested areas, high towers of 140 meters or more are required, especially in areas away from the coast. Most wind projects, however, are located along the long coastline, in the northern parts of the country in particular; but projects are also being developed elsewhere. While the Finnish grid is stable and in good condition, further reinforcement is needed to accommodate wind power in some areas. The Finnish Transmission System Operator Fingrid is currently upgrading the grid to allow smooth transmission from the new wind installations being built in the northern part of the country.

In 2015, the Finnish wind industry employed 2,200 people in project development, installations and O&M, and a further 2,000-3,000 people in component manufacturing. There's a potential for wind power jobs in Finland to grow to 7,000[2] by 2020, if the opportunities for wind power development are realized.

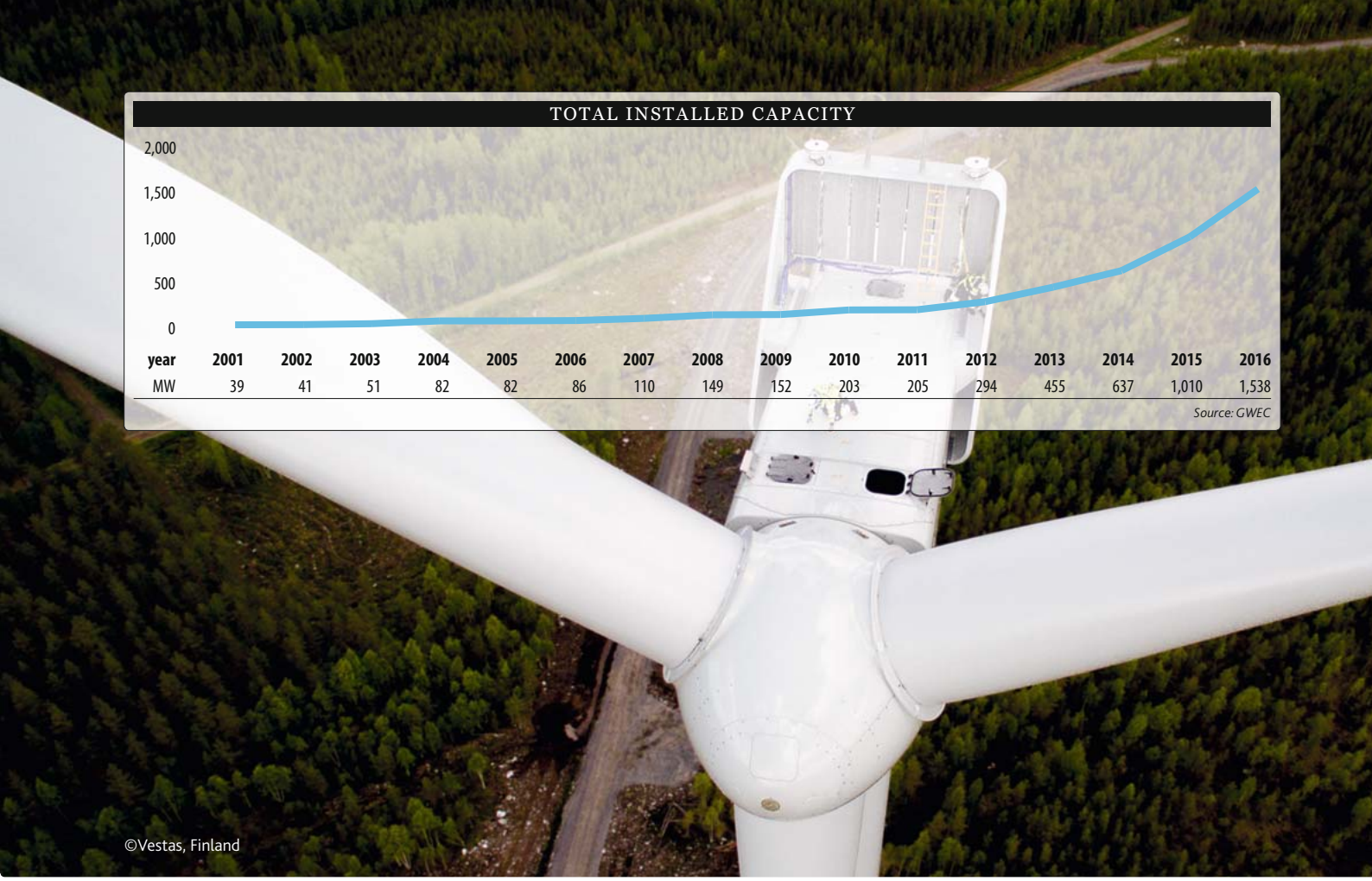
Key market players in Finland are Tuuliwatti Oy with a 24% market share, Taaleri pääomarahastot with 13%, EPV Tuulivoima with 8% and Allianz with 5%. The leading turbine manufacturers are Vestas with 49%, followed by Nordex (23%) and Gamesa (8%).

Finland has a feed-in premium set at EUR 83.50/MWh (USD 88.1/MWh) for twelve years for new wind power projects. Originally the system was open for 2,500 MW of wind power, but after national elections in 2015 the new government set a November 2017 deadline for granting support for wind power projects. This system will be replaced by the new auctioning system.



1 http://tem.fi/en/energy-and-climate-strategy-2016

2 http://www.tuulivoimayhdistys.fi/filebank/520-finnish-wind-industry-road-map-2014_2017.pdf



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NEW POLICY DEVELOPMENTS

The Finnish government released its *Climate and Energy Strategy for 2030* in November 2016. The strategy sets out concrete measures to achieve its energy and climate goals for 2030. According to the guidelines, the share of renewable energy of final energy consumption will rise to over 50% in the 2020s. The long-term goal is for the energy system to become carbon neutral and to be strongly based on renewable energy sources.

A new technology neutral auction for renewable energy of 2 TWh per year was introduced for the period 2018-2020. The details of the auctioning system are yet to be finalised. For offshore wind the use of investment subsidies for new technologies might provide an additional support option. However, the legislation is pending the results from a study on possible wind power health effects. The results of the study are expected to be published during spring 2017.

According to a survey conducted by Finnish Energy, more than 70% of Finns want more electricity to be produced by wind power. The share has been declining during recent years (81% in 2014), but wind power still remains the next most popular option after solar. Wind power gets a lot of media attention despite its modest share in the Finnish energy mix. Wind power is still a new phenomenon in Finland, and small but vocal opponent groups play a role.

Offshore wind power

Finland's wind power installations are mainly onshore. However Finland has excellent offshore wind conditions and a 40 MW offshore wind farm is currently being constructed by Suomen Hyötytuuli Oy to Tahkoluoto, located in the Gulf of Bothnia, in the north of the Baltic Sea. The wind farm is expected to come online in 2017. In addition to the feed-in premium the project has also received a EUR 20 million demonstration subsidy from the government to support research on offshore arctic conditions which will be conducted over the lifetime of the project. The research will contribute to a growing pool of cold-climate wind power technology research conducted by leading Finnish institutes.

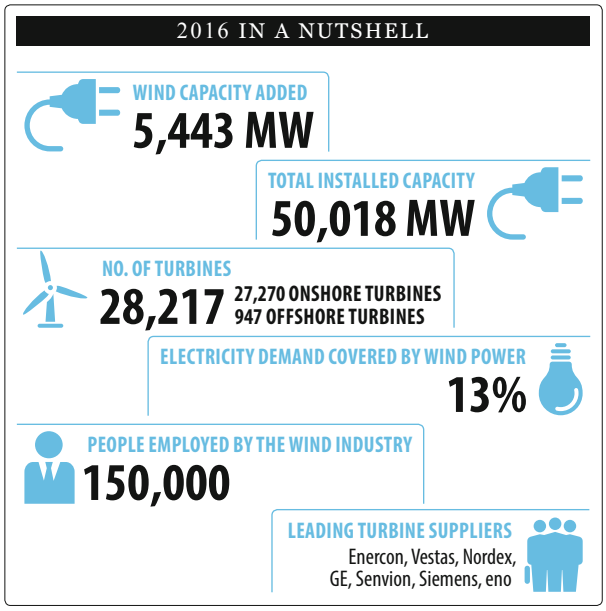
KEY BARRIERS TO WIND ENERGY DEVELOPMENT

At present, the key priority for the industry is ensuring that the details of the new auctioning system taking effect in 2018 will support the industry effectively.

OUTLOOK FOR 2017 AND BEYOND

The Finnish wind industry is expecting another record-breaking year in 2017, with 500-600 MW expected to come online prior to the closing of the feed-in tariff support scheme. For 2018-2020 the auctions of 2 TWh per year equal to about 600 MW of wind, spread over three years. This means that wind development in Finland is likely to slow down after 2017.

With input from the Finnish Wind Energy Association



GERMANY

WIND MARKET IN 2016

The German wind market met the expectations set for 2016 by adding 5,443 MW of new wind power to the grid, of which 813 MW was offshore. In cumulative terms, Germany ended the year with 50,018 MW, making it the third largest market globally, producing nearly 80 TWh of electricity, enough to cover 15% of Germany's total electricity consumption.

In 2016, onshore installations were up by 24% from the previous year. The number of turbines dismantled accounted for 366 MW, meanwhile repowering accounted for 679 MW. At state level, Lower Saxony led the way with an impressive 900 MW, more than doubling its 2015 market. Schleswig-Holstein came in second with 651 MW, after three consecutive years in the top place in among German federal states.

The average size of newly installed onshore wind turbines was 2.848 MW, with an average rotor diameter of about 109 meters, and average hub height of about 128 meters. All figures are up by 4% compared to 2015.

Onshore wind power remains the cheapest power source in the German energy system. The wind industry has gone through a considerable learning curve during the past few years: better system compatibility, more operating hours and greater power yields have made up for the reduction in remunerations in the *Renewable Energy Sources Act* (EEG), and this is expected to continue in 2017.

LATEST POLICY DEVELOPMENTS

Unlike in previous years, wind power expansion in 2016 was increasingly spread across the whole country. Southern states are starting to catch up with the rest of the country, in particular Baden-Wuerttemberg. Wind power's share in the central German states remains almost unchanged. The Bavarian market is dependent upon project approvals applied prior to the introduction of the *10H Minimum Distance Regulation*, which sets a minimum distance from wind farms to residential housing of ten times the total height of the wind power plant. Municipalities shall, however, be able to stipulate exceptions to the general rule in municipal zoning plans.

From 2017 onwards, wind development in the so-called *grid expansion region* in the north will be limited due to the new tendering system taking effect. According to the draft *Grid Expansion Area Ordinance,* the grid expansion area includes Schleswig-Holstein, Mecklenburg-Western Pomerania as well as the northern region of Lower Saxony and the city-states of Bremen and Hamburg. The expansion region was defined by the Federal Network Agency.

Switching to auctioning

The *Renewable Energy Sources Act 2017* created a paradigm shift: The allocation of renewables support moved from guaranteed feed-in tariffs (FIT's) to competitive auctions for most renewables installations from 1 January 2017 onwards. The aim is to use the market to make renewables prices more competitive.

Operators of new wind turbines have to compete for funding by bidding a price per kilowatt hour. The auction system for offshore wind projects will effectively only apply to projects built after 2020. Frequently held auctions, starting with the first auction on 1 May 2017 with a volume of 800 MW and two further auctions to be held on 1 August and 1 November (each 1,000 MW), are hoped to establish a market price. During 2018 and 2019, four auctions per year are planned to be held with a capacity of 700 MW each, followed by 3 auctions per year from 2020 onwards.

OFFSHORE WIND POWER

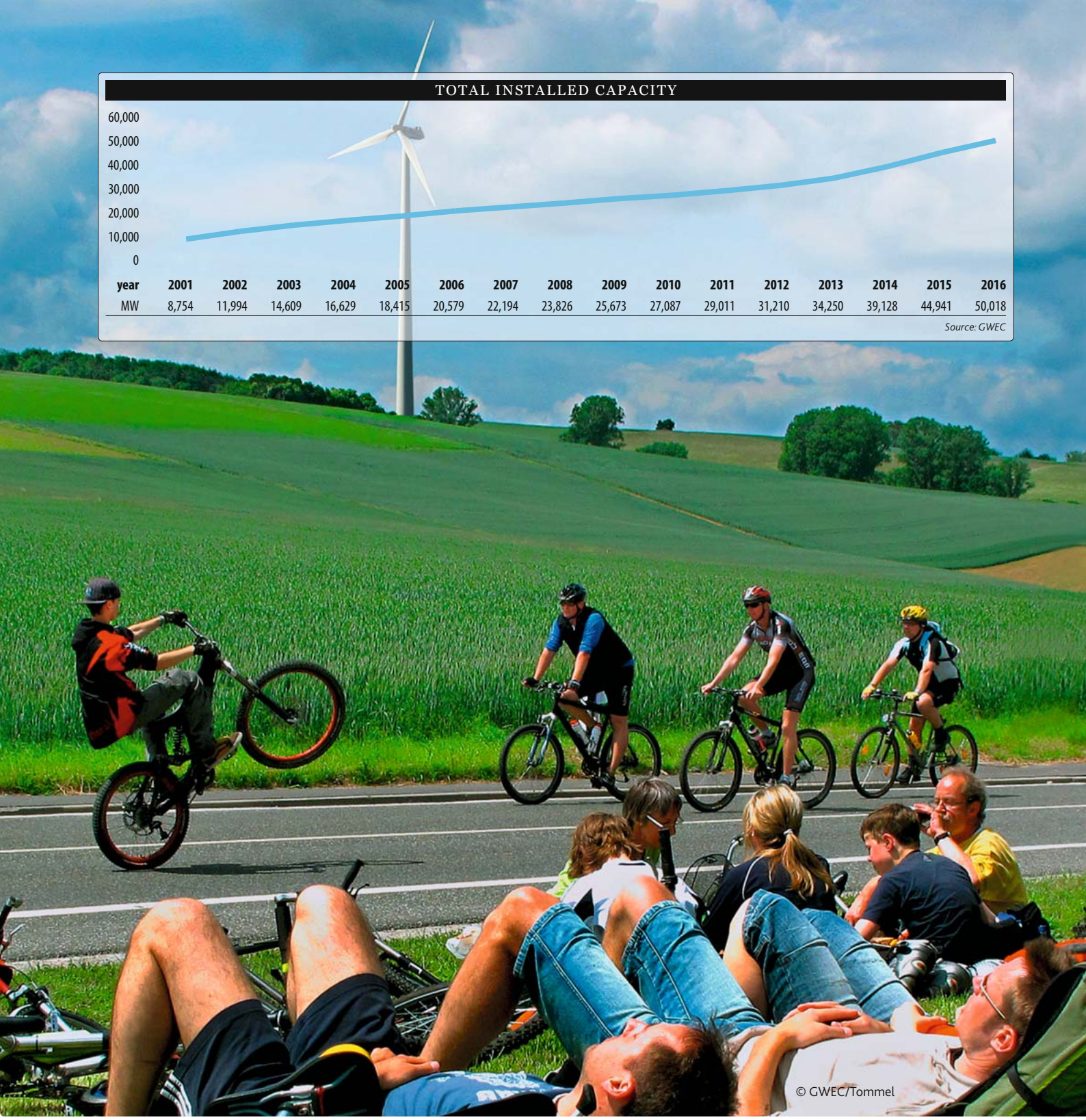
Stable growth with substantive cost reduction

The Offshore Wind Act was adopted as part of the EEG 2017 and includes the introduction of auctioning for offshore wind. The aim of this act is to ensure dovetailing between site planning, regional planning, approval of installations, funding and grid connection. The target for offshore wind has been set at 15 GW by 2030.

The German offshore wind industry added 818 MW of new installations in 2016. Overall, 947 offshore wind turbines were grid connected with a total capacity of 4,108 MW at the end of the year, enough to produce 13 TWh of electricity and to power 3 million homes. This represents an increase of nearly 57% compared to the 8.3 TWh generated in 2015, consolidating offshore wind power's position in the German power mix. The offshore wind expansion is expected to continue with about 1,400 MW in 2017 followed by a steady average of around 1,000 MW per year until 2019.

KEY BARRIERS TO WIND DEVELOPMENT

The key challenges faced by the German wind industry are the implementation of the new competitive tendering system; the need for timely grid expansion; and difficult conditions in some important export markets.



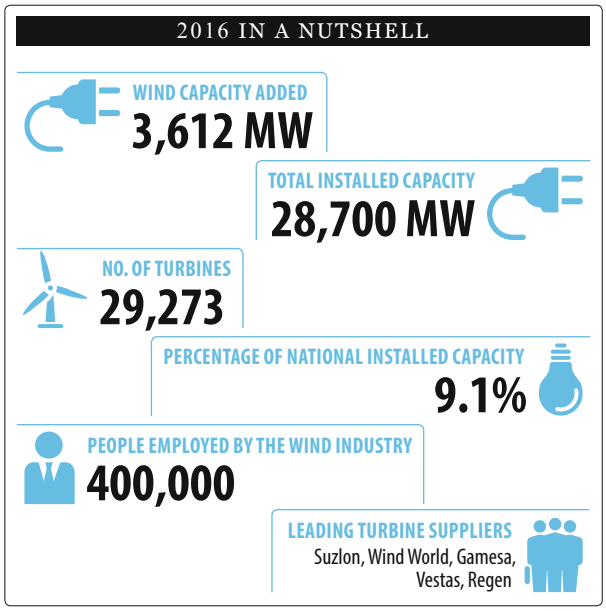
year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MW	8,754	11,994	14,609	16,629	18,415	20,579	22,194	23,826	25,673	27,087	29,011	31,210	34,250	39,128	44,941	50,018

Source: GWEC

OUTLOOK FOR 2017 AND BEYOND

For the transition years of 2017 and 2018, prior to the new tendering system coming fully into effect, the German wind industry expects significant growth. By the end of 2016, a pipeline of about 8,500 MW of wind projects were permitted, and are expected to come online by the end of 2018. This strong expansion is necessary to supply the heating and transport sectors with as much power from renewable sources as possible to meet government targets. The introduction of the new tendering system will only be fully implemented by 2019. At that time, the volume of onshore wind installations is expected to shrink below 2,800 MW. The new tendering system will allow citizens in Germany to participate in the transition to a cleaner energy supply in an improved manner through citizens' energy projects.

With input from the German Wind Energy Association, BWE and VDMA Power Systems



INDIA

India had a record year and is now the fourth largest market globally both in terms of cumulative capacity and annual additions last year. 3,612 MW of new wind power was added to reach a total of 28,700 MW at the end of December 2016.

The total renewable energy capacity installed in the country crossed the 50 GW mark at the end of 2016. Among renewables, wind power accounted for over 57 percent of the installed capacity.

India's wind power installations accounted for a 6.6 percent share of the global market in 2016. Wind power capacity accounted for over 9.1 percent of total domestic installed capacity[1].

In February 2015, India committed to installing 60 GW of Wind and 100 GW of solar by 2022. Further, India made a commitment at COP21 to raise the share of non-fossil-fuel power capacity in the country's power mix to 40% by 2030.

Cumulative Installed Capacity by State

State	Total installed capacity (MW)
Andhra Pradesh	2,092.5
Gujarat	4,441.5
Karnataka	3,154.2
Kerala	43.5
Madhya Pradesh	2,288.6
Maharashtra	4,666.1
Rajasthan	4,216.6
Tamil Nadu	7,694.3
Telangana	98.7
Other	4.3
Total	**28,700.4**

1 http://www.cea.nic.in/reports/monthly/installedcapacity/2016/installed_capacity-12.pdf

The tariff for FY 2016-17

Wind Energy	Levelised Total Tariff (FY 2016-17) INR / kWh	Benefit of Accelerated Depreciation (If availed) INR / kWh	Net Levelised Tariff (adjusted for AD benefit, if availed) INR / kWh
Wind Zone -1 (CUF 20%)	6.61	0.70	5.90
Wind Zone -2 (CUF 22%)	6.01	0.64	5.37
Wind Zone -3 (CUF 25%)	5.29	0.56	4.72
Wind Zone -4 (CUF 30%)	4.40	0.47	3.94
Wind Zone -5 (CUF 32%)	4.13	0.44	3.69

CUF: Capacity Utilization Factor

WIND MARKET IN 2016

In 2016, the majority of wind farms have come up in the States of Rajasthan, Madhya Pradesh, Maharashtra and Andhra Pradesh. These projects were built by large IPPs such as Renew Power, Hero Future, Continuum, Orange, Mytrah, Oriental Green Power and others.

During 2016 wind power development grew at a strong pace. Wind power producers opted for the tax-based AD incentive (originally 80 percent depreciation in the first year of installation) or the GBI of INR 0.5/kWh for at least four years and up to ten years. The AD will be available at a reduced rate of 40 percent from April 2017 and the GBI could be discontinued.

Industry Developments

The top-five OEMs in India are Suzlon (35.4%), WindWorld (18%), Gamesa (10.1%), Vestas (7.6%) and Regen (7.3%). LM Wind Power set up its second blade factory in Vadodra, Gujarat. Senvion, an established European player, started up its operations in India and acquired the Kenersys manufacturing facility. Gamesa set up new factory at Nellore in Andhra Pradesh, Acciona entered the market last year, and Envision and Sany Global are expected to enter the market soon. The current manufacturing capacity in the country is around 9,500 MW.

Support framework for wind energy

28 states and union territories have defined a Renewable Purchase Obligation (RPO) for renewables. However, the renewable energy certificate (REC) framework linked to the RPO, which was introduced for inter-state purchase and sale of renewables-based power, has not been a success. This is largely due to the non-compliance and weak enforcement of the RPO by the states and market regulators.

Wind power producers can either opt for preferential tariffs decided by the state regulator, or tradable certificates to add to the average power purchase price from the utility.

LATEST POLICY DEVELOPMENTS

The State Electricity Regulatory Commissions determine the tariff for wind projects. However, the Central Electricity Regulatory Commission comes up every year with a tariff guideline for the entire country based on wind power density in five zones.

© LM Wind Power

To address grid integration challenges, the government has initiated the Green Corridor programme. The objective is to improve linkage between India's regional grids with its national grid. This will facilitate interstate transmission.

The government's 'Green Energy Corridor' initiative to facilitate the transfer of power from the high renewable energy installation states to other parts of the country, consists of 765 kV and 400 kV high voltage transmission lines and an associated 765/400kV substation and associated equipment; and four HVDC terminals (two at 800 kV and two at 320 kV) as part of the increased inter-regional connectivity between India's western and southern regional power grids.

2016 saw a number of new policies for promoting wind power including the draft *'wind-solar hybrid policy'*, Guidelines for Development of Onshore Wind Projects, Guidelines for Prototype Wind turbines, and the Proposal for Evaluation of Small Wind Energy and Hybrid Projects.

Further, in November 2016, the Ministry of New and Renewable Energy (MNRE) issued Guidelines for a transparent bidding process for 1000 MW of wind, to be connected to the interstate transmission system. The results were announced in March 2017[2].

2 http://pib.nic.in/newsite/PrintRelease.aspx?relid=153212

BARRIERS TO WIND ENERGY DEVELOPMENT

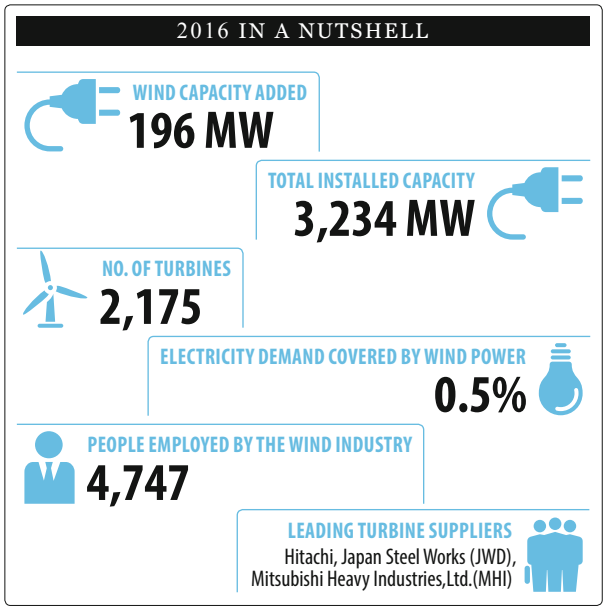
Most of the state level power sector utilities in India suffer from poor financial health and are unable to comply with the National RPO announced in 2016. Delayed payments by certain state DISCOMs is also an on-going concern.

The high cost of finance remains a challenge. High interest rates and limited availability of debt financing are challenges for developers as well as OEMs in the country.

OUTLOOK FOR 2017 AND BEYOND

The government, in its latest budget announcement for FY 2016-17, has reduced the AD from 80% to 40%. Furthermore, the Generation Based Incentive will come to an end at the end of the 2016/17 financial-year in India. These two factors will likely contribute to a rush of installations at the end of the 2016-17 fiscal year. However, the first auctions for wind power were held in early 2017 successfully. We expect installations during 2017 to reach approximately 4,000 MW.

With input from Indian Wind Turbine Manufacturers Association, IWTMA



JAPAN

WIND MARKET IN 2016

The Japanese wind industry has grown gradually, installing 196 MW in 2016, down 20% from 2015. Cumulative installations reached 3,234 MW at the end of 2016, producing about 5.3 TWh of electricity in 2016, which is about 0.5% of Japan's total electricity supply.

More than 12 GW of new projects are pending completion under the long EIA process, of which 88% are located in the Hokkaido and Tohoku regions which have rich wind resources but poor grid connection availability. However, the projects at the most advanced stage in the EIA process, which total about 3.77 GW, have acquired permits for grid connection and FIT approval at JPY 22/kWh, and are expected to come online over the next four years.

Offshore wind power capacity reached 59.6 MW with a total of 28 turbines in Japanese waters. In 2016, one MHI 7MW floating turbine was installed as a part of the Fukushima FORWARD project. The 3rd Hitachi 5MW floating turbine is under commissioning and is due to start operation in March 2017.

LATEST POLICY DEVELOPMENTS

The Japanese Ministry of Economy, Trade and Industry (METI) released the latest *2030 Energy Mix Plan* in July 2015. Wind power was allocated only a 1.7% share of electricity supply by 2030. This would translate to 10 GW of total capacity including 0.82 GW of offshore wind. This means only 7 GW of new installations over the coming 14 years.

Japan's energy policy is currently at a crossroads. The struggle over the future of nuclear power continues, and even new coal fired power plants using cheap Australian coal are considered. New solar PV installations are stalled by the rapid reduction in the FIT price, and wind power annual installations have decreased since the introduction of the FIT. The Japan Wind Power Association (JWPA) is working hard to improve the situation and its roadmap for development *WindVision* envisages 36.2GW of wind power capacity by 2030.

Feed-in tariff

Feed-in tariffs are re-assessed annually based on the latest market price in Japan. In 2016, METI lowered feed-in tariffs for wind and solar over three years until 2019. The FIT for onshore wind power will decrease by JPY 1/kWh per year, gradually lowering from JPY 22/kWh (EUR 0.18 /USD 0.20) in 2016 to JPY 19/kWh in 2019. The FIT for offshore wind is maintained at JPY 36/kWh (EUR 0.30/USD 0.32) until 2019. The FIT for repowering is set at JPY 3/kWh lower than the tariff for onshore wind power.

Meanwhile, the FIT approval timelines have been moved earlier and feed-in tariffs will now be approved in the middle of the EIA process, 2 to 3 years prior to the project start. This can significantly improve the predictability of wind power profitability.

Grid restrictions

Priority access to the grid for renewable energy is yet to be implemented in Japan. The mismatch between the location of wind resources and electricity demand causes grid connection problems. The northern area, namely the Hokkaido and Tohoku regions, have the best wind resources in Japan, but due to low population density the grid infrastructure is limited.

In 2016, Tohoku Electric Power Company halted new requests for grid connection for wind power in the three northern prefectures of Aomori, Iwate and Akita. The Hokkaido Electric power Company asked wind power developers to set large scale batteries at wind farms to stabilize the fluctuation of output. After talks with METI, both electric power companies have agreed to improve this situation.

Another problem is linked to unlimited curtailment without compensation. The current Japanese electric power system rule allows electric power companies to curtail renewable energy when the rate reaches a certain ratio, which is estimated at less than 30% in Hokkaido and Tohoku, and at 10% in Kyushu and Shikoku. This unlimited curtailment brings uncertainty and creates a new hurdle for financing.

Eurus Energy Holdings has announced that it is starting construction on a new local grid line in northern Hokkaido in 2019, which is expected to begin operating in 2022. The new grid will enable several hundred megawatts of new wind power installations in the area.

However, the critical inter-regional grid extension still depends on the progress of Japan's Electric Power System Reform, which is progressing gradually. The unbundling of power generation, transmission and distribution in the country is scheduled to be carried out by 2020.

OFFSHORE WIND POWER

By the end of 2016 Japan had 59.6 MW of offshore wind power, including two 2MW and one 7MW floating wind turbines. A further 2,486 MW of offshore wind power projects are currently under various stages of development. The 60MW Yasuoka project is likely to start construction in 2018, and several other

The 16MW JRE Nakakyushu-Onitayama Wind Farm in Miyazaki, Hitachi 2MW X 8 units © JRE

Wind power project pipeline at the end of 2016

Status			MW
In operation (at the end of 2016)			3,234 MW
Under construction (due in operation by March 2017)			144 MW
Planned projects	EIA	Latter stage (draft EIA)	3,770 MW
		Middle Stage (scoping)	3,510 MW
		Primary stage (consultation)	3,213 MW
	Pre-EIA process*		1,596 MW
	Total in planning		12,089 MW
	Total		**15,467 MW**

** Offshore projects at pre-EIA stage or free from EIA*

projects are expected to start construction within the next couple of years.

Offshore wind power has developed at a slow pace in recent years in Japan, despite the huge potential resource that could help Japan move away from nuclear and fossil fuel power.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

Some challenges in the Japanese wind market include:

- No priority dispatch for renewables
- Unlimited curtailment without compensation
- Grid infrastructure needs improvement
- Government targets for wind power are set too low
- Decreasing FIT level
- EIA process is very slow

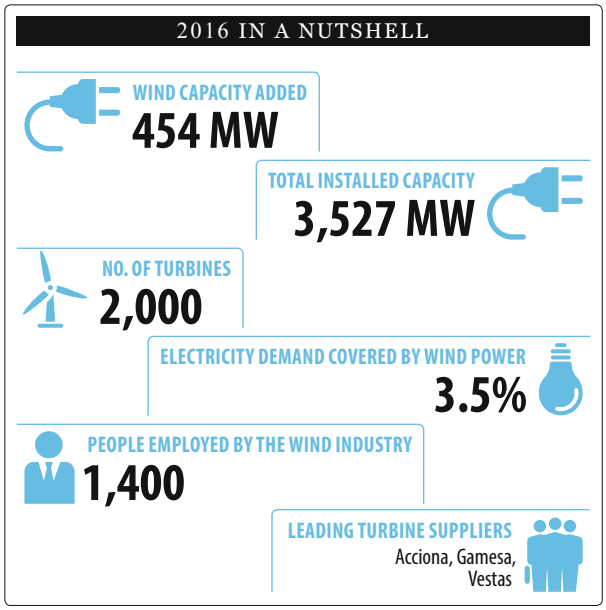
OUTLOOK FOR 2017 AND BEYOND

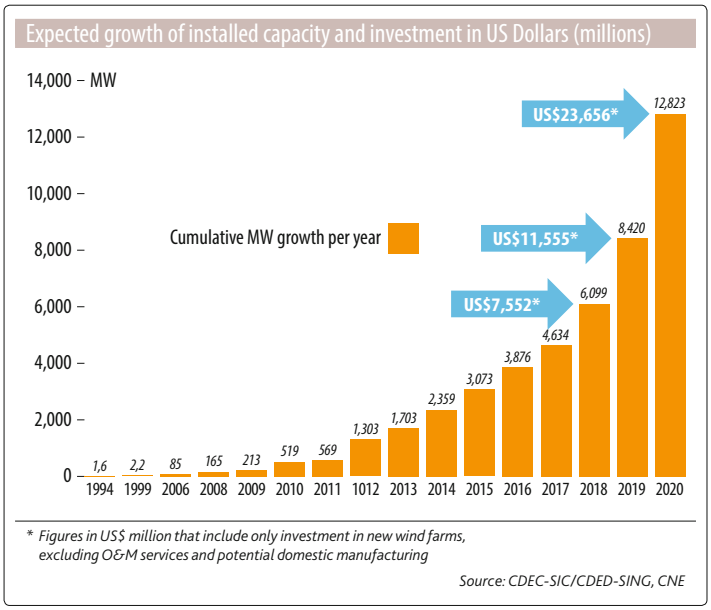
JWPA promotes wind power development in Japan and is making consistent efforts to achieve its target of 36.2 GW by 2030. Japan has installed over 3.2 GW by the end of 2016. There are 3.3 GW of new wind power projects that have almost finished the lengthy EIA process and have acquired FIT approval, and are expected to come online in the next four years.

Many important issues which have an impact on wind development in Japan are expected to change by 2020, including:

- The unbundling of the electric power generation, transmission and distribution
- Inter-regional grid system which allows using of the rich wind resources in northern parts of the country
- Vestas and Siemens have announced the development of a new anti-typhoon class wind turbine for the Japanese market by 2019
- The Japanese Ministry of Land, Infrastructure, Transport and Tourism (MILT) intends to extend their new interests in offshore wind power
- A new law on *General common sea area* is expected to be settled by 2020, which helps to reduce risk for offshore wind power in Japan

With input from the Japan Wind Power Association, JWPA and the Japanese Wind Energy Association, JWEA





MEXICO

WIND MARKET IN 2016

Despite a slower than expected year in 2016, wind power in Mexico has continued to grow, and the new policies and legal framework resulting from the country's energy reform are likely to foster rapid evolution of the Mexican wind market.

In 2016, Mexico added 454 MW of new wind power to the country's electricity grid, bringing total capacity to 3,527 MW, representing about 5% of total generation capacity.

Mexico's wholesale electricity market began to operate in 2016. In addition, the first two auctions held last year came in at historically low prices, with wind and solar beating conventional technologies. This demonstrates the highly competitive nature of wind power in the country, while acknowledging that there still are some major challenges ahead as Mexico moves towards a more diverse generation mix. However, the Mexican wind industry is determined to see 12,000 MW installed by the end of 2020, and then up to 15,000 MW by the end of 2022.

Mexico's 42 wind farms are located in the states of Oaxaca, Baja California, Chiapas, Jalisco, Tamaulipas, San Luis Potosi, Nuevo Leon, Puebla and Zacatecas.

The key turbine manufacturers in the Mexican wind market are Acciona, Gamesa and Vestas. To date, wind power has generated USD 6.9 billion (EUR 6.5 bn) of new investment and an investment of USD 23.6 billion (EUR 22.1 bn) is expected for the period from 2017-2020.

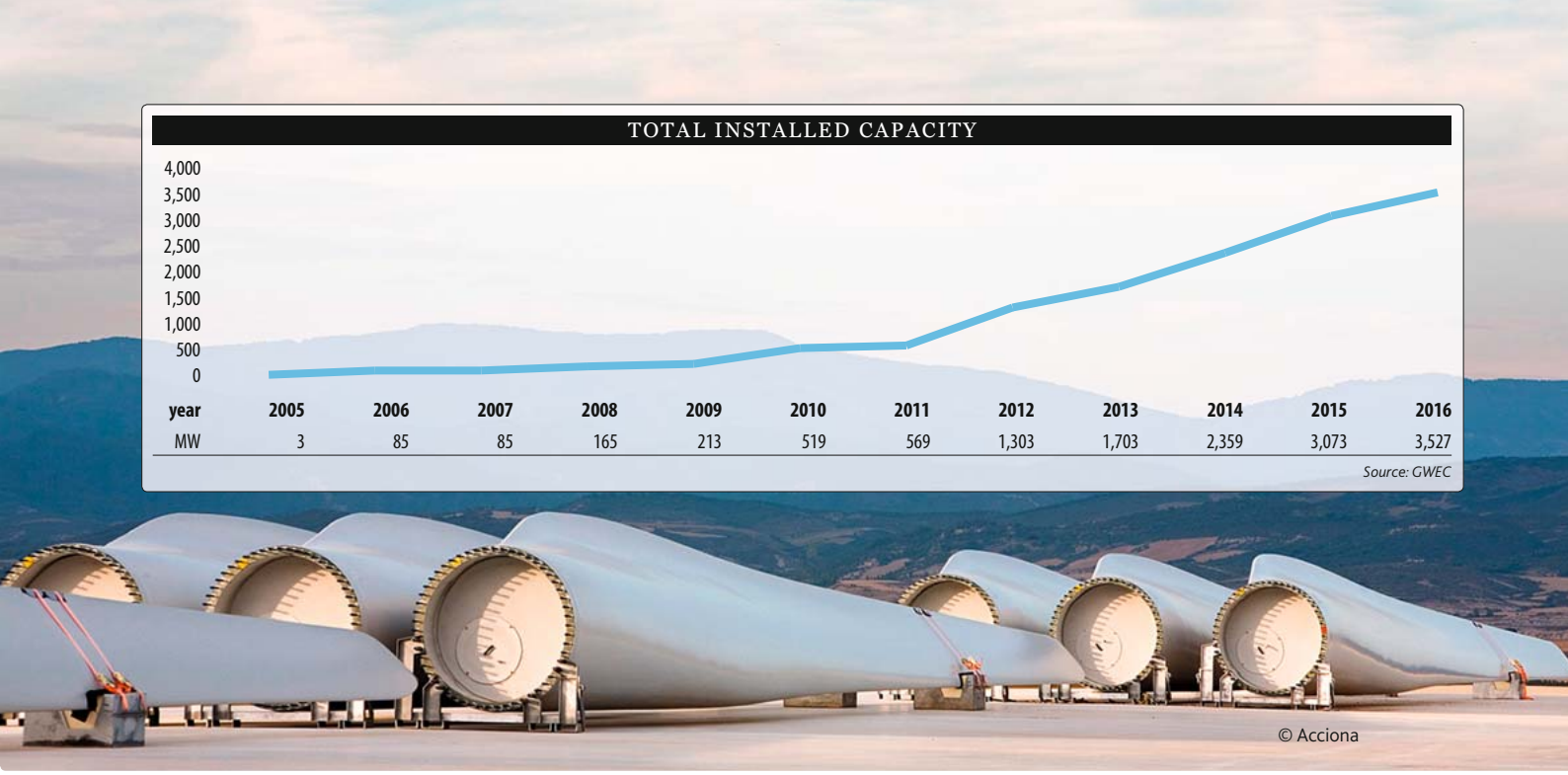
LATEST POLICY DEVELOPMENTS

Mexico's recently enacted energy reform is intended to foster competitiveness and private investment throughout the electric power sector value chain in order to support economic growth and job creation by delivering competitively priced, reliable, clean, and secure electricity. This means dramatic changes in the power sector: the system is moving from a completely state owned national utility providing everything from generation to transmission, distribution and retail to a highly competitive market. The main features of the new system include the following:

- The former state owned monopoly (CFE) has been transformed into several generation companies and will ultimately be spun off into separate and independent distribution and retail companies.
- An independent system operator has been established, which is responsible for both the regulation of the market and the planning and expansion of the system (CENACE, Centro Nacional de Control de Energía).
- A wholesale market has now been implemented for most of the country.
- Market access for IPPs.
- The possibility for private entities to get into the transmission business.
- An auction system: the first two auctions were held in 2016 and a third is planned for April 2017.
- A green certificate system along with a purchase obligation system. Large consumers must get 5% of their power from clean energy sources by 2018. The government has also set a clean energy target for the power sector of 35% by 2024, 37.7% by 2030 and 50% by 2050, up from 21% now.

Auctions for renewables

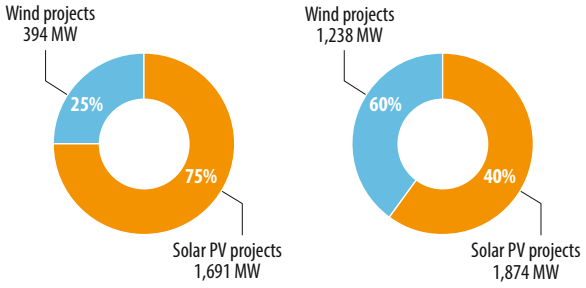
To facilitate the clean energy transition, the government has introduced annual energy auctions, with the first two being awarded in 2016 and a third one planned for April 2017. Power producers will receive Clean Energy Certificates (CLE's) for every megawatt-hour of clean energy generated, and will sell 20-year certificates through the auctions to large electricity users.



The long-term auction system has proved to be hugely successful. The outcome of the first two auctions shows that both wind and solar PV are highly competitive. Some key observations of the two long-term auctions held in 2016:

1st Auction	2nd Auction
18 winners from 11 companies	56 winners from 23 companies
394 MW of wind power	1,238 MW of wind power
Assigned projects from 18 MW up to 500 MW	Assigned projects from 27 MW up to 388 MW
Allocations represent 1.9% of the forecasted annual generation for 2018	Allocations represent 3% of the annual generation for 2019
Investment of USD 2.6 billion	Investment of USD 4 billion
Participants from Mexico, Spain, Italy, US and China	Participants from Mexico, France, Portugal, Spain, Italy, Germany, Netherlands, United Kingdom, US, China and Korea

Awarded technology share: Solar vs wind installed capacity



KEY BARRIERS TO WIND ENERGY DEVELOPMENT

Some of the main challenges include:

- The new legal and regulatory framework is still a work-in-process, and some essential rules need to be further defined.
- Some further clarifications by CENACE are needed on procedures and regulations linked to the trading of energy, forecasting, quality of energy requirements etc in the new scenario.
- Electricity tariffs have been historically low during the past two years, also for natural gas, but they are currently rising.
- Transmission infrastructure is constrained in regions with good wind resources; reinforcement of the power grid and additional transmission lines are needed.
- The requested level set for Clean Energy Certificates for 2018 is not likely to be reached since the projects providing the certificates will only be commissioned in 4Q 2018. This situation is, however, expected to improve in the next years to come. The level of certificates required will increase year by year until 2024.
- Public opposition by interest groups or communities who don't directly benefit from wind power.

OUTLOOK FOR 2017 AND BEYOND

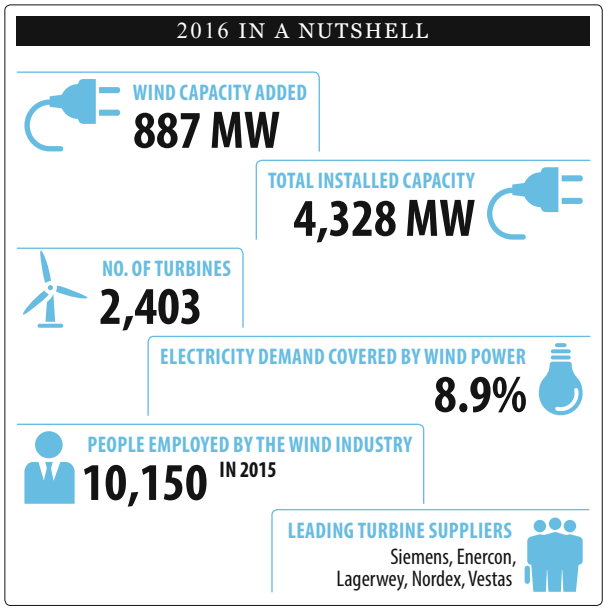
While Mexico is faced with some challenges related to its geopolitical situation, the country's economy is growing due to strong industrial development and vibrant tourism. The Mexican Energy Ministry's forecast[1] estimates a growth rate of 3.4% for electricity demand for the 2016-2030 period. This means that a minimum of 57 GW of new capacity will be needed during 2016-2030, of which wind power is expected to cover at least 21%.

For the first time in Mexico, there will also be private sector participation in a tender for a new HVDC transmission line from Oaxaca to central Mexico. This tender is scheduled for the second half of 2017.

The Mexican wind industry expects to install about 1,100 MW in 2017 from the eleven wind farms that are currently under construction. By 2020, the industry expects to see more than 12,000 MW installed, and up to 15,000 MW by the end of 2022.

With input from the Mexican Wind Energy Association, AMDEE

1 (PRODESEN, National Electric System Development Program)



NETHERLANDS

The Netherlands scored multiple records in 2016, entering the global top 10 in terms of annual market for the first time in decades, with 887 MW of new wind power installed. Most of the new capacity, 691 MW, came from offshore wind power, making the country the world's fifth largest offshore market. The Netherlands finished the year with a total of 4,328 MW, and wind energy now supplies 8.9% of the country's electricity demand.

The Netherlands is blessed with a relatively long coastline, and although it is a densely populated country, there is ample room for onshore wind development. The provinces with the best wind resources are Zeeland, North Holland, Flevoland, Friesland and Groningen. Additionally, the Dutch part of the North Sea is ideally suited for offshore wind development thanks to its favourable wind conditions, relatively shallow waters, good harbour facilities, an experienced industry and a robust support system.

The Netherlands has good interconnectivity with its neighbouring countries. The operator of the Dutch grid, TenneT, builds and maintains the high-voltage grid that is used to transport large quantities of electricity in the Netherlands and a large part of Germany. TenneT also collaborates with its Danish counterpart Energinet.dk, and they are currently jointly installing a submarine high voltage cable that will directly interconnect the electricity grids of the two countries. This 325 km COBRA cable will have a capacity of about 700 MW and will run from Eemshaven (the Netherlands) to Endrup (Denmark) via the German sector of the North Sea. The installation works started in 2016 and are expected to be completed in 2019. The Dutch grid is also interconnected with the Norwegian grid by the NorNed cable (700 MW) and with the British grid via the BritNed cable (1000 MW).

WIND MARKET IN 2016

2016 marked a record year for the Dutch wind market with new installations totalling 887 MW, of which 691 MW was offshore. Overall, 79 turbines with a total capacity of 222 MW were added onshore last year, including the now almost fully operational Noordoostpolder wind farm. Once completed, the 429 MW Noordoostpolder project, will consist of 48 turbines in the IJsselmeer and 38 turbines on land, and will be the country's largest onshore project generating about 1.4 TWh/yr. Works were also completed at the Gemini project, one of the world's largest offshore wind farms at 600 MW.

The main turbine manufacturers in the Dutch wind market are Siemens, Enercon, Lagerwey, Nordex and Vestas.

LATEST POLICY DEVELOPMENTS

The Dutch incentive scheme for renewable energy was amended in 2017 (Stimulering Duurzame Energieproductie/Encouraging Sustainable Energy Production, SDE+[1]). The incentive scheme for onshore wind power supports production instead of capacity and is based on the average wind speed in the municipality where the windfarm will be located. The country is divided into four tariff categories into which each municipality is placed according to its average wind speed. With this change, the cap on full load hours no longer applies.

Four wind categories for onshore wind power feed-in tariff:

- sites with winds stronger than 8 m/s are remunerated with EUR 0,064/kWh
- sites with winds in the range 7.5-8 m/s: EUR 0,070/kWh
- sites with winds in the range 7-7.5 m/s: EUR 0,075/kWh
- sites with winds lower than 7 m/s: EUR 0,085/kWh

For wind on dikes:

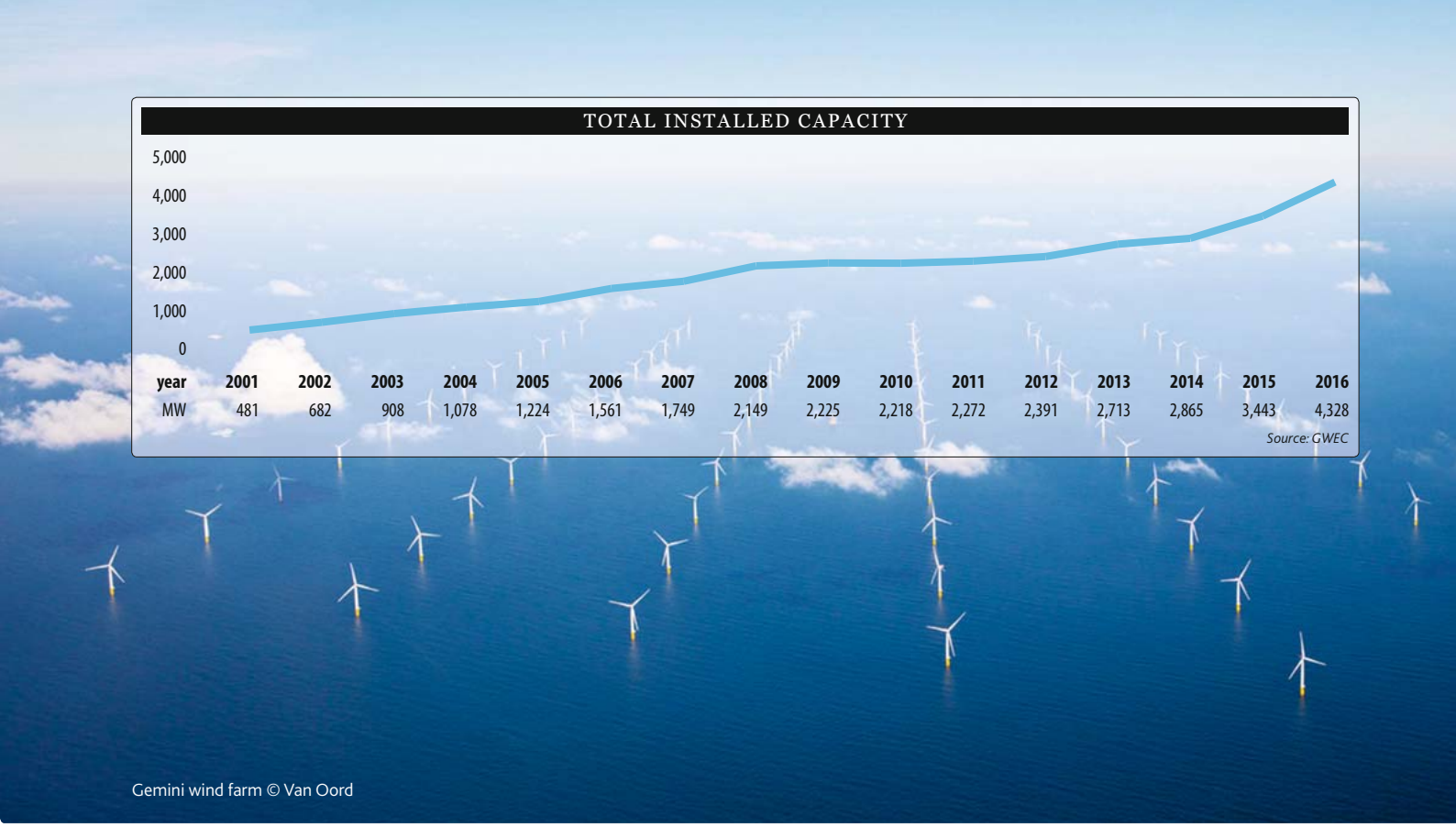
- sites with winds stronger than 8 m/s are remunerated with EUR 0,069/kWh
- sites with winds in the range 7.5-8 m/s: EUR 0,075/kWh
- sites with winds in the range 7-7.5 m/s: EUR 0,080/kWh
- sites with winds lower than 7 m/s: EUR 0,091/kWh

For wind projects in lakes the tariff is set at EUR 0,104/kWh.

Offshore wind power

The Dutch government has set a target to lower the cost of offshore wind power by 40% in 2024 compared to 2014. This price drop is an integral element of the government's *Energy Agreement for Sustainable Growth*[2]. Hence, prices for each tender will be capped, starting at EUR 124/MWh for Borssele Wind Farm Sites I and II. The price cap will be lower for each subsequent tender. In 2016, the price cap for bids to build Borssele Wind Farm Sites III and IV, was set at EUR 119.75/MWh. It then drops to EUR 107.5/MWh for the 2017 tender, then to EUR 103.25/MWh in 2018 and EUR 100/MWh in 2019.

1 http://english.rvo.nl/sites/default/files/2017/03/170307%20Brochure_SDE2017UK%20def.pdf
2 www.government.nl/topics/energy-policy/contents/energy-agreement-for-sustainable-growth



Gemini wind farm © Van Oord

OFFSHORE WIND POWER

There is at present 1,118 MW of offshore wind power installed in Dutch waters, consisting of three relatively small wind farms and the 600 MW Gemini wind farm, located north of the Wadden Islands. The Dutch wind industry expects to reach a total of 4,500 MW of offshore wind power by 2023.

The Dutch grid operator TenneT has been appointed as the transmission operator (TSO) for offshore wind power and is responsible for grid connection and for upgrading the grid infrastructure needed for the new offshore wind farms.

A key challenge for the sector is to ensure a smooth running of the planned tenders for offshore wind energy. The first two tenders were successfully held in 2016, encompassing a total of 1,400 MW in the Borssele area off the coast of Zeeland in the southwest.

The industry is well on the way to achieve the objective to reduce costs by 40% over the next five years. Already the first tender was well below the price cap with a winning bid by Dong at EUR 72.7/MWh (USD 76.9/MWh), excluding grid costs. The second tender was awarded to a consortium made up of Shell, Van Oord, Eneco and Diamond Generating Europe Limited at a new record low cost of EUR 54.5/MWh (USD 57.6/MWh), excluding grid costs. The Dutch North Sea has a huge potential to further develop large scale wind after the 2023 targets have been achieved, beginning with the already designated area of *IJmuiden-Ver* which could accommodate 6,000 MW of offshore wind power, after it's been cleared of its current spatial claims.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

The main obstacles to onshore wind development in the Netherlands are linked to radar regulations, provincial policies, and public opposition in some areas. Currently, some coastal communities concerned about impacts on tourism and nature are opposing plans for offshore wind development, causing project delays.

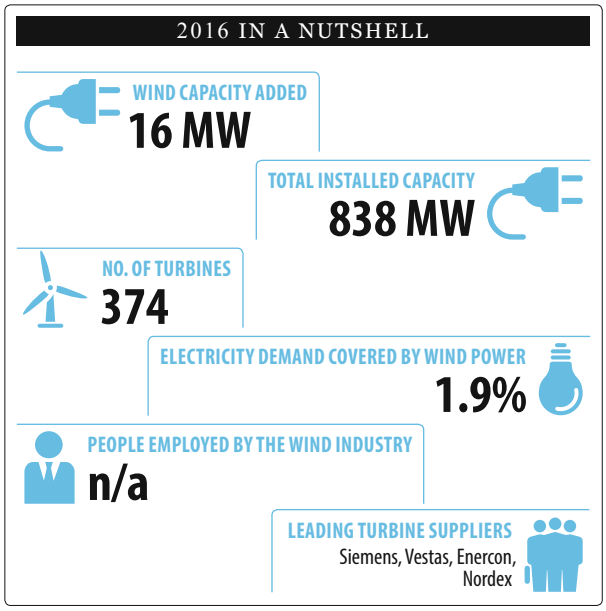
OUTLOOK FOR 2017 AND BEYOND

The very low market prices for electricity in the Netherlands at the moment is the main concern with regard to the relatively high floor price for the incentive scheme for 2016. Fortunately, the floor price was lowered in the new SDE+ 2017[3] support system. The Dutch government aims to promote renewable energy and has set a target for 14% of all energy to be generated from renewable sources by 2020, rising to 16% by 2023. The Government hopes that wind power will play a significant role in meeting these targets and has set a target to reach 6,000 MW of onshore wind power by 2020, and 4,500 MW of offshore wind by 2023.

The government's Energy agenda, published in the end of 2016, includes a solid plan for offshore wind development showing an upscaling of the current 700 MW/year to 1 GW per year. The first tender of this new round will be carried out right after the last tender of the current scheme, ensuring a smooth continuation of the roll-out of offshore wind energy in the Netherlands providing certainty for project developers and investors.

With input from the Netherlands Wind Energy Association, NWEA

3 http://english.rvo.nl/subsidies-programmes/sde



NORWAY

WIND MARKET IN 2016

While wind power development in Norway has been slow until now, 2016 marked a year of significant change. During 2016, 16 MW of new onshore wind power was installed bringing the country's total capacity to 838 MW. Additionally, a strong project pipeline of 1,460 MW is under development.

In 2016, construction works started at the Fosen wind farm, located in Central Norway on the Fosen peninsula, the island of Hitra and in Snillfjord, a coastal area providing some of the best wind conditions in the country. The Fosen wind farm consists of six onshore sites with a combined capacity of just over 1 GW, exceeding Norway's current overall wind capacity. Once completed, the Fosen wind farm will be Europe's largest onshore wind farm. The project is expected to be completed by 2020. Three smaller projects were also begun in 2016: Egersund with 112 MW; Tellenes with 160 MW; and Raskiftet with 112 MW.

Wind power in Norway generated 2.52 TWh in 2015, 1.9% of the total electricity consumption of 130.3 TWh in the country.

NEW POLICY DEVELOPMENTS IN 2016

Since January 2012, Norway and Sweden have had a joint electricity certificate market. Over the period until 2020, the two countries aim to increase their production of electricity from renewable energy sources by 28.4 TWh. The joint market permits trading in both Norwegian and Swedish certificates, and a generator can receive certificates for renewable electricity production in either country for each MWh produced for 15 years. The certificates are purchasable by consumers of electricity – with an exception of some specific industry sectors, and traded on an open common market. Under the bilateral agreement, the Norwegian Water Resources and Energy Directorate (NVE) and its Swedish counterpart the Swedish Energy Agency, compile progress reviews on an annual basis. Progress reviews are conducted in order to adjust parameters of the scheme; such as to adjust the quotas of certificate consumption in line with fluctuations in the consumption of electricity.

The Swedish government has opted to increase its RES target under the certificate scheme by 18 TWh, and to extend the duration of the scheme until 2030. Norway will, however, not participate in this extension, and won't hence approve any new production under the scheme from 2021 onwards. Both the NVE and the Swedish Energy Agency have recommended that all certificates will still be traded in one market place, irrespective of time of issuance or geographical origin, even after the market "split". The details of the agreement are subject to political discussions between the two countries' governments and conditional upon parliamentary approval.

Policy framework

Onshore wind power is included under the Energy Law of 1991. For offshore power generation, the applicable law is the Ocean Energy Law (havenergilova). In both cases, the NVE is responsible for processing applications and granting concessions to build and operate power plants, with the Ministry of Petroleum and Energy (OED) as appellate body. Concessions are granted for both the building of the power plants, as well as for grid connection and power supply.

Onshore wind power

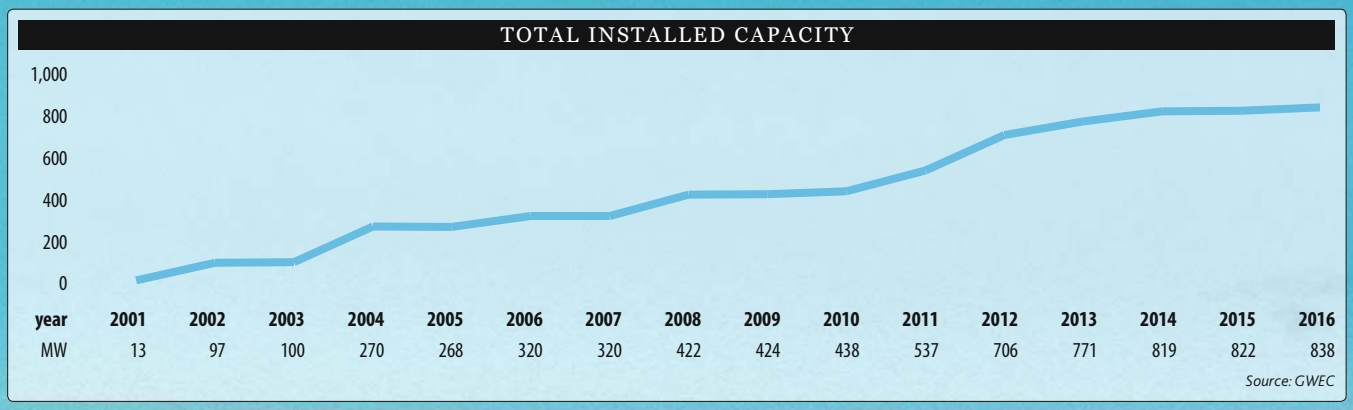
The government is preparing a new framework for renewable energy development in Norway. In the new framework specific *green zones* will be introduced in areas with well-established grid connection and low potential for conflicts of interest. However, the government has pointed out that concessions for renewable energy projects can be granted also outside of the green zones.

Offshore wind power

In 2016, two parliamentary decisions were made regarding offshore wind power. Firstly, the Standing Committee on Energy and the Environment made a request to the government in the White Paper on energy policy *(vedtak 869)* to introduce a support scheme for offshore wind power and other forms of renewable offshore technologies during 2017. Secondly, offshore wind is mentioned in the bi-partisan agreement supporting the 2017 national budget. In the agreement, a parliamentary majority requires that the government will include in its budget for 2018 at the latest, a strategy for commercial development of floating wind turbines.

Public acceptance

An annual survey *Klimabarometer*, conducted by TNS-gallup, is considered as the most important measure of public acceptance of renewable energy in Norway. The survey covers both power plant construction and operation, and also takes into account people's views on whether Norwegian authorities are



doing enough to combat and adapt to climate change. In 2016, 43% of respondents believed that the Norwegian authorities were doing too little to adapt to climate change. When people were asked what climate action they would like national politicians to prioritise, the top two answers were: 1) research and development on new renewable energy technologies; and 2) further promotion of renewable energy. Of those asked, 65% believed that "Norway is not putting enough effort into the promotion of renewables". At the same time, 70% of the respondents were favourable towards onshore wind power, and 73% were positive about offshore wind power.

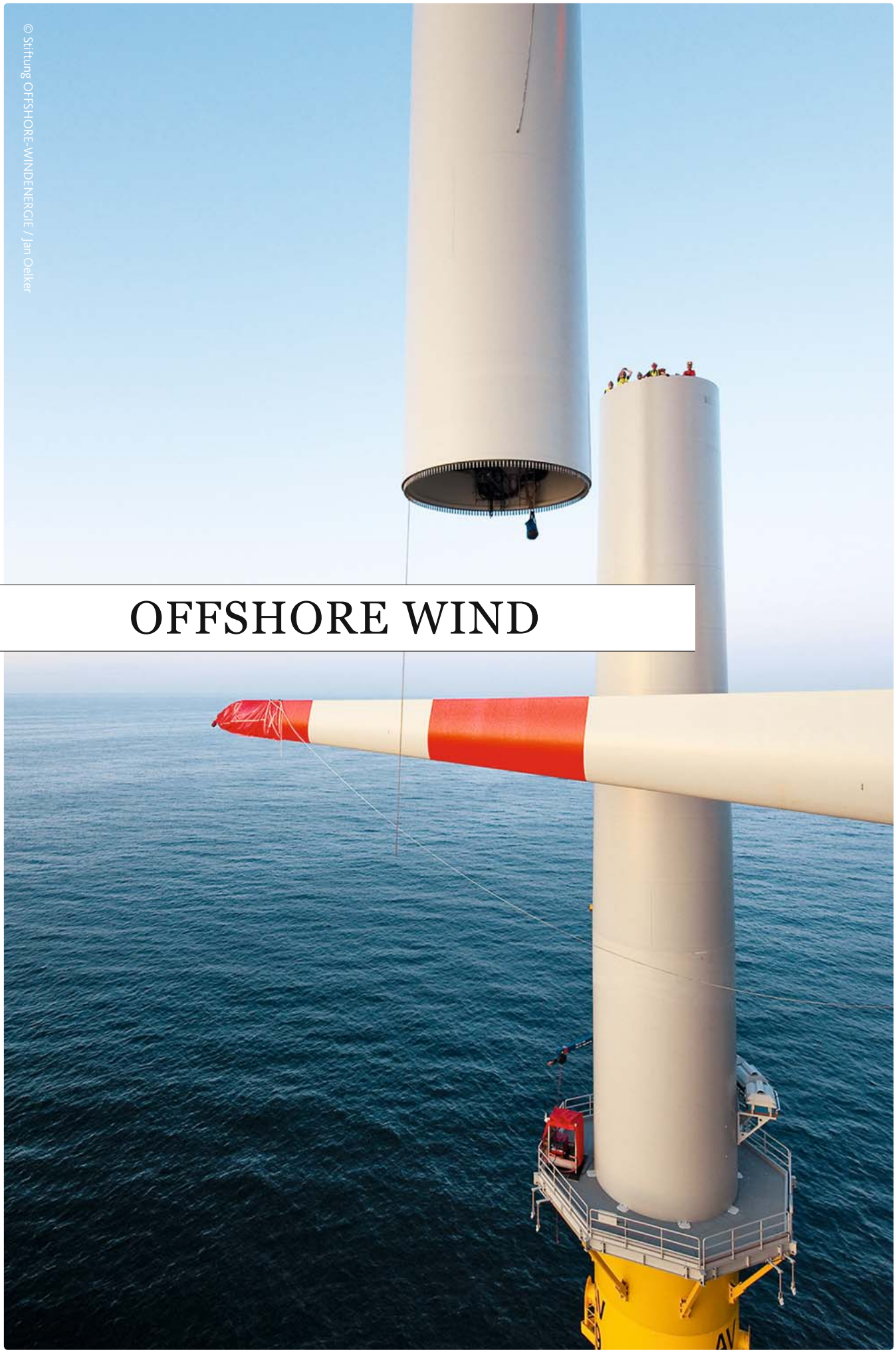
KEY BARRIERS TO WIND POWER DEVELOPMENT

Lack of targets for new RES development forms one of the key barriers in Norway, following the decision not to continue Norwegian participation in the green certificates scheme. Additionally, the low power price has raised discussion, but does not seem to be dampening the willingness to make positive investment decisions.

OUTLOOK FOR 2017 AND BEYOND

The Norwegian wind industry is looking forward to a strong 2017, with more than 340 MW of new capacity expected to come online. There are still close to 1,500 MW of projects in the pipeline ensuring steady growth for the coming years. All these projects are expected to come online by the end of 2021, as this marks the end of the Norwegian participation in the green certificate scheme. Work in the Water Resources and Energy Directorate has started for the preparation of a new plan for the future wind power development in Norway.

With input from the Norwegian Wind Energy Association, NORWEA



OFFSHORE WIND

A total of 2,219 MW of new offshore wind power was installed across seven markets globally in 2016, and although numbers were down 31% from last year's record, the future looks promising. Overall, there is now 14,384 MW of installed offshore wind power capacity in 14 markets around the world.

At the end of 2016, nearly 88% (12,631 MW) of all offshore wind installations were located in waters off the coast of ten European countries. The remaining 12% is located largely in China, followed by Japan, South Korea and the United States.

The UK is the world's largest offshore wind market and accounts for just under 36% of installed capacity, followed by Germany in the second spot with 29%. China passed Denmark in 2016 to achieve 3rd place in the global offshore rankings with 11%. Denmark now accounts for 8.8%, the Netherlands 7.8%, Belgium 5% and Sweden 1.4%. Other markets including Finland, Ireland, Spain, Japan, South Korea, the USA and Norway make up the balance of the market.

The spread of the offshore industry beyond its northern European home to North America, East Asia, India and elsewhere has begun. The first US offshore wind farm came on line last year, there is a renewed push in China, and an ambitious programme in Taiwan; we can hope to see global growth start to take off in earnest in the next few years, although Europe will continue to dominate for the foreseeable future.

However, the big story in 2016 was the dramatic reduction in offshore wind prices. It started with the Dutch tender for Borssele 1 & 2 in June coming in at EUR 72/MWh, well below expectations; followed by a Danish nearshore tender in September at EUR 64/MWh. This was followed in November with the winning bid for the Danish Krieger's Flak project coming in at an astonishing EUR 49.90/MWh; and then Borssele 3 & 4 in the Netherlands coming in at EUR 54.50/MWh in December. We now have the strange situation where at least at the moment, in some circumstances, *offshore is cheaper than onshore!*

The reasons are many: the maturing of the industry, the improvement and maturation of the technology and management thereof, growing investor confidence, and the introduction and deployment of a new generation of 6-8 MW (and now 9 MW with the up-rating of the Vestas V-164) machines, with enormous swept area and tremendous output.

Summary of work carried out at European offshore wind farms during 2016

Wind farm name	Country	Status
Gode Wind I	Germany	Fully grid-connected
Gode Wind II	Germany	Fully grid-connected
Gemini	Netherlands	Fully grid-connected
Westermeerwind	Netherlands	Fully grid-connected
Sandbank	Germany	Partially grid-connected
Burbo Bank Extension	United Kingdom	Partially grid-connected
Nobelwind	Belgium	Turbines installed
Nordergründe	Germany	Turbines installed
Nordsee One	Germany	Foundations installed
Veja Mate	Germany	Foundations installed
Wikinger	Germany	Foundations installed
Dudgeon East	United Kingdom	Foundations installed
Galloper	United Kingdom	Foundations installed
Race Bank	United Kingdom	Foundations installed
Rampion	United Kingdom	Foundations installed
Hooksiel	Germany	Decommissioned
Lely	Netherlands	Decommissioned
WindFloat phase 1	Portugal	Decommissioned

Source: WindEurope

EUROPEAN OFFSHORE WIND INVESTMENT UP 40% IN 2016

The European offshore wind industry added 1,558 MW of new capacity - 338 turbines in six wind farms in 2016, representing a decrease of 48% compared to 2015. However, eleven projects accounting for 4,948 MW reached Final Investment Decision (FID) and are expected to become operational by 2018 or 2019 depending on the project. Europe invested a total of EUR 18.2bn (USD 19.6 bn) in offshore wind in 2016, up 39% from 2015.

Overall, there are now 12,631 MW of installed offshore wind power capacity in the waters of the EU. Including sites with partial grid-connected turbines, there are now 81 offshore wind farms in ten European countries.

The UK has the largest offshore wind capacity in Europe, with 5,156 MW, followed by Germany (4,108 MW) and Denmark (1,271 MW). The Netherlands took over fourth place in 2016 with 1,118 MW, with Belgium fifth (712 MW). Combined, the top five EU countries represent 97% of all grid-connected offshore wind installations in Europe.

Installations in the North Sea account for 72% of all offshore wind capacity in Europe, a slight increase from the previous year. The Irish Sea has 16.4% of installed capacity, followed by the Baltic Sea with 11.5%.

Siemens Wind Power is the leading offshore wind turbine supplier in Europe with 67.8% of total installed capacity. MHI Vestas Offshore Wind (16.4%) is second, followed by Senvion (6.2%), Adwen (5.2%) and BARD (3.2%).

In terms of ownership, Northland Power connected the most MW in 2016, representing 23% of ownership, followed by DONG Energy with 20.4%. Global Infrastructure Partners (10.5%), Siemens (7.7%) and Vattenfall (7.6%) complete the top five owners in new additional capacity, accounting for 69.2% of the 2016 market.

The average installed offshore wind turbine size was 4.8 MW, a 15% increase over 2015, and the first 8 MW turbines were grid-connected in 2016. The average size of a grid-connected offshore wind farm in 2016 was 380 MW, 12% larger than the previous year. The average water depth of offshore wind farms where work was carried out in 2016 was 29.2 m, slightly more than in 2015 (27.2 m). The average distance to shore for those projects was 43.5 km, a small increase on the previous year (43.3 km).

Looking ahead, a strong pipeline of projects ensures over 3 GW of installed capacity in 2017. Projects expected to go through FID in 2017 are estimated at a combined capacity of 2.8 GW. These include Borssele I & 2 (700 MW) and Borssele 3 & 4 (700 MW), Global Tech II (553 MW), Kriegers Flak (600 MW), and the financial close of Deutsche Bucht (252 MW). The refinancing of Butendiek (288 MW) and the minority stake in London Array (630 MW) are also scheduled for financial close in 2017. Financing needs could top EUR 7bn based on disclosed transaction costs.

Number of wind farms with grid-connected turbines, no. of turbines connected and no. of MW grid-connected at the end of 2016 per country

Country	Belgium	Germany	Denmark	Spain	Finland	Ireland	Netherlands	Norway	Sweden	UK	Total
No. of farms	6	18	13	1	2	1	6	1	5	28	81
No. of turbines connected	182	947	517	1	11	7	365	1	86	1,472	3,589
Capacity Installed (MW)	712	4,108	1,271	5	32	25	1,118	2	202	5,156	12,631

Source: WindEurope

A slight decrease is expected for annual installations between 2018 and 2020. Nevertheless, European offshore wind is on track to reach at least 24 GW of cumulative installed capacity by 2020.

UK continues global leadership

The UK remains the world leader in terms of cumulative offshore wind installations with 27 wind farms and a total capacity of over 5.1 GW. The largest wind farm is the London Array (630 MW), followed by the largest Welsh wind farm Gwynt-y-Mor (576 MW) and Greater Gabbard (504 MW). While no new offshore wind farms came into full operation in 2016, three windfarms gained consent (Triton Knoll, Hornsea P1 and Blyth).

The new Government elected in 2016 seems supportive of offshore wind, and a second contract for difference allocation round has been announced with results expected in summer 2017. The UK has confirmed its next carbon budget and remains committed to the *Climate Change Act,* placing the focus more on low carbon than renewables specifically, but there is an indication that offshore wind will play a major role in this.

The Offshore Renewable Catapult[1] delivered the third annual *Cost Reduction Monitoring Framework* in January. It showed that industry has met the target of £100/MWh by 2020 four years early in 2016, with offshore wind energy prices falling by 32% since 2012.

Scottish offshore wind projects are being challenged under judicial review. Closure of the renewables obligation is rapidly approaching in 2017, and beyond this allocation round there is a lack of clarity on future allocation rounds and long term visibility. Offshore wind investors are also watching the outcome of negotiations to leave the European Union.

The pipeline of projects is strong with about 12 GW of consented offshore wind farms. The current government sees offshore wind as a key sector for decarbonisation. With an industrial strategy and clean growth plan scheduled for this year offshore wind is likely to take a key role.

Stable growth until 2019 in Germany

In 2016, the German offshore wind industry installed 156 new offshore wind turbines with a total capacity of 818 MW. Overall, 947 offshore wind turbines are grid connected with a total capacity of 4,108 MW, enough to produce 13 TWh of electricity and to power 3 million homes in Germany. This represents an increase of nearly 57% compared to the 8.3 TWh generated in 2015, consolidating offshore wind power's position in the German power mix. The offshore wind expansion is expected to continue with about 1,400 MW in 2017 followed by a steady average of around 1,000 MW per year until 2019.

However, after 2020 the federal government has reduced the target for offshore wind to 500 MW per year. This places a strain on the value chain for the offshore wind industry and overshadows some positive changes brought by the revised *EEG 2017*, such as an extension of the permissible service life of turbines beyond the EEG funding period of 25 years.

A reliable political framework and sufficient expansion volumes are needed for the offshore industry to be able to achieve further cost reductions. This includes swifter grid reinforcement both off and onshore.

The Offshore Wind Act was also adopted as part of the EEG 2017 and includes the introduction of auctioning for offshore wind. The aim of this act is to ensure dovetailing between site planning, regional planning, approval of installations, funding and grid connection. The target for offshore wind has been set at 15 GW by 2030.

Denmark plans to double offshore capacity by 2021

While no new offshore wind was installed in 2016, the Danish offshore wind industry has grand plans for the sector in the near future. At present, Denmark has a total installed offshore capacity of 1,271 MW from 947 grid-connected turbines.

The Danish ambition to cover 50% the country's electricity consumption by wind by 2020 entails an offshore wind target of 1,500 MW. This includes the two tenders which were carried out in 2016 for the 600 MW Krieger's Flak offshore wind farm located in the Baltic Sea and the near shore tenders of 350 MW, which are split up into Vesterhav Syd and Vesterhav Nord, located in the North Sea. Additionally, the installation of the 400 MW Horns Rev 3 also located in the North Sea, will begin in 2017. Overall, Denmark is planning to install nearly 1,400 MW of offshore wind by 2021, more than doubling its current capacity.

The impressive news in 2016 in Denmark was the dramatic reduction of offshore wind prices: the winning bid for the Danish Near Shore tender came in at DKK 475/EUR 64/USD 69 MWh, followed by the world's record low offshore price for the Krieger's Flak project at DKK 372 /EUR 49.90/USD 53 MWh.

In 2017, the world's first offshore wind farm, Vindeby (5 MW) will be decommissioned. The Vindeby wind farm played a crucial role in proving the case for offshore wind after it was installed in 1991.

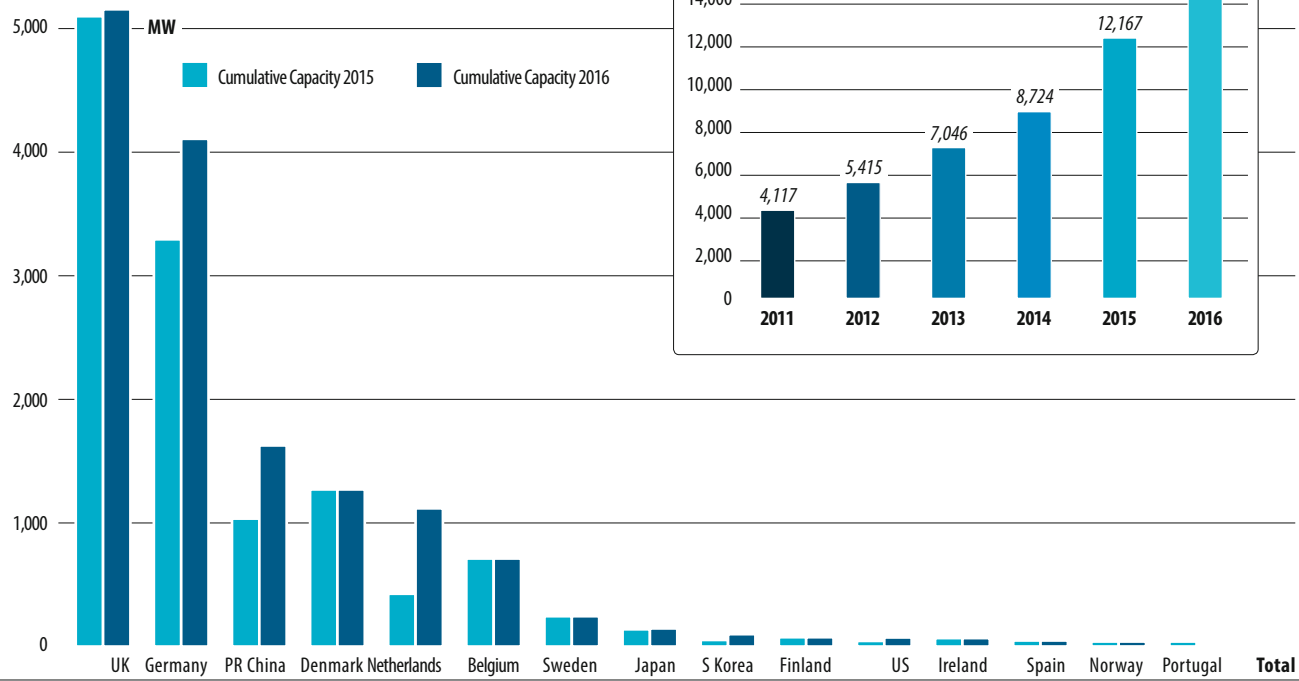
Offshore wind development in Denmark is expected to continue running smoothly with the target to install nearly 1,400 MW by 2021.

Netherlands scores record in 2016

The offshore wind industry in the Netherlands had a record year in 2016. A total of 177 offshore wind turbines with a capacity of 691 MW came online making the Netherlands the 2nd largest market in 2016.

1 https://ore.catapult.org.uk/

GLOBAL CUMULATIVE OFFSHORE WIND CAPACITY IN 2016



ANNUAL CUMULATIVE CAPACITY (2011-2016)

	UK	Germany	PR China	Denmark	Netherlands	Belgium	Sweden	Japan	S Korea	Finland	US	Ireland	Spain	Norway	Portugal	Total
Total 2015	5,100	3,295	1,035	1,271	427	712	202	53	5	32	0.02	25	5	2	2	**12,167**
New 2016	56	813	592	0	691	0	0	7	30	0	30	0	0	0	-2	**2,219**
Total 2016	5,156	4,108	1,627	1,271	1,118	712	202	60	35	32	30	25	5	2	0	**14,384**

Source: GWEC

In cumulative terms, there are 1,118 MW of offshore wind power installed in Dutch waters, the fifth largest market globally, consisting of three relatively small wind farms in the North Sea and the 600 MW Gemini project, located north of the Wadden Islands. The Dutch wind industry expects to reach a total of 4,500 MW of offshore wind power by 2023.

A key challenge for the sector is to ensure the smooth implementation of the planned tenders for offshore wind energy. The first two tenders were successfully held in 2016, encompassing a total of 1,400 MW in the Borssele area off the coast of Zeeland in the southwest.

The industry is well on the way to achieve the objective to reduce costs by 40% over the next five years. Already the first tender was well below the price cap with a winning bid by Dong at EUR 72.7/MWh (USD 76.9/MWh), excluding grid costs. The second tender was awarded to a consortium made up of Shell, Van Oord, Eneco and Diamond Generating Europe Limited at a new record low cost of EUR 54.5/MWh (USD 57.6/MWh), excluding grid costs. The Dutch North Sea has a huge potential to further develop large scale wind after the 2023 targets have been achieved, beginning with the already designated area of *IJmuiden-Ver* which could accommodate 6,000 MW of offshore wind power, after it's been cleared of its current spatial claims.

The government's *Energy Agenda*, published at the end of 2016, includes a solid plan for offshore wind development showing an upscaling of the current 700 MW/year to 1 GW per year. The first tender of this new round will be carried out right after the last tender of the current scheme, ensuring a smooth continuation of the roll-out of offshore wind energy in the Netherlands providing clear visibility for project developers and investors.

CHINA PASSES DENMARK TAKING 3rd PLACE

In 2016, 592.2 MW of new offshore capacity was added in China, up 64% from 2015, bringing the total to 1,627 MW. Shanghai Electric led installations with 82.5% of total installed capacity, followed by Envision (8.5%), Goldwind (8.1%) and CSIC (0.8%).

New offshore wind installations in 2016

Manufacture	Turbine Size (kW)	Units Installed	Total Capacity (MW)
Shanghai Electric	3,600	28	100.8
	4,000	97	388
Envision	4,200	12	50.4
Goldwind	3,000	16	48
CSIC	5,000	1	5
Total		**154**	**592.2**

Limited potential for new onshore wind development in the Northern and Western regions of China helps push developers to move offshore, while the technology has steadily improved in the past few years, with some of the domestic manufacturers now developing bigger turbines to harness the wind offshore.

Additionally, all new installations in 2016 were near shore projects, not the inter-tidal projects that have previously dominated offshore development in China. This is a significant development showing the industry's readiness for take-off. The

Offshore wind power in Japan at the end of 2016

Type	Location	Distance (km)	Depth (m)	Rated (MW)	No. of WTG	Total (MW)	Start operation	
Fixed	Hokkaido	Setana Port	0.7	13	0.6	2	1.2	Dec.2003
	Akita	Akita Port	0.1	-	3.0	1	3.0	Feb.2015
	Yamagata	Sakata port	0.05	4	2.0	5	10.0	Jan.2004
	Ibaraki	Kamisu	0.04	4	2.0	7	14.0	Feb.2010
		Kamisu	~0.05	4	2.0	8	16.0	Feb.2013
	Chiba	Choshi*	3.1	12	2.4	1	2.4	Mar.2013
	Fukuoka	KitaKyushu*	1.4	14	2.0	1	2.0	Jun.2013
Floating	Nagasaki	Fukuejima	5.0	100	2.0	1	2.0	Apr.2016
	Fukushima	Iwaki city	20	120	2.0	1	2.0	Dec.2013
		Naraha			7.0	1	(+5.0)	Mar.2016
					5.0	(1)		2017
Total						**28**	**59.6**	

** projects under commissioning/construction*

Offshore wind projects in the pipeline in Japan

Type	Location	Area	WTG (MW)	No.of WTGs	Total (MW)	Start Operation	EIA Status	
Fixed	Hokkaido	Wakkanai port	Port			10		Pre EIA
		Ishikari new port	Port	4.0MW	26	104	2020	Draft EIA
	Aomori	Mutsuogawara port	Port	2.0MW	40	80	2018~	Draft EIA
	Akita	Noshiro port	Port	3.3-6.0	20	100	2021	Scoping
		Akita port	Port	3.3-6.0	14	70	2022	Scoping
		Akita North	Gen.	3.3-5.0	120	455	2023	Scoping
		Yurihonjo	Gen.			560		Pre EIA
	Yamagata	Sakata port	Port			15		Pre EIA
	Ibaraki	Kashima port1,1st	Port	5.0MW	20	100		No EIA needed as project started before 2012
		Kashima port1,2nd	Port	5.0MW	5	25		No EIA needed
		Kashima port2	Port	5.0MW	25	125		No EIA needed
	Fukuoka	Kitakyushu port	Port			228.8		Pre EIA
		Kitakyushu	Gen.			300**		Pre EIA
	Niigata	Iwafune, Murakami	Gen.	5.0MW	44	220	2025	Pre EIA
	Yamaguchi	Yasuoka, Shimonoseki	Gen.	4.0MW	15	60		Draft EIA
Floating	Fukushima	Iwaki city Naraha*	Gen.	5.0MW	1	5	2017	No EIA needed as total project size smaller than 10MW
	Fukuoka	Kitakyushu*	Gen.		2	7.5	2018	No EIA needed
	Nagasaki	Fukuejima	Gen.	2.0-5.0	10	21		Consulting
Test Field	Niigata	Awashima	Gen.					No EIA needed
	Nagasaki	Kabashima	Gen.					No EIA needed
Total						**2,486.3**		

**National projects **Estimated by JWPA*

13th Five-Year Plan sets a feed-in tariff of RMB 0.85/EUR 0.11/ USD 0.12 kWh for offshore/nearshore and RMB 0.75/EUR 0.10/ USD 0.11 kWh for intertidal projects, which are expected to provide the major driving force for the sector for the next five years.

Ten manufacturers dominate the Chinese offshore market, with the leading four - Shanghai Electric, Envision, Sinovel and Goldwind - taking 90% of the market share. Shanghai Electric, which started its offshore business as a joint-venture with Siemens that came to an end in 2015, leads with 58% of the total share.

On the legislative side, China's National Energy Administration (NEA) issued a new regulation *Offshore Wind Construction and Management Rules* to replace the *Interim Rules on Offshore Wind Construction and Management,* which was issued in 2010. This new rule is a big step forward, clarifying and simplifying issues such as the project approval process, offshore planning and environmental protection. Moreover, provincial governments have been given more autonomy, and are now the key government bodies for project approval.

The 13th Five-Year Plan sets a target of 5 GW by 2020 for the Chinese offshore wind industry.

JAPAN HAS A STRONG PROJECT PIPELINE

By the end of 2016, Japan had 59.6 MW of offshore wind power, with a total of 28 turbines in Japanese waters, including three (two 2 MW and one 7 MW) floating wind turbines. The 7 MW MHI floating turbine was installed as a part of the Fukushima FORWARD project. A further 5 MW Hitachi floating turbine is under commissioning and due to start operation in March 2017.

In 2016, a 2 MW floating turbine situated about 1km off the coast of the Goto islands in Kabashima was moved 10km southwest next to the neighbouring, larger island of Fukuejima and re-connected to the grid starting operation in April 2017. This is the first and only offshore wind project which could enjoy Japan's feed-in tariff for offshore wind at JPY 36/ EUR 0.30/USD 0.32 kWh.

A further 2,486 MW of offshore wind power projects are currently under various stages of development. The 60 MW Yasuoka project is likely to start construction in 2018, and several other projects are expected to start construction within the next couple of years.

Japanese construction company Penta Ocean Company has announced that they will build their own jack-up ship in 2016.

Marine areas in Japan are categorised either as a *Port associated area or as a General common sea area.* The Japanese Ministry of Land, Infrastructure, Transport and Tourism (MILT) amended the *Port and Harbor Law* in May 2016, to promote offshore wind power development in port associated areas. The amended law allows the use of the designated water zone in the port area for developers for 20 years which reduces project risk. Port areas have good infrastructure facilities for construction and grid connection, and most offshore wind power projects are planned in port areas in Japan today.

The City of Kitakyushu held an offshore wind tender in February 2017 according to this new rule in August 2016, which was won by a local consortium which includes J Power, a subsidiary of Kyushu Electric Power Company.

When it comes to the *General common sea area,* there is no law or regulation for offshore wind power. It is governed by Thomas Hobbes' so-called *the war of all against all,* and therefore, it is a huge business risk to undertake projects in the *General common sea area.* The Japanese Cabinet in charge of ocean policy together with MILT are trying to improve the situation but it will take some time.

Offshore wind power has developed at a slow pace in recent years in Japan, despite the huge resource in the country. According to a new study[2] by the Institute for Energy Economics and Financial Analysis (IEEFA) Japanese offshore wind is hugely underestimated. The study found that Japan's move away from nuclear and fossil fuel power could be helped by 10 GW of offshore wind by 2030.

However, this would require a major lowering of regulatory and grid barriers to renewable energy projects, changes that will allow Japan to tap capital markets to support national renewable energy programmes. At the moment the industry is faced with long lead times for environmental permits and local agreements, slowing down wind development in the country.

The Japan Wind Power Association's roadmap for development calls for 700 MW of offshore capacity by 2020, including 100 MW of floating capacity. By 2030 it envisages 10 GW of offshore capacity in total, including 4 GW of floating capacity.

2 http://ieefa.org/wp-content/uploads/2017/03/Japan-Greater-Energy-Security-Through-Renewables-March-2017.pdf

KOREA OFFSHORE MOVES FORWARD

2016 was a significant year for the South Korean offshore wind industry, which was stalled for a few years, but is now moving forward with the installation of the 30 MW Tamra project. Along with two demonstration turbines (5 MW) installed in 2011, the country's total installed offshore capacity now stands at 35 MW. All projects are located off Jeju Island.

The Tamra project, with 3 MW Doosan turbines located 0.5-1km from the shore, is the first utility scale offshore wind project in South Korea. The Tamra project is part of first phase of the 2.5 GW Southwestern Offshore wind project, developed by a state-owned company, Korean Offshore Wind Power (KOWP). Doosan, and potentially Hyosung, will supply turbines for the first phase of the project. Another 60-80 MW are planned to be installed by 2019.

The second phase with about 400 MW is planned to start operation by 2022. The remaining 2 GW doesn't have a timeline for installation, but is expected to come online before 2030, when experience from the first phase can be applied to accelerate the rest of the work.

Driven by the *Carbon Free Island Jeju by 2030* plan, another +400 MW of offshore wind is expected to come online by 2022, contributing to the 100% clean energy goal of the local government.

TAIWAN IS SET FOR A NEW BOOM

The first two turbines of the 128 MW Formosa 1 project came online in March 2017, a significant step forward for a promising new Asian offshore market. The first two turbines are Siemens 4 MW machines and the remaining 120 MW is scheduled to be installed by 2019.

With the new president's reiteration of the target to source 20% of electricity from renewables by 2025, combined with good offshore wind and seabed conditions, the offshore wind industry is looking at another GW size market in Asia. Offshore wind is the backbone for delivering the government's objective of phasing out nuclear power by 2025. The target for offshore wind is set at 3 GW by 2025, five years earlier than in the previous plan. 36 offshore locations have been identified for future planning.

The offshore wind market in Taiwan is easy for international players to enter. Dong Energy is now looking at another 4 projects, totalling 2 GW, located in the Taiwan Strait, while other international players, both developers and manufacturers, see Taiwan as a strategic location for developing their offshore business in Asia.

Developers can choose between two options for a feed-in tariff in Taiwan. The first is set at TWD 5.740 EUR 0.176/ USD 0.189 per kWh for 20 years, and the second option at TWD 7.108/ EUR 0.218/USD 0.235 kWh for the first ten years, and at TWD 3.459/EUR 0.106/USD 0.114 kWh for the following ten years. Further incentives are provided for demonstration projects, such as government-supplied wind masts, Environmental Impact Assessments (EIA) and interest-free loans.

US OFFSHORE WIND ENERGY AT LAST A REALITY

American offshore wind energy is at last a reality, bringing an energy source familiar in Europe to the US for the first time. The US commissioned its first offshore wind project in December 2016, the 30 MW, five turbine Block Island project off the coast of Rhode Island. Additional projects are proposed in both state and federal waters off the Atlantic and Pacific coasts, as well as in the Great Lakes.

In March 2017, Statoil and the US Bureau of Ocean Energy Management (BOEM) formally executed the lease of 321sq km offshore New York, paving the way for the Norwegian giant to explore the potential development of an offshore wind farm. The lease comprises an area that could potentially accommodate more than 1 GW of offshore wind, with a phased development


© LM Wind Power

expected to start with 400-600 MW. The New York Wind Energy Area is located 30-60km offshore, spans 321sq km, and covers water depths between 20-40 meters.

The wind farm would provide New York with a significant, long-term source of clean and renewable electricity.

In addition to the recent offshore wind developments in Massachusetts, Rhode Island and New York, the latest news comes out of North Carolina: Avangrid Renewables has won a Department of Interior auction to develop a project off the state's coast. North Carolina's first land-based wind farm recently became operational, and now offshore wind is on its way. Situated near Kitty Hawk, the site of the Wright Brothers' first flight, the ocean parcel could soon power thousands if not millions of American homes. Millions of dollars in private investment drawn to this new ocean energy resource will help boost North Carolina's economy, creating new demand for skilled jobs, factories and US flagged vessels.

In all, 13 offshore wind projects on both coasts and in the Great Lakes remain under various stages of development. The US Department of Energy's roadmap for wind power, *Wind Vision*[3] envisages offshore wind providing 2% of US electricity demand in 2030 and 7% in 2050.

UPCOMING MARKETS

India takes steps forward

The Indian Ministry of New and Renewable Energy announced *India's Offshore Wind Policy* in 2015. India's National Institute for Wind Energy (NIWE) was designated as the nodal agency for implementing the policy and creating the necessary ecosystem for the sector.

The first comprehensive assessment of offshore wind potential in two key coastal states is being undertaken by the FOWIND project[4], a GWEC led consortium. This is a four-year European Union co-financed project. NIWE is the knowledge partner to FOWIND.

FOWIND is undertaking the first offshore wind resource measurement in the Gulf of Khambhat, off the coast of Gujarat. India's first offshore wind research platform is being installed under this project. FOWIND, the Indian Ministry of New and Renewable Energy (MNRE), and the National Institute of Wind Energy (NIWE) have developed the platform jointly. The National Institute of Ocean Technology (NIOT) provided technical support during the platform design phase. FOWIND will install India's first offshore LiDAR in 2017.

Also, NIWE is in the process of finalising the first geo-physical surveys along the Gujarat coast. Another offshore platform is in the works for the Tamil Nadu coast.

The Offshore Wind Policy outlines an international competitive bidding mechanism for the sector. The first tender is likely to be announced in 2019.

Vietnam's abundant offshore wind resources

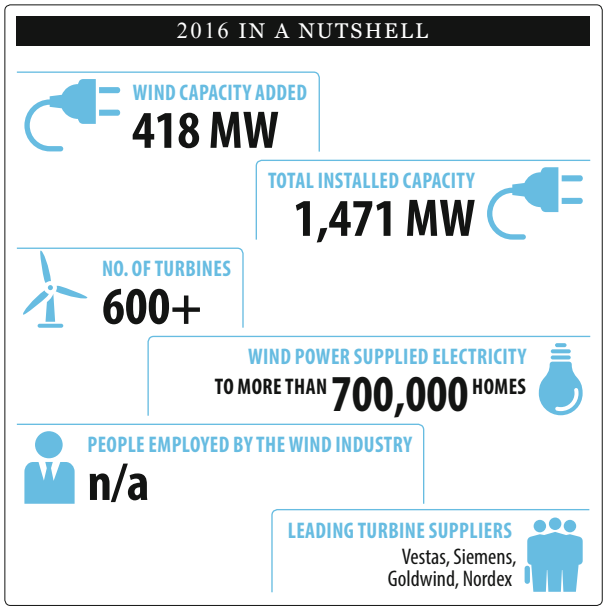
Vietnam's first near-shore/intertidal wind project, the 99.2 MW Bac Lieu wind farm, is Asia's first offshore wind farm in the Mekong Delta region, and came online in stages from 2013-2015. Another nearshore wind project, the 800 MW Phu Cuong wind farm, also located in Mekong Delta, is now gearing up. The first phase, the Phu Cuong 1 Wind Farm (170 MW), is expected to reach financial close in 2018.

In 2016, new projects, both onshore and offshore, were being developed in Soc Trang Province, which is emerging as the next hot spot for wind development in Vietnam.

Despite slow progress to date, the Vietnamese wind market has started attracting world leading turbine manufacturers and investors. Vietnam may become the next gigawatt sized wind market in Asia, once the regulatory and financial conditions are corrected, which may come during the course of 2017.

With input from AWEA, BWE, CWEA, DWIA, JWPA/JWEA, KWEIA, NWEA, RenewableUK, VDMA, WindEurope

3 https://energy.gov/eere/wind/maps/wind-vision
4 Facilitating Offshore Wind in India (FOWIND). For more info visit www.fowind.in



SOUTH AFRICA

2016 saw an unfortunate impasse for the South African wind industry due to political issues with the national utility provider Eskom. This meant that 37 renewable energy projects, including 12 wind farm developments, have been unable to reach financial close due to Eskom's refusal to sign Power Purchase Agreements (PPAs). There are now positive signs that the standoff may soon be over and PPAs will soon be signed.

Despite this, a total of 418 MW of wind power was added to the country's electricity grid, bringing the cumulative capacity to 1,471 MW. After taking a decade for the first 10 MW of wind power to be installed, there's presently more than 3,365 MW under different stages of development.

The development of South Africa's wind industry, under a government designed competitive bidding programme, has taken place within a relatively short period of about five years, placing South Africa among the leading new wind markets globally. The wind industry and its supply chain are becoming firmly established with 20 wind farms now fully operational, and many more under construction.

WIND MARKET IN 2016

With bidding for the first four rounds of South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) completed, and after three rounds of preferred bidders have reached financial close, by 2015 the wind industry has established itself as a major new infrastructure sector and is now worth about ZAR 75 billion (EUR 5.5/USD 5.8 bn).

Unfortunately, due to the aforementioned delays, the REIPPPP programme has not progressed, meaning no further projects have reached financial close. The status remains that the first three rounds of the REIPPPP totalling 1,984 MW have reached financial close. Financial close for another 1,363 MW (REIPPP Round 4(a) and (b)) is pending while the preferred bidders for the Expedited REIPPPP Round 4, with at least 800 MW, have yet to be announced.

South Africa has excellent wind resource, detailed in the wind map[1] developed by WASA. More than 80% of SA's land mass has the wind conditions to produce high load factors (more than 30%). Upscaling renewables development in the country has become a necessity, as renewable energy is the only source of new power that can be deployed fast enough to help ease South Africa's chronic electricity shortages.

South Africa's revised *Integrated Resource Plan* is currently out for consultation and has allocated at least 37,000 MW of wind power by 2050. It is expected to be finalised later this year.

SOCIO ECONOMIC DEVELOPMENT

The REIPPPP procurement rules include a strong government ambition to create a high level of local content, with an incentive to boost employment and to support local communities.

Across the six bid windows, a total of ZAR 19.3 billion (EUR 1.4/USD 1.5 bn) (2.2% of revenue) has been committed by the industry, for socio-economic development i.e. 120% more than the minimum requirement. Of this, ZAR 15.2 billion (EUR 1.1/USD 1.17 bn) is specifically allocated for local communities where the IPPs operate.

Of the 64 IPPs from bid windows 1-3.5, 58 are operational and their SED spend amounts to ZAR 256 million (EUR 18.6/USD 19.7 mn).

The REIPPPP is also stimulating local manufacturing and creating sustainable jobs. By March 2016 over ZAR 30 billion (EUR 2.2/USD 2.3 bn) had been spent on local content and a further ZAR 65.7 billion (EUR 4.8/USD 5.1 bn) is expected to be spent by projects that have yet to commence construction.

The total projected value of goods and services to be procured from broad-based black economic empowerment suppliers is more than ZAR 101 billion (EUR 7.4/USD 7.8 bn). ZAR 91.1 billion (EUR 570/USD 600 mn) is committed to various development initiatives under the REIPPPP.

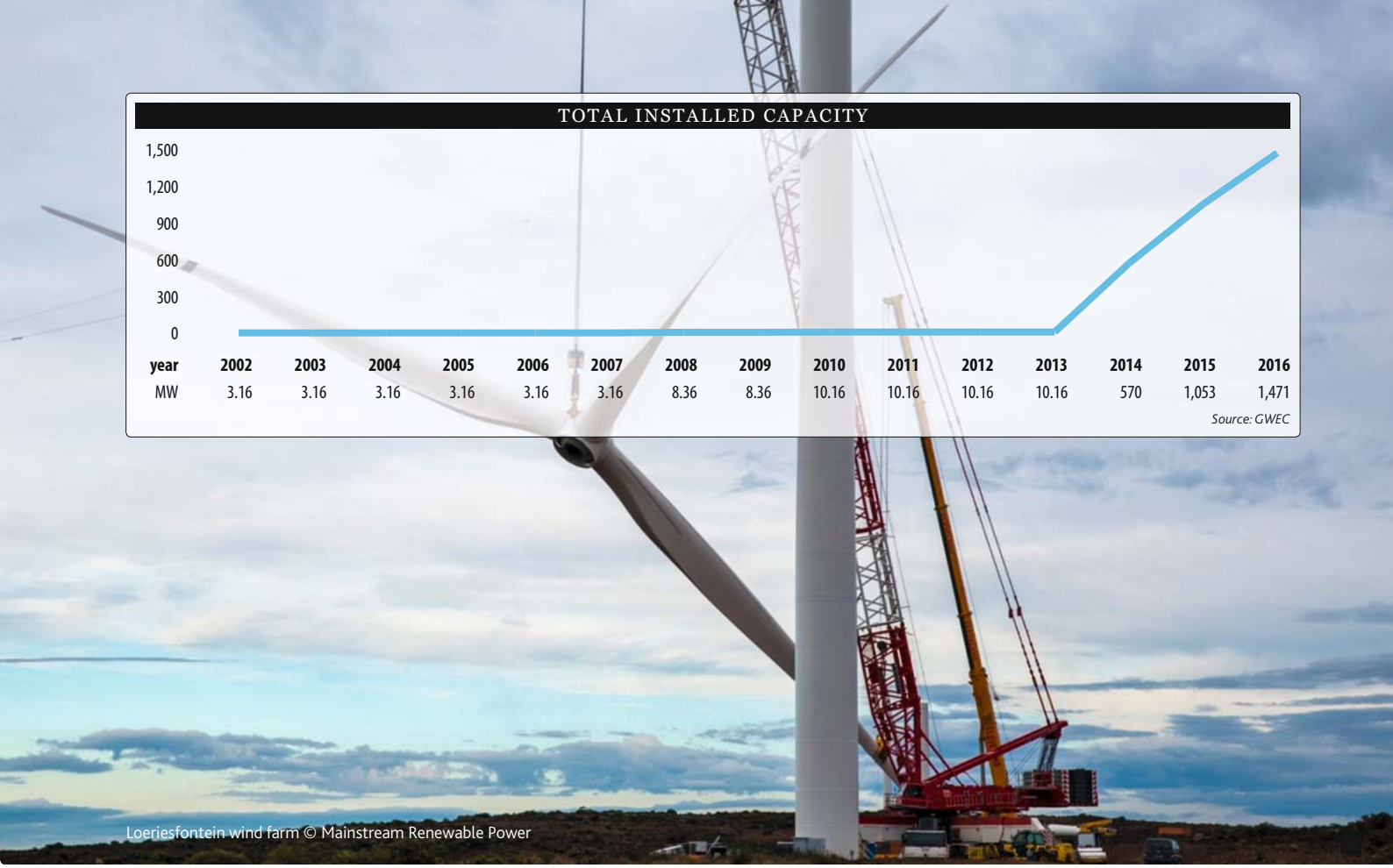
Many of the large international developers and utilities are active in the South African market. The key manufacturers are Vestas, Siemens, Goldwind and Nordex.

WIND POWER CHEAPEST SOURCE OF ELECTRICITY

South Africa has the world's seventh largest coal reserves, and coal supplies about 77% of South Africa's primary energy, followed by oil and solid biomass and waste. South Africa's energy balance also includes relatively small shares of natural gas, nuclear, and hydroelectricity. South Africa's dependence on hydrocarbons, particularly coal, has made the country the world's 13th largest CO_2 emitter.

The maintenance of the coal fleet has been challenging and capacity factors are down to about 70%, leading to regular electricity shortages, which could be eased by rapid deployment of renewable energy, especially wind power.

1 http://www.wasaproject.info/



TOTAL INSTALLED CAPACITY

year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MW	3.16	3.16	3.16	3.16	3.16	3.16	8.36	8.36	10.16	10.16	10.16	10.16	570	1,053	1,471

Source: GWEC

Loeriesfontein wind farm © Mainstream Renewable Power

Historically, South Africa had had very low electricity prices, but in recent years they have been rising quickly. The REIPPPP is bringing renewable energy to the National grid fast and cheaper than new-build coal. Construction times for projects average less than two years, and the electricity price paid to projects has declined 68% within three years.

The price of wind energy in the last Round 4 expedited was ZAR 0.62/kWh (EUR 0.045/USD 0.047) more than 40% less than forecast prices for Eskom's new-build coal plants Kusile and Medupi.

In 2015, a new report by the Council for Scientific and Industrial Research (CSIR) showed less-than-zero costs for renewable energy to the country. According to CSIR, wind and solar power combined saved ZAR 4 billion from January to June 2015. Wind energy produced net savings of ZAR 1.8 billion and was also cash positive for Eskom by ZAR 300 million.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

Some remaining obstacles to the wind industry include:

- The problems and political challenges surrounding relying on South Africa's sole utility provider to provide Power Purchase Agreements and grid connections.
- The extensive works to facilitate grid integration are under the responsibility of the country's power utility, Eskom, who had previously subsidised the associated costs. However, these costs are now increasingly being transferred to project developers resulting in more costly projects. Additionally, extended transmission and distribution works are needed, and the cost recovery rules for this are not yet transparent or consistent. This issue is currently being addressed by the South African Renewable Energy Council through the Grid Code Advisory Committee.
- The costs involved in tendering for the procurement programme are high and create a challenge for smaller players.
- South Africa's economy is stagnating, and exchange rate fluctuations cause challenges to the REIPPPP by exerting upward pressures on bid prices. It also creates challenges for foreign investors hoping to evacuate hard currency from South African projects. A change in the sovereign credit rating may impact on the risk premium foreign investors require.

OUTLOOK FOR 2017 AND BEYOND

If the current impasse can be overcome, which looks likely, the wind industry in South Africa can pick up its very rapid growth phase from where it stalled. The country's chronic power shortages and the large boost in allocation for renewable energy in the revised IRP mean that the REIPPPP is likely to be expanded once more. South Africa is moving towards a large wind industry with a domestic installed capacity in excess of 6,000 MW by 2020, if not sooner, and an allocated one of at least 37,000 MW by 2050 if the draft IRP is made policy.

With input from the South African Wind Power Association, SAWEA

2016 IN A NUTSHELL

WIND CAPACITY ADDED
1,387 MW

TOTAL INSTALLED CAPACITY
6,081 MW

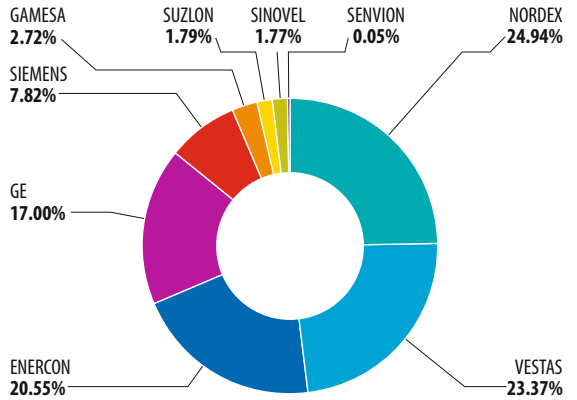
NO. OF TURBINES
2,658

ELECTRICITY DEMAND COVERED BY WIND POWER
7.3%

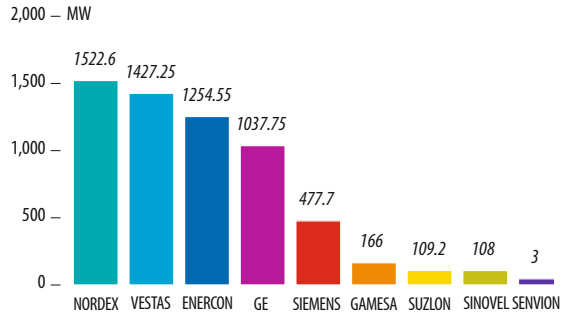
PEOPLE EMPLOYED BY THE WIND INDUSTRY
n/a

LEADING TURBINE SUPPLIERS
Nordex, Vestas, Enercon, GE, Siemens, Gamesa

TURKEY



Turbine Manufacturers at the Turkish wind market



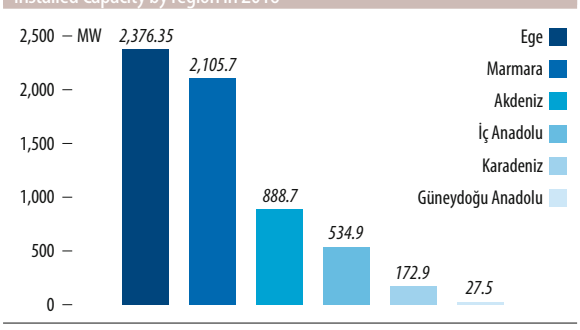
Source: TUREB

WIND ENERGY MARKET IN 2016

In 2016, Turkey added 1,387 MW of new wind power to the country's electricity grid, bringing total capacity to 6,081 MW, consisting of 2,658 turbines in 149 wind farms. This was enough to supply 7.3% of Turkey's electricity demand in 2016.

Turkey has become one of the world's leading onshore wind markets, and in 2016 was the 3rd largest annual market in Europe, and 7th largest globally. Turkey has a strong pipeline of wind projects, and the Turkish Wind Energy Association estimates that under the current regulatory framework a total installed capacity of 10 GW could be reached within the next three years. The government has set a national target for wind power to reach 20 GW by 2023.

Turkey's rich wind resources are estimated at 48 GW from areas with >7 m/s wind speeds at 50 meters. As of the end of 2016, the Aegean region (EGE) had the highest installed wind capacity with a total of 2,376 MW, followed by the Marmara region with 2,106 MW and the Akdeniz region with 889 MW.



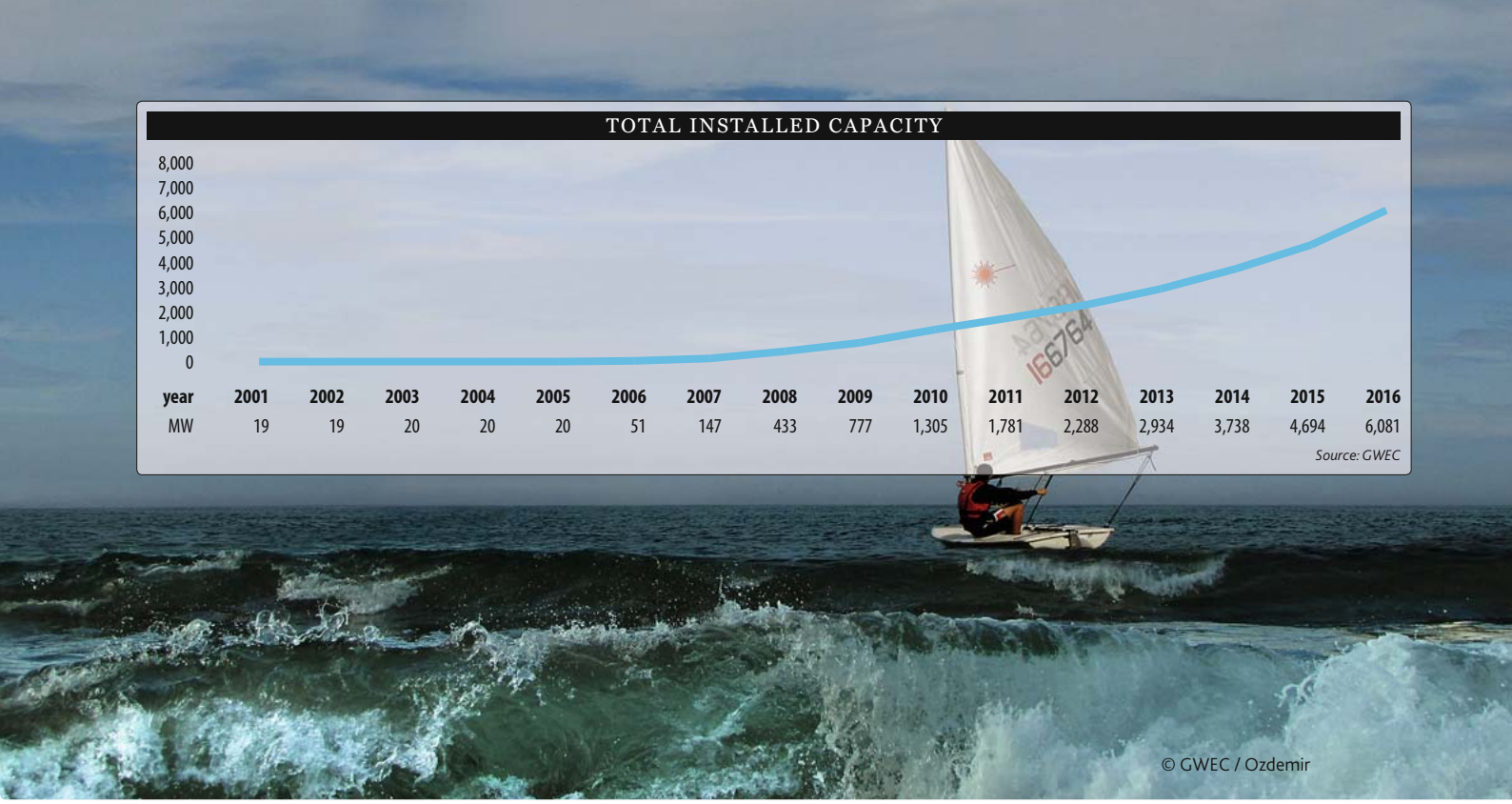
The leading players in the Turkish wind market are Polat Energy (561 MW), Demirer Holding (409 MW), Güriş (404 MW) and Bilgin Energy (372 MW), followed by Borusan EnBW (332 MW).

Turkey is one of the fastest growing power markets in the world. With very limited oil and gas reserves, Turkey is increasingly turning to renewable energy sources to improve its energy security, seeking to provide 30% of its electricity from renewable energy by 2023. However, to match rapidly growing energy demand, more investments are needed.

Support framework for wind energy

Turkey's Renewable Energy Law came into force in 2005, and was amended in 2010. It sets the legal framework for the promotion of electricity generation from renewable sources. The law defines the feed-in tariff, purchase obligation, priority connection and an exemption from license obligations for small-scale generators. The feed-in tariff for wind power is set at USD 7.3 cent/kWh (EUR 6.9 cent/kWh) for a period of ten years and applies to power plants that come into operation before 31 December 2020. The law allows an additional bonus of up to USD 3.7 cent/kWh (EUR 3.5 cent/kWh) for up to five years for using locally manufactured components.

Another incentive is the 85% discount for the right of easement on state owned land for transportation and transmission. This incentive applies to facilities that commence operations before 31 December 2020. The discount will apply during the first ten years after the establishment of the wind farm. The amended law also allows for the construction of renewable energy projects in national and natural parks, protected regions, conserved forests, wildlife development zones, special environmental protection zones and natural protected areas, provided that the necessary permissions are obtained from the Ministry of Environment and/or regional protection boards.



NEW POLICY DEVELOPMENTS

Enhancing energy security and the promotion of renewable energy are at the heart of Turkey's energy agenda. The *Energy and Electricity Market Law*, published in April 2013, introduced a new *Electricity Market License Regulation* which entered into force in November 2013, and was further amended in January 2017.

Under this regulation, wind projects that exceed 1 MW are required to obtain a generation license from Turkey's Electricity Market Regulatory Authority (EMRA). There are two stages for the licensing procedure: pre- license and license. In the pre-license period, applicants are given 24 months (which can be extended to 36 months under certain conditions) to seek the necessary permits for urban planning, construction, land acquisition etc. If the necessary permits cannot be obtained over a period of 24 months, or the requirements specified by EMRA cannot be fulfilled, the applicant will not be granted an electricity generation license.

Each year on a fixed date, the Turkish Electricity Transmission Company (TEIAS) announces the available transformer capacity for wind projects, which is established on a regional basis and determines how much wind power can be connected to the regional grid system.

The new *Regulation on Renewable Energy Resources Zones* issued by the Ministry of Energy and Natural Resources (MENR) came into force on 9 October 2016. This regulation introduces a new investment model to support investment in renewable energy and to encourage local manufacturing. The main purpose of the regulation is to promote the use of renewables by identifying renewable energy zones on both public and private land. This helps to speed up investment in renewables, supports local manufacturing and contributes to research and development activities through technology transfer.

The RE-Zones identified by the General Directorate of Renewable Energy (GDRE) are classified by technology, resource potential and estimated electricity generation cost in line with the objectives set by the MENR. The selected RE-Zones to be opened for an investment are determined by the MENR. The GDRE obtains all required land usage permits, conducts Environmental Impact Assessment studies, geological and geotechnical studies, prepares scaled maps and carries out electricity connection/transmission infrastructure works for each RE-Zone to make it ready for investment. The first tender for the Wind Energy Resources Zones is planned to be held in the first quarter of 2017.

KEY BARRIERS TO WIND ENERGY DEVELOPMENT

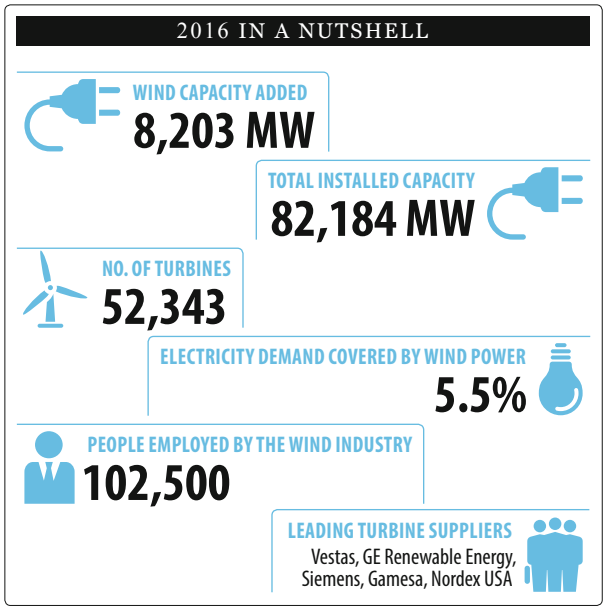
Although many improvements have been achieved in the regulatory framework and steps towards a more liberalised power market have been taken, some barriers to wind development in Turkey still remain, including:

- An immature electricity and gas market, which impedes the predictability of market prices.
- Technical difficulties in transmission and lack of continuous and predictable grid connection capacity allocation.
- Long administrative procedures with the involvement of numerous central and local authorities.

OUTLOOK FOR 2017 AND BEYOND

The Turkish Wind Energy Association expects Turkey to reach an installed capacity of 7 GW in 2017, and to increase installations with an average of 1.5 GW per year up to 2022-2023.

With input from the Turkish Wind Power Association, TUREB



UNITED STATES

WIND ENERGY MARKET IN 2016

The US wind industry installed 8,203 MW of new capacity in 2016, including 6,478 MW during the fourth quarter alone, making it the second strongest quarter for installations on record. The new installations bring total wind power capacity in the US up to 82,184 MW across 40 states, enough to power about 24 million average American homes.

US wind power surpassed conventional hydroelectricity to become the number one source of renewable capacity in the country at the end of 2016, and has grown at an average annual rate of 12% over the last five years. Over the past seven years, the cost of wind power dropped an impressive 66%, according to Lazard's Levelized Cost of Energy Analysis report from November 2016[1].

As a result of advancing technology and domestic manufacturing, wind is one of the most affordable sources of electricity today in the United States and a leading choice for new generation for both utilities and corporate purchasers. Wind is now a major economic contributor, attracting over USD 143 billion (EUR 134.6 bn) in project investment over the past ten years.

LATEST POLICY DEVELOPMENTS

The main policy development driving activity today is the multi-year extension of the Production Tax Credit (PTC) and alternative Investment Tax Credit (ITC) passed by Congress on 15 December, 2015. The bipartisan-supported government spending bill secured the predictable business environment needed to keep the US domestic supply chain operating and to keep scaling up American wind power. The tax credits, available at full value for projects that started construction by the end of 2016, have now begun phasing down by 20% each year through the end of 2019. After starting construction, projects must be placed in service within four calendar years to qualify for the credit.

On the regulatory front, the fate of the Clean Power Plan (CPP) remains to be decided by the courts. The Environmental Protection Agency (EPA) released the final rule of the Clean Power Plan (CPP) in August 2015, mandating emissions reductions from most existing fossil generating units. Following heavy litigation, the US Supreme Court placed an emergency stay on the EPA in February 2016, halting the administration from implementing the rule until both the D.C. Circuit Court and the Supreme Court provide judgment on the rule's legality. The CPP is estimated to reduce carbon emissions 32% from 2005 levels by 2030. According to economic analysis from the US Energy Information Administration of the proposed Clean Power Plan, wind can supply the majority of the lowest-cost Clean Power Plan compliance mix.[2]

With the primary federal policy mechanism secured in the phase-down and the ultimate fate of the CPP unknown, policy attention has shifted to the states. Multiple states strengthened their renewable portfolio standards (RPS) during 2016, and there are now five states and the District of Columbia with RPS targets of at least 50%. Oregon passed legislation in February, increasing the RPS to require 50% renewable energy by 2040. On the east coast, New York passed legislation requiring 50% renewable energy procurement by 2030, and the District of Columbia increased its RPS to 50% by 2032. Massachusetts passed an energy bill requiring the procurement of 9.45 million MWh of clean energy generation and 1,600 MW of offshore wind capacity, and Rhode Island extended its renewable energy standard from 2019 through 2035, ultimately requiring 38.5% renewable energy by 2035.

State RPS policy activity has continued into early 2017. At the beginning of the year the two-year freeze of Ohio's RPS expired, making the standard mandatory again. In February, Maryland lawmakers overrode the Governor's veto to increase their RPS to 25% and accelerate compliance to 2020.

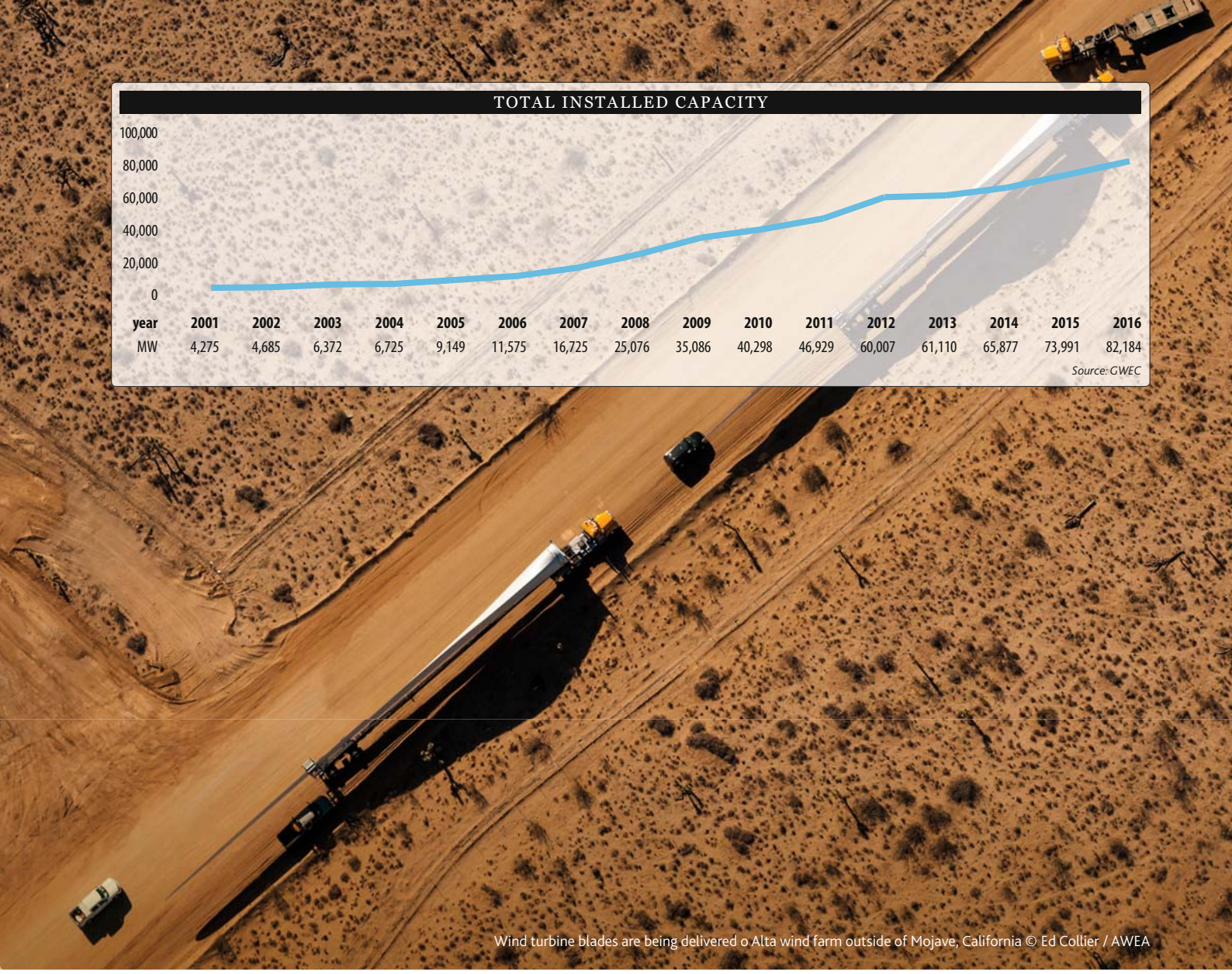
OUTLOOK FOR 2017 AND BEYOND

Combining the multi-year PTC extension with recent RPS increases and falling technology costs, the US wind industry expects robust growth to continue in 2017 and beyond. As of the end of 2016, more than 18,300 MW of wind capacity were under construction or in advanced development across 31 states. Over half of current construction activity is located in Texas while the Plains and Midwestern states continue to add significant wind capacity. Oklahoma surpassed California to become the third-ranked state in installed capacity at the end of 2016, and Kansas surpassed Illinois to become the fifth-ranked state.

Utilities responded to the multi-year extension of the PTC during 2016 with announcements to build and operate large-scale wind projects across the country. New announcements include MidAmerican Energy's 2,000 MW Wind XI project in Iowa, Alliant Energy's planned 500 MW Whispering Willow expansion in Iowa, and multiple projects by Xcel Energy in Colorado, Minnesota and North Dakota.

1 https://www.lazard.com/perspective/levelized-cost-of-energy-analysis-100/

2 http://www.eia.gov/analysis/requests/powerplants/cleanplan/pdf/powerplant.pdf



TOTAL INSTALLED CAPACITY

year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MW	4,275	4,685	6,372	6,725	9,149	11,575	16,725	25,076	35,086	40,298	46,929	60,007	61,110	65,877	73,991	82,184

Source: GWEC

Wind turbine blades are being delivered o Alta wind farm outside of Mojave, California © Ed Collier / AWEA

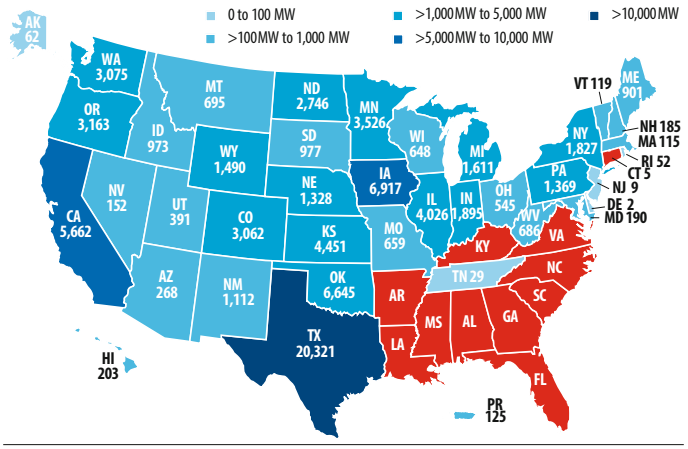
Meanwhile, utilities and corporate purchasers continue to sign long-term contracts for wind energy. Over 4,000 MW of power purchase agreements (PPA) were signed for wind power during 2015. For the year, corporate purchasers comprised 39% of the total capacity contracted - 57% of which were located in Texas. These PPAs include purchasers such as Amazon, General Motors, Google, Microsoft, Johnson & Johnson, 3M, and the US Army, who are turning to wind energy to provide clean, stably-priced electricity for their operations.

American offshore wind energy is at last a reality, bringing an energy source familiar in Europe to the US for the first time. The US commissioned its first offshore wind project in December 2016, the 30 MW, five turbine Block Island wind project off the coast of Rhode Island. Additional projects are proposed in both state and federal waters off the Atlantic and Pacific coasts, as well as in the Great Lakes.

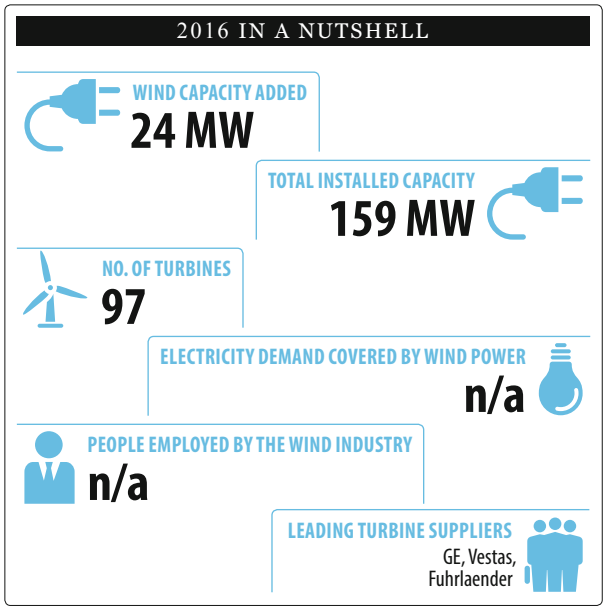
In today's rapidly shifting US environmental and energy policy landscape, an important goal of the wind industry is to secure a policy framework that provides certainty to the industry and appropriately values its attributes, including zero emissions power and price stability. A policy environment that values such attributes will free the industry to realize the DOE's *Wind Vision*, providing 10% of the country's electricity in 2020, reaching 20% by 2030, and providing over a third by 2050, all while saving consumers money.

With input from the American Wind Energy Association, AWEA

Installed wind power capacity by state



Source: American Wind Energy Association



VIETNAM

WIND MARKET IN 2016

Vietnam has some of the most abundant wind resources in Southeast Asia. The country's more than 3,500 kms of coastline, along with its many islands scattered in the South China Sea, provide ideal conditions for wind power development. A study conducted by the World Bank has found that 8.6% of Vietnam's total land area has high to very high potential for large scale wind development, with average wind speeds exceeding 7m/s. The overall onshore wind potential has been estimated at 24 GW.

Wind development in Vietnam is still at the early stages, with an overall capacity of 159 MW, up 24 MW from 2015. Vietnam has four wind farms: the 30 MW Tuy Phong, Phu Quy (6 MW) and Phu Lac (24 MW) wind farms in Binh Thuan province; and the 99 MW Bac Lieu wind farm in the Mekong Delta's Bac Lieu Province. The two most promising regions for wind power are Ninh Thuan and Binh Thuan provinces. Binh Thuan has a *Master plan for wind power development for 2020,* approved by the Ministry of Industry and Trade (MOIT). In 2016, new projects, both onshore and offshore, have begun development in Soc Trang Province, which is emerging as the next hot spot for wind in Vietnam.

Despite slow progress to date, the Vietnamese wind market has started attracting leading turbine manufacturers and investors. Vietnam may become the next gigawatt sized wind market in Asia, once the regulatory and financial conditions are corrected, which may come during the course of 2017.

Trends in the electricity sector

Vietnam's economy is growing rapidly and has a high demand for new power generation. According to the government's *National Master Plan for Power Development for the period 2011-2030,* electricity demand is expected to increase by 10% annually during 2016-2020 and by 7-8% per year from 2021 to 2030. During this period new electricity installations are expected to triple, reaching a total of 110 GW by 2030. The government is under pressure to strengthen the electricity sector in the next decade to fulfill its economic goals.

Existing installed capacity consists of a mix of hydropower, gas-fired, oil-fired and coal-fired plants. The importance of hydro and thermal plants in the total installed capacity has alternated, but generally hydro remains dominant and today accounts for more than half of installed capacity. Further harnessing of hydro power resources is challenging, given its environmental impact, and the fact that most of the big rivers are regional rivers where exploitation of resources needs coordination with neighboring countries. Importing more coal for power is a poor choice not only for the environment but also economically, as Vietnam is already heavily dependent on imported fossil fuels. Against this background, the Vietnamese government is turning towards the country's abundant natural resources as the next strategic option for electricity production. Wind energy is on top of the government's agenda, given the country's rich wind resources.

Targets

The *National Power Development Plan* was introduced by the government in 2011 to enhance energy security, for the promotion of the use of renewable energy, and to further liberalize the power market. The goal of the plan is to increase electricity production from renewables to 4.5% in 2020 and 6% by 2030, from 3.5% in 2010. This target was further revised in March 2016, introducing an interim target of 2 GW of wind by 2025.

Target by technology in 2020, 2025 and 2030

	2020 (MW)	2025 (MW)	2030 (MW)
Wind	800	2,000	6,000
Biomass	500	2,000	
Hydropower	21,600	24,600	27,800
(Pumped Storage)		1,200	2,400
Thermal Power	26,000	45,800	
Solar	850	4,000	12,000
Nuclear		46,000 (first reactor)	

(Source: National Power Development Plan, Updated in 2016)

Feed-in tariff

In addition to the target set for wind development, the government has also issued a regulation (Decision No. 37/QD-TTg) introducing a feed-in tariff for the sector in 2011. The price is set at VND 1,614/kWh (USD 7.8 cents/EUR 7 per kWh) which includes a government subsidy of VND 207/kWh (USD 1.0 cent/kWh) through the Vietnamese Environmental Protection Fund. The rest of the 6.8 cents/kWh comes from the country's only grid operator and utility *Vietnam Electricity* (EVN). The tariff is valid for 20 years by a PPA signed between the wind developer and EVN.

The tariff is not sufficient to spur investment in the sector, which is one of the major reasons why wind development has not taken off in the country since the FIT was introduced in

2011. According to the industry, a tariff of USD 10 cent/ kWh is considered as the minimum for a viable wind energy project, given the country's financial and regulatory conditions. During 2016 progress was made at governmental level to improve the FIT level to stimulate renewables development. Once the new FIT kicks in, if at a reasonable level, wind development in Vietnam is expected to boom.

Grid infrastructure and the capacity and electricity market

The electricity market in Vietnam is dominated by vertically integrated EVN, which is the only off-taker, except for projects under 3 MW. EVN's core businesses include electricity generation, transmission and distribution.

The power grid is run by five sub-grids under the EVN, namely, EVN-NPC, EVN-HCMC, EVN CPS, EVN SPC and EVN Hanoi. There is also a line importing about 1.6% of Vietnam's electricity from China, as well as a line exporting electricity to Cambodia.

Regional wind development

The most promising areas for wind development can be found in the coastal and highland areas in South-Central Vietnam, including Ninh Thuan, Binh Thuan, Lam Dong, Tra Vinh, Soc Trang, Quang Binh, Quang Tri, Thua Thien, Hue and Binh Dinh. Most of the current discussion is focused on onshore wind potential, but given country's the long coastlines, offshore potential is also tremendous. Additionally, many of the islands are good sites for both on and offshore development.

KEY BARRIERS TO WIND DEVELOPMENT

The key barriers for wind projects in the Vietnamese wind market are:

- The EVN should be restructured by splitting up with separate powers and duties for operation, transmission, distribution etc.
- More transparent policies and mechanisms are needed to make wind projects bankable
- Too low feed-in tariff

OFFSHORE WIND POWER

Vietnam's first near-shore/intertidal wind project, the 99.2 MW Bac Lieu wind farm, is Asia's first offshore wind farm in the Mekong Delta region, which came online in stages from 2013-2015. Another nearshore wind project, the 800 MW Phu Cuong wind farm, also located in Mekong Delta, is now gearing up. The first phase, the Phu Cuong 1 wind farm (170 MW), is expected to reach financial close in 2018.

OUTLOOK FOR 2017 AND BEYOND

The Vietnamese government has set out targets for wind power of 800 MW by 2020, 2,000 MW by 2025 and 6 GW by 2030. A lot will depend on developments in the regulatory framework and pricing, but there are great expectations that the government's targets can be met or exceeded.

ABOUT GWEC

OPENING UP NEW MARKETS FOR BUSINESS

GWEC is a member-based organisation that represents the entire wind energy sector. The members of GWEC represent over 1,500 companies, organisations and institutions in more than 80 countries, including manufacturers, developers, component suppliers, research institutes, national wind and renewables associations, electricity providers, finance, insurance companies and law firms.

Our mission is to ensure that wind power establishes itself as the answer to today's energy challenges, providing substantial environmental and economic benefits.

GWEC works with national and international policy makers and industry associations to help open new markets for wind power i.e. UNFCCC, the IEA, international financial institutions, the IPCC and IRENA. GWEC has a proven track record of success in helping to build the wind power industry in emerging markets around the world, including Brazil, China, India, Mexico and South Africa.

MOVE AHEAD INTO NEW MARKETS AND JOIN GWEC TODAY!

> Vaisala's GWEC membership directly supports the growth of our renewable energy measurement and consulting business. Through innovative programs, industry events, and policy development work at international events such as COP21, we view GWEC as a key partner in the growth of our business, the renewable industry and betterment of our planet
>
> **Kjell Forsen, Vaisala CEO**

GWEC MEMBERSHIP BENEFITS

- **Access to first-hand market analysis** – we provide authoritative research and analysis on the wind power markets around the world.
- **Speaking opportunities** at leading industry events attended by government officials and influential industry players
- **Exclusive networking opportunities,** including contacts with companies, national governments and trade associations around the world, which help GWEC members stay one step ahead of the competition.
- **Tailor-made communication** advice and tools for members to optimise global reach as well as target specific emerging markets.
- **Optimisation of your marketing budget** with discounts to events (booths and delegate passes), advertising space with our major industry media partners and on GWEC's communication channels.

Find out more about GWEC's policy work, publications, events and other membership benefits on our website.

www.gwec.net

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Opening up key emerging markets for business

"Our GWEC membership has helped us to get access to many local players in Mexico."

JOAN AYMAMÍ, VICE-PRESIDENT OF INTERNATIONAL BUSINESS, UL AWS TRUEPOWER

"GWEC data is the only data that we use for forecasting and budgeting because we know that it is dependable. We then know what to chase in terms of assets to 2020 and that is priceless to us."

NATALIE HILS, DIRECTOR OF REVENUE MARKETING, SENTIENT SCIENCE

"GWEC single-handedly opened up the Latin American market for wind."

STUART MULLIN, DIRECTOR OF MARKETING & COMMUNICATIONS, MHI VESTAS

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