
GWEC | GLOBAL WIND REPORT 2019



In Memory of Steve Sawyer

10 July 1956 – 31 July 2019

Steve Sawyer came into the wind industry after a courageous and distinguished career as a campaigner and then Director of Greenpeace International, where he notably campaigned against nuclear testing on the Rainbow Warrior, and led the campaign to hold the government of Francois Mitterrand to account following the bomb attack against the Warrior in July 1985. He faced personal danger on numerous occasions, before steering the organisation towards an increased emphasis on the issue of climate change, and with it, greater engagement with the nascent renewable energy industry.

He joined GWEC as its first General Secretary in 2007, as he was convinced that wind industry would play a fundamental role in replacing greenhouse gas emissions and in leading the transition to a new energy system. For over 10 years, Steve tirelessly represented the wind industry and worked to convince governments to adopt wind as the solution to grow their economies while reducing emissions.

During Steve's tenure at the head of GWEC, global wind installations grew from 74GW to 539GW and became one of the world's most important energy sources. He contributed significantly to the development of the wind industry in places such as India, China, Brazil and South Africa. He was a prominent speaker in public and private forums, and wrote innumerable articles, blogs and position papers. He was a mentor to many young people and their inspiration for getting involved with wind energy, and he was a faithful and loyal friend to many of us in the industry,

Steve Sawyer was a true wind warrior and an inspiration for everyone involved in the climate and renewables area. Here at GWEC, we are determined to continue his legacy and passion for fighting climate change and creating a world that is powered by 100% renewable energy.



GWEC Events



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Published

25 March 2020

Design

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Morten Dyrholm
Chairman Global Wind Energy Council

Word from the Chairman

I've been in the renewables sector long enough to look back and measure our progress. From niche beginnings, wind and solar are now helping to stabilize global energy-related CO₂-emissions in 2019. This is a tremendous achievement and a strong point of departure for a new decade.

The good news is that wind and solar will grow significantly over the years to come. From being rather expensive two decades ago, wind and solar are today more cost-competitive than new-built coal or gas in about two-thirds of the world. Over the next decade, it will become more cost-efficient to build new wind and solar than to run existing coal or gas plants. Combine this with the increasing global commitment to combat climate change and we will see tremendous growth ahead of us.

To take advantage of this opportunity, focus now needs to be on how to speed up the energy market transformation. There is little doubt the current energy system is probably not the answer to the question of what a highly

renewable and zero-emission society looks like. Today's task is to adapt today's systems to the characteristics of variable renewable energy sources. Markets need to be designed to provide fair remuneration to technologies, infrastructure and solutions enabling the decarbonisation of energy and governments need to disincentivise the polluting technologies that belong to yesterday.

We don't have to start from zero. Experience from more and more countries and regions that successfully showcase the integration of double-digit shares of renewables is creating a growing body of knowledge on how to successfully decarbonise our energy systems. This experience will prove helpful to countries that are still in the earlier phases of transition. As an industry, we need to support this knowledge step and commit to be a key and responsible player in the transforming energy markets.

We have to go beyond individual renewable energy technologies

recommending policy solutions thought up in isolation. We now have to start working together – across sectors, across countries – and start discussing how to promote technologies that increase system value, broad renewables-based electrification, from wind to solar, electric vehicles to fuel-cells, from electric heating to power-to-X. This is a task no sector will be able to deliver on its own. But as the wind sector, we can and must lead the way.

GWEC as the global wind organisation is well positioned to push for the changes that are needed. The many new members who joined us in the course of 2019 prove that GWEC has become more relevant than ever. This year we must build on this success and make GWEC even stronger to lead the global fight for a fully decarbonised energy sector.

It's Time to Put Climate First

Climate change is progressing at an alarming speed, and fighting it is a challenge we must all accept to make sure the next generation will find life on this earth worth living. Through its high CO₂ abatement potential, wind energy can help stop global warming. It is not only the most sustainable but also the most economical source of energy. Well aware of these opportunities and our responsibility, we take a strong stand, as reflected in our motto for WindEnergy Hamburg 2020: "It's time to put climate first."

We want to provide the industry with the opportunity and space to network, pave the way to the future of wind energy, and drive the energy transition. In pursuit of this goal, we collaborate closely with the Global Wind Energy Council (GWEC). We are delighted that Hamburg Messe und Congress has arranged a long-term partnership with GWEC for WindEnergy Hamburg, the global onshore and offshore event, and is once again the sponsor of the Global Wind Report. Because in these times of great challenges, the wind

industry needs not only plenty of energy and perseverance but also solid data and facts.

For the next WindEnergy Hamburg in September 2020 we have stepped up our collaboration with GWEC and WindEurope. For the first time, we are planning an open conference programme on three stages set up right in the middle of the exhibition halls. This entirely new event concept will drive knowledge transfer around the globe and allow all trade fair visitors to get directly involved. Our "Global Business" stage, run by WindEurope and GWEC, will cover mainly non-European markets and how to do business there. The "Empowering People" stage will be run by WindEurope and focus on the human side of the energy transition: health and safety, skills, acceptance and permitting, happy coexistence with communities and other stakeholders such as maritime spatial planners, community engagement, and biodiversity preservation. Our "Power4Climate" stage will be all about the "downstream" side of the energy transition, in particular electrification of energy consuming

activities like heating, transport and industrial processes, as well as energy storage, hydrogen, and power-to-X. Furthermore, we are once again offering a traditional, centralised conference with a comprehensive agenda, lectures and discussions. Together with our Global Partner GWEC and our co-organiser WindEurope we are pleased to once again welcome 1,400 exhibitors and 35,000 attendees from over 100 countries to the biggest gathering of the global wind industry. Let us join together to put climate protection at the top of our priority list, because that is where it belongs.



Bernd Aufderheide
President and CEO
Hamburg Messe und Congress





Ben Backwell
CEO Global Wind Energy Council

Welcome to the Global Wind Report 2019

Last year was a big year for the wind industry. With installations of 60.4 GW, 2019 was the second largest year in history and close to the bumper year of 2015 (63.8 GW)

However, the industry is still far from reaching the accelerated level of growth which we know we can deliver, and which is expected from us by international institutions, governments and the public.

The challenge ahead of us is to create a sustained, accelerated period of growth

There is unprecedented political momentum behind the scaling up of wind and other renewable energy technologies, as young people around the world take action in response to the growing climate emergency, and policy makers realise that the window for taking action on a sufficient scale to preserve a liveable environment is closing. As we move toward the crucial COP26 meeting in

November, governments are setting increasingly ambitious targets, obliging the total decarbonisation of the power sector and rapid progress on decarbonising transport, manufacturing, heating and other sectors.

However, these targets are largely “top-down” statements of intent – the hard work of delivering greater volumes of wind installations across the world to meet these targets remains to be done.

The challenge ahead of us is to create a sustained, accelerated period of growth that will see the wind industry quickly reach installations of 100+ GW per year, and then rise by the end of the decade to 200 GW per year and beyond.

In 2019, the rapid growth in installations was largely the result of a strong year in both China and the US – the world’s two largest markets ahead of the expiry of Feed-in Tariffs for onshore in the first country and the PTC in the second.

Some of the world’s other large mature markets, for example India

and Germany, once again reflected institutional weakness, while in some emerging markets, growth stalled as governments delayed scheduled tenders. This pattern of stop-go growth needs to be overcome if the wind industry is to step up and meet the expectations of the global community.

In the Global Wind Report four years ago, GWEC’s then-Secretary General Steve Sawyer (who sadly passed away in July last year - see page 5) was able to report on a year of record installations (2015), and point to one clear factor driving growth forward: the establishment of wind as the most price competitive source of new power capacity.

The continuing progress that our industry has made to reduce LCOE is an achievement of lasting significance that puts our industry in a position of strength. However, it has since become clear that cost-competitiveness alone will not necessarily guarantee that the energy transition is carried out at the required pace, or that wind will be installed to replace fossil fuels.

In some countries, the impact of ambitious targets and competitive prices has been nullified by inadequate permitting systems or lack of access to land or transmission infrastructure. In others, weak regulatory systems or a lack of transparency in procurement have meant that public and private

allows renewable energy to be installed steadily and rapidly and incentivises the phaseout of fossil fuels from the system.

That's why the theme of this year's Global Wind Report is: "Beyond LCOE – Moving towards an accelerated rate of wind energy

As the climate emergency becomes more acute, governments will need to consider the urgency of improving policies to address these challenges.

actors continue to install damaging coal power generation plants, despite the attendant high economic and social costs.

The move from FiTs to auction-based procurement and other market-based mechanisms has undoubtedly had positive effects in terms of price discovery and pushing down the cost of energy. However, it has too often benefited incumbent fossil fuel generation, and in some markets has nurtured a "race to the bottom" that is challenging the sustainability of our supply chain and our companies. In GWEC's view then, there is a strong need for an adequate enabling system which

installations to power the energy transition". The report looks at a number of key challenges which need to be addressed in order to supersede this bumpy pattern of growth and uses case studies to illustrate these challenges.

These challenges include: the need for appropriate market design which accounts for the effect of fast-growing volumes of variable renewable power on wholesale prices, and the positive impact of long-term price visibility; the impact of inadequate enabling environments – the biggest contributing factor in slowing renewables' growth and investments; weak policy targets;

weak government capacity – for instance to design regulatory frameworks for onshore and offshore wind, and to align permitting processes between different levels of authority; and inadequate investment in grid.

In GWEC's view, as the climate emergency becomes more acute, governments will need to consider the urgency of improving policy to address these challenges. This may require radical changes in how legal systems and institutions are organised.

As an industry, the strong achievements we have made in the last decade in technology, knowhow and scale mean we stand ready to play a crucial part in the energy transition. But we are going to have to work hard this year ahead of COP26 in Glasgow to ensure that policy makers understand the changes needed in order for us to meet key challenges and deliver wind power's global potential.

These issues will be at the centre of GWEC's work in 2020 and beyond. We invite you all to work with us to reach our objectives and safeguard the position of wind power in the energy transition.



The image shows two large, three-bladed wind turbines standing on a hillside. The turbines are light blue or grey. The background features a range of hills under a sky with a warm, orange and yellow sunset glow. The foreground is filled with dense green trees.

INTRODUCTION

2019 – An outstanding year for wind energy

2019 was a big year for the global wind industry with new installations surpassing the 60 GW milestone for only the second time in history, and showing year-over-year (YoY) growth of 19 per cent.

Market status

The 60.4 GW of new installations brings global cumulative wind power capacity up to 651 GW. In the onshore market, 54.2 GW was installed, an increase of 17 per cent compared to 2018. China and USA remained the world's largest onshore market, together accounting for more than 60 per cent of new onshore additions.

Asia Pacific ranks as the No.1 regional onshore market with 27.3 GW installed last year. Although onshore installations in Germany shrunk by 55 per cent last year, Europe still saw a 30 percent YoY growth in new installations, which is primarily due to strong growth in Spain, Sweden and Greece. Developing markets in Africa, the Middle East, Latin America and South-East Asia showed steady but unspectacular growth with combined installations of 4.5 GW during 2019.

Thanks in large part to jump of 45 per cent in installations YoY in China, the global offshore wind industry had a record year in 2019 with 6.1 GW of new additions, bringing its market share in global new installations to the 10 per cent level for the first time. Total cumulative capacity has now passed 29 GW, representing 4.5 per cent of total cumulative capacity.

the pervious year. Counting on continued technology innovation and economics of scale, a further 30 per cent cost reduction for offshore wind was achieved in the UK CfD Allocation Round 3 compared to CfD Round 2. Starting from 1 January 2021, all newly approved onshore wind projects in China will reach “grid parity” (zero- subsidy). All of this demonstrates that wind power

2019 was a big year for the global wind industry with new installations surpassing the 60 GW milestone for only the second time in history, but COVID effects on the market outlook are still to be quantified.

Market dynamics

Market-based mechanisms continue to dominate the global wind market in 2019 with China and Colombia launching auctions for the first time. Auctioned wind capacity surpassed 40 GW (25 GW onshore and 15.8 GW offshore) during 2019, more than twice the amount announced in

continues to build its competitive advantage and is ready to take the lead in energy transition. 2019 also saw new business models and new solutions continuing to drive the growth of wind energy. The volume of signed corporate PPAs increased by nearly 30 per cent last year, reaching 9 GW globally according



Feng Zhao
Strategy Director
Global Wind Energy Council

to BloombergNEF. New solutions such as hybridisation are increasingly being implemented in both mature and emerging markets to support the integration of wind and other renewables. To accelerate the global energy transition, large stakeholders in the wind industry are also taking part in initiatives to accelerate industry collaboration with sectors such as hydrogen.

Impact of COVID-19 pandemic

In early 2020, GWEC Market Intelligence completed its Q1 2020 global wind market outlook and believed that 2020 would be a new record year, with installations of 76 GW. We also forecast that over 355 GW of new capacity would be added in the next five years, implying 71 GW of new installations each year until 2024. According to the outlook, annual offshore wind installations would reach 15 GW by 2024 bringing its market share in global new installations to 20 per cent.

Since we completed the outlook, however, the world, and the wind sector with it, has been hit hard by the COVID-19 virus, first in China, then other Asian countries and Middle East, and now in Europe

and North America. Although China managed to get the virus under control within two months, damage has been done to the flow of supply chain and project execution in 2020 and a 1-2 months delay is expected, specifically for onshore wind. At present, Europe and North America are still in the middle of the crisis. Considering the current measures of virus control in Europe and the US, it is hard to predict at this stage when the virus can be completely brought under control and when society and markets will return to normality, and in turn it is impossible to quantify the exact impact of the pandemic and the looming economic recession on global wind power installations in 2020 and beyond. Therefore, GWEC has decided to keep its Q1 outlook unchanged in this report while the world responds to the crisis. GWEC will monitor the situation closely and quantify the effects on the industry as soon as it is able, and will publish its updated 2020-24 outlook in our Q2 Global Market Outlook Update.



INDUSTRY SUSTAINABILTY



Key Topic: Designing energy markets for an accelerated energy transition

Introduction

Wind energy has expanded by leaps and bounds in the last 20 years. It began the century as a niche energy source in Europe and the US, and ended 2019 as a mainstream source of clean, cost-competitive energy around the world. In 2019, the global wind energy market reached a new milestone of 651 GW cumulative installed capacity, with strong continued growth foreseen across Asia, the Americas and Europe. (see Market Outlook 2020-2024) And as onshore wind technology has matured, offshore wind has been embraced by governments and international institutions as the next game-changer in the energy transition.

Wind power will play a leading role in achieving a low-carbon or – in many markets – net-zero future, one which requires a completely carbon-free energy sector and deep cuts in emissions in all other areas of the economy. An IRENA scenario for a 1.5-degree compliant pathway by

2030 calls for a threefold increase of global onshore wind power capacity, a 10-fold increase of offshore wind power capacity and widescale electrification.¹

But several roadblocks must be urgently cleared in order to deliver this accelerated growth – amounting to more than 100 GW

enable accelerated growth of renewable energy deployment towards 2030 and beyond. It discusses how policymakers must shift the focus on LCOE to address the policy and regulatory frameworks needed to carry out the energy transition. This includes providing the enabling environment to install capacity at

Market design must be adapted to enable accelerated growth of renewable energy deployment towards 2030 and beyond.

in annual onshore and offshore wind installations over the next decade. Progress in building new wind capacity is consistently falling short of what is needed, leading to a growing divide between top-down targets and the private sector's ability to deploy and invest at the right pace.

This chapter addresses how market design must be adapted to

the necessary pace and sending the right market signals: adopting system value for energy sources, structuring markets to ensure adequate remuneration for renewable energy and mobilising financing for the transformation of grids.

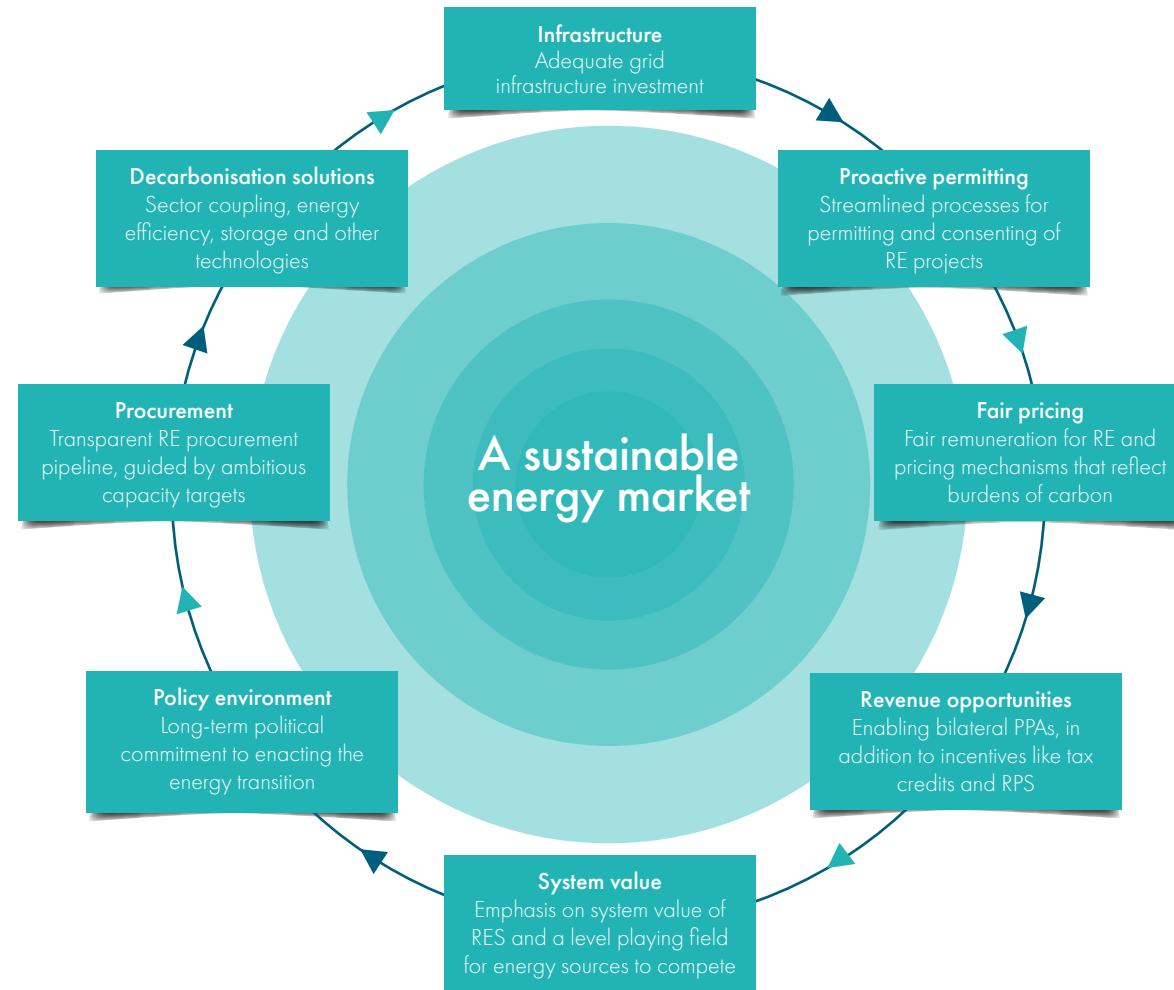
1. https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Oct/IRENA_Future_of_wind_2019.pdf

Case studies in this section on India, Germany and Brazil highlight some of the strong challenges that wind and other renewable technologies currently face, which have created stop-go cycles or sluggish growth in many individual markets. These challenges include:

- Weak signals to retire existing fossil generation capacity or prevent the construction of new capacity, leading to a situation where wind energy is still niche in many markets, despite price and other advantages;
- A “race to the bottom” outlook, as wind and renewables compete for marginal increases in generation capacity, posing a challenge to industry sustainability;
- Broken permitting systems and issues around land allocation and public acceptance
- Transmission bottlenecks;
- Policy volatility due to political cycles and the influence of incumbent interests

These case studies are designed to provide an instructive view of market barriers and the challenges which must be resolved to secure the sustainability of the global wind industry.

Components of sustainable market design



In today's energy markets, simply being more competitive does not mean that the energy transition will happen spontaneously, or that wind energy and other renewables will replace fossil fuels within the needed timeframe

A large and lumpy wind market ahead in India

With input from: MEC Intelligence

India is the world's fourth-largest onshore wind market by installations, with 37.5 GW of wind capacity as of 2019. Two fundamental drivers are in place to sustain market growth: rising energy demand and political ambition.

Over the next 10 years, electricity demand is set to double in the country of 1.35 billion people. Accordingly, India's government is targeting 175 GW of renewable energy capacity by 2022, of which 60 GW will come from wind energy, and a whopping 450 GW by 2030, of which 140 GW will be wind-based generation.

In the last decade, this scale of activity attracted multinational utilities, investors and supply chain players to India's wind market. An influx of capital and technology initiated a downward slide in prices, with LCOE of wind declining by 40 per cent from 2015 to 2019. Currently, wind is the second cheapest power source on the grid after solar at INR 2.81/kWh (USD 39.31/MWh), and nearly 35 per cent cheaper than conventional fuels.

Meanwhile, project installation is deflating. Only 2.4 GW of wind capacity was installed in 2019 – nearly half of the 4.1 GW installed in 2017. While more than 17 GW of capacity has been auctioned across the country by various power purchasing agencies in last three years, nearly one-third went unsubscribed or was cancelled post-award due to various factors: stringent tender conditions; low tariff caps; offtaker risks; unavailability of grid; and/or land availability. More than 80 per cent of awarded projects have been delayed by 6 to 12 months, according to analysis by MEC Intelligence in January 2020.

Looking beyond LCOE

Wind power's LCOE reductions over the last decade (and in particular over the last five years) have fundamentally changed its competitive position and put the industry in a strong position to carry out the energy transition.

The costs of both onshore and offshore wind have plummeted by more than 50 per cent on average in the last five years, with prices for new-build offshore wind declining by one third from 2018 to 2019 alone, according to BloombergNEF. Driving these cost reductions are larger turbines which allow better energy capture and capex/opex savings, global supply chain efficiencies and competitive procurement mechanisms.

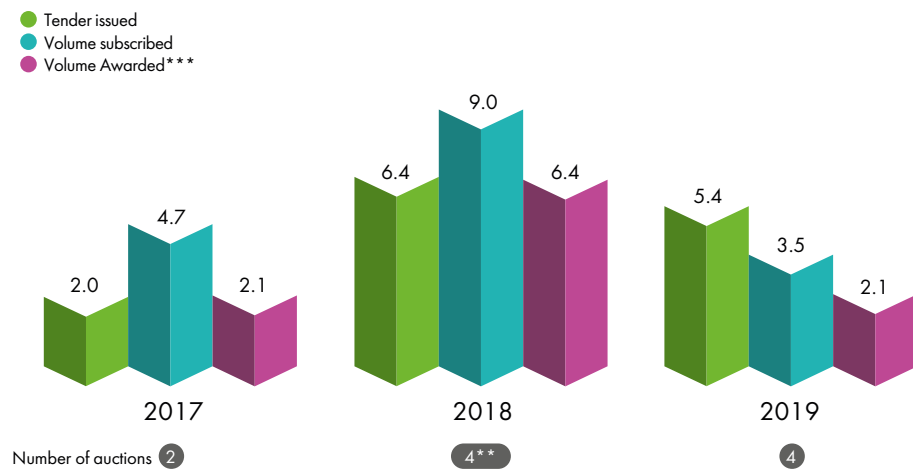
Ultra-low LCOE for onshore wind, and offshore wind in the future, means the industry has sailed past the tipping point of competing on cost with fossil fuel generation in most places in the world. But in today's energy markets, simply being more competitive does not mean that the energy transition will happen spontaneously, or that wind energy and other renewables will replace fossil fuels within the needed timeframe.

Low prices captured at auction are **increasing cost pressures on wind industry actors across the value chain**, from power producers to OEMs to service providers. The squeeze on revenue streams is reflected in rapid supply-side consolidation – an industry which once had more than 100 turbine manufacturers now has 37 players, according to GWEC's Supply Side Data 2018 report. Of these, the top five turbine suppliers supply two-thirds of market share.

One example is India, where intense competition in onshore wind auctions from 2017 to early 2019 drove prices to as low as INR 2.4/kWh (USD 33.55/MWh in today's terms). These low captured prices were used to benchmark bids in subsequent auctions, all of which went undersubscribed; at the same time, barriers to implementation increased. As a result, awarded capacity has been abandoned or relinquished, installation has slowed significantly and many suppliers have struggled, reflecting the very real hazard of price/revenue attrition compounding existing market risks.

Auction participation has declined over years in India

Federal - Total tender announced vs capacity awarded (GW)



States* - Total tender announced vs capacity awarded (GW)



Note: Does not include Hybrid auctions

*Includes Maharashtra auctions which were issued for procurement from existing wind projects with expired PPAs

** Auctions retendered with changes in design have been considered as single auctions (Applicable on SECI V and Gujarat III)

*** Projects abandoned at a later stage after contract award are a part of volume awarded

Source: SECI; GUVNL; MSEDCL; TANGEDCO; NTPC; MNRE; MEC+ analysis

Steep pricing competition has come at a cost. Central government tenders have lost steam, following a decision to use the extremely low prices (INR 2.4-2.8/kWh, or USD 33.55-39.15/MWh) captured in the first seven auctions as a benchmark for an upper price cap in the last three auctions of 2019. Meeting such tariffs was not feasible in the face of exhausted grid infrastructure and changes to local land use criteria for awarding new sites.

Furthermore, the seven states which manage wind procurement themselves have seen a major decline in activity. Total orders by these states contracted by 60 per cent from 2017 to 2019. Auctions are severely undersubscribed due to the offtaker risk associated with the weak financial position of DISCOMs (distribution companies) and chronic payment delays to projects installed from 2013 to 2017. Facing financial pressure, two states have moved to central auctions to hedge their payments with federal guarantees while four states have not conducted any new procurement in the last three years most of these states have moved to central auctions to hedge their payments with federal guarantees.

Amid the current obstacles to execution, awarded onshore capacity is likely to total 1.5-2.5 GW per year through 2022, with central auctions contributing most of the volume. Wind installations will be highly concentrated in Gujarat and Tamil Nadu, with some projects coming online in Karnataka and Maharashtra.

The market is expected to be lumpy in the next three years, due to supply and demand realities. On the supply side, the time required for grid enhancement and site development will backload installations to around 2022. Accelerating project timelines would require more expensive land or lower-resource sites; the increased capital requirements would in turn drive wind prices upward. On the demand side, prices that exceed DISCOM-sanctioned budgets will face delays in approval.

The government must keep realistic price expectations in future auctions and ensure the market – particularly at state level – is sufficiently liquid. Efforts by the government to lower barriers around pricing, grid and land infrastructure must be intensified, in order to revive auction appetite and resolve the execution challenges facing India's wind market.

Under India's highly federalised structure, the seven states with strong wind resource manage their own procurement, while the central government handles procurement for the 20 other states.

In addition, **providing investment signals for different generation sources – both new and already existing – based on wholesale market prices is at odds with a long-term mission to decarbonise the power sector.**

Wind power is variable in nature, with near-zero costs of dispatch. Integration of larger shares of variable, low-cost generation into a wholesale market designed around marginal cost results in increasingly volatile and, in many cases, low or negative power prices.

A move by governments to introduce “zero-subsidy” (often understood as a pure merchant environment) principles for the creation of new power generation could undermine the ROI case for new wind projects and sharply increase risk, thus undermining the acceleration in investment which the energy transition requires.




Urgent debate and action are required to redesign markets to look beyond LCOE and MW/h prices. Adequate market design should focus on **system value** – the net sum of positive and negative impacts of all energy sources on society as a whole.

This approach accounts for elements such as grid and balancing costs, pollutant emissions, energy system flexibility needs and socioenvironmental impact.

A system-value approach to market design will be necessary to attain high shares of renewable energy in an energy matrix, while securing the reliability and flexibility required for powering a low-carbon economy. This approach reflects society’s need for clean generation in alignment with national/international policy targets; at the same time, it compels governments to resist focusing on integration and grid infrastructure costs without weighing the crucial system benefits of additional wind power generation.

Furthermore, measuring energy sources on LCOE alone does not adequately account for the economic burden of polluting fossil fuels. Already one of the most cost-competitive power sources, **wind energy would be even more competitive if greenhouse gas emissions were priced** via a carbon tax or other mechanisms. An effective and punitive carbon pricing

From LCOE to market and system value

		
<p>LCOE Average cost per unit of electricity output</p>	<p>Market value and value factor Average revenue per unit of electricity output Shows, if divided by the average wholesale power price (value factor), how much of the average price can be captured by a power plant or a power generating technology</p>	<p>System value Interplay of positive (e.g. lower carbon emissions, high market value, reduced fuel costs etc.) and negative effects (e.g. additional grid infrastructure costs, re-dispatch costs/curtailment etc.) of a power generating technology on the system</p>

Source: Vestas

mechanism would go a long way in pushing fossil fuel generation off the grid – particularly if international schemes included trade or “border” mechanisms that would **strongly discourage markets around the world from making new investments in carbon-intensive generation.**

In short, gains in LCOE put wind and other renewables like solar power in a strong position to play a pivotal role in the energy transition. But while wind and solar can – and should – proudly spotlight their

cost-competitiveness, current market design fails to fairly value renewable energy. As a result, relying on wholesale markets alone will fail to enable the deployment of renewables at the scale needed.

It is time for a hard rethink of regulatory and market design. Policymakers need to send the right signals by adopting system value optimisation as a compass for procurement and taking stronger measures to phase out harmful carbon emissions.

Avoiding a “race to the bottom” in future remuneration models

The feed-in-tariff policies which allowed onshore wind power to mature, providing fixed streams of revenue in return for relatively low shares of the energy mix, have been increasingly replaced by auctions in the last decade. More

predicted for offshore wind – are leading to calls for zero-subsidy or subsidy-free wind power – in effect an environment where projects are based on revenues from future wholesale prices, which are virtually impossible to predict. China will phase out subsidies for onshore wind by

Wind has undeniably benefited from proving its cost-competitiveness at auction

than 100 countries have held at least one renewable energy auction, many doing so for the first time in the last three years, according to IRENA.¹

Auctions have become a popular tool to generate cost competition and price transparency, while still guaranteeing predictable remuneration to power producers. And wind has undeniably benefited from proving its cost-competitiveness at auction, as reflected in more ambitious capacity targets around the world.

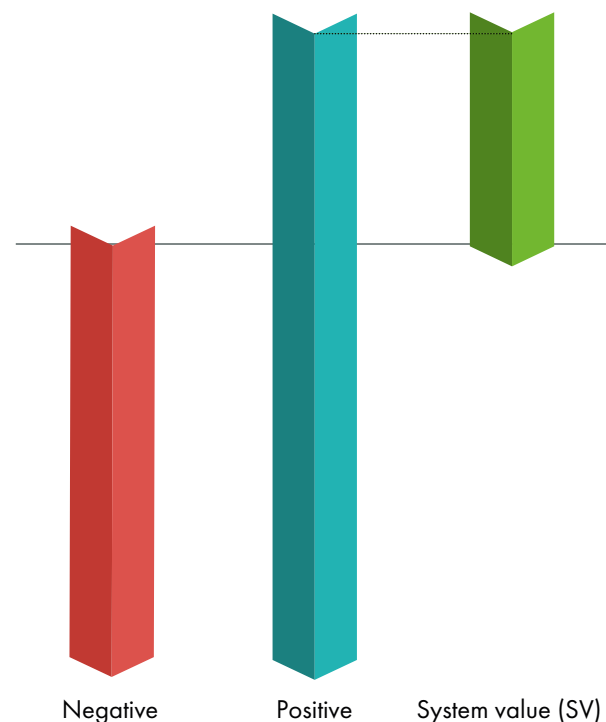
The staggering cost reductions of onshore wind – and those

2021, while merchant utility-scale wind projects are already underway in Denmark and the UK. Governments have been holding “subsidy-free” offshore wind auctions in Germany since 2017 and in the Netherlands since 2018.

However, GWEC does not support moves to “subsidy free” auctioning or a pure merchant environment based on existing wholesale markets.

1. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Dec/IRENA_RE-Auctions_Status-and-trends_2019.pdf

Calculating system value



- Negative effects of additional capacity**
- Additional grid and balancing costs
 - Additional profile costs (= generation pattern? demand pattern)
 - Increased curtailment
 - Higher operating cost for other power plants
 - Decommissioning waste
 - Etc

- Positive effects of additional capacity**
- Reduced fuel costs
 - Reduced CO2 and other pollutant emission cost
 - High market value
 - Reduced water consumption
 - Reduced load shedding
 - Etc

Industry sustainability

The most important reason is that these types of frameworks **do not provide long-term price/value visibility**. Basing long-tenor PPAs on forecasted power prices – which can be unpredictable due to technology advancements, the uncertain evolution of trade restrictions and the impact of global financial market conditions – **necessarily increases risk, and therefore the cost of capital for wind energy**.

Existing wholesale markets, designed for large-scale fossil fuel and nuclear generation at high marginal cost, are not well-equipped to integrate large volumes of variable energy sources at zero marginal cost. Markets such as Germany, California and Australia have shown the pricing distortions that can occur when periods of high renewable generation create oversupply and force wholesale prices to low or even negative levels, while analysts consider regular periods of negative prices as “the new normal.”

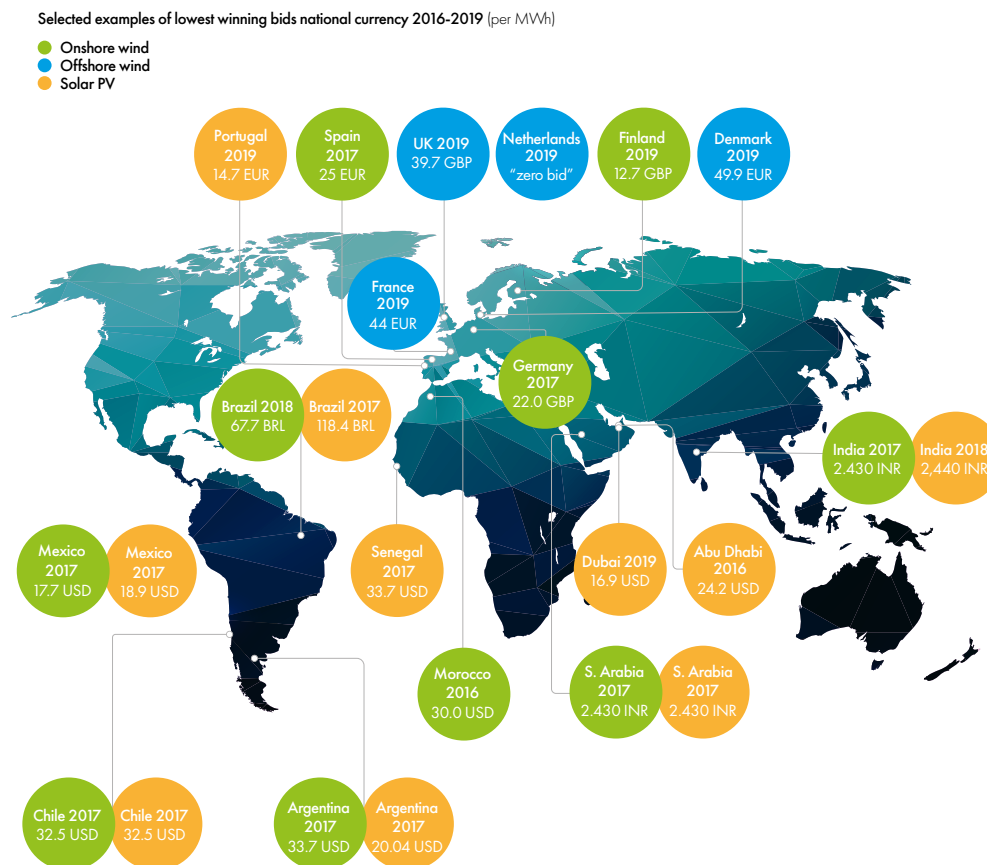
Without strong signals, markets are likely to become increasingly susceptible to renewable energy “cannibalisation” effect and power

producers will be exposed to increased price volatility.

Competitive mechanisms which provide a reliable, long-term view of captured prices and a predictable timeline for procurement offer a steady path forward. These might take the form of a one- or two-sided Contract for Difference, for instance, which accounts for competitive pricing and market reference pricing while granting revenue certainty for a long duration.

Market-based mechanisms such as corporate PPAs have been successfully employed, most often alongside support schemes that still reflect a high exposure to power price fluctuations. They allow energy customers to hedge the risk wholesale price exposure, while providing wind energy producers with long-term revenue stability. Through these bilateral PPAs, corporations have purchased more than 50 GW of renewable energy from 2008 to 2019, of which 19.5 GW was contracted in 2019 alone, according to BloombergNEF.

Low bid levels around the world in last three years



Auction bids per technology, though auctions are either technology-specific or neutral
Auction rules are market-specific, for a holistic comparison of auction results other factors, such as PPA length, have to be considered

Source: GWEC Market Intelligence Auction Database Status January 2020, national regulators, press

Amid falling prices at auction, free market expansion drives growth in Brazil

With input from: Elbia Gannoum, ABEEólica

2019 was a turning point for Brazil's wind energy market, marking 10 years since the first wind technology-specific auction in the country. Brazil's highly efficient and competitive auction model drove wind energy's installed capacity to grow from around 600 MW to 15.4 GW over the last decade.

The next 10 years will see the market transform to a model which encourages development of the free market (ACL), where power buyers/sellers/traders can directly negotiate PPAs. The Ministry of Mines and Energy (MME) is currently discussing new policies within the scope of "Modernization of the Electric Sector" which will: integrate a greater volume of renewables into the energy matrix; give consumers more freedom of choice; and adopt new technological solutions, such as storage. Market liberalization will be the mainstage for these changes, but will also bring insecurities and challenges, such as in hourly pricing.

Brazil's ACL has been expanding for several years, and by 2018 more than 2 GW of wind capacity was sold in the free market, compared to 1.25 GW in the regulated market (ACR). This trend continued in 2019, with more than 2 GW sold in the ACL, compared with 1.13 GW via auctions.

The strengthening of the ACL is related to heightened competition and falling prices at auction; this relationship exists due to the function of the Brazilian transmission system. The transmission system is interconnected nationally, except for a small part which represents 0.7 per cent of consumption. Due to previous cases where wind farms were built but lacked grid connection, the government has now made it necessary for developers to have an "access document" which guarantees a viable transmission line for the project.

At present, it is both faster and easier to obtain an "access document" for

projects in the ACR, rather than in the free market. As a result, since 2018 many wind power projects selected at auction sell only part of the project's installed capacity on the ACR, enough to ensure transmission for the entire project, but reserve a significant portion to sell on the free market. This strategy may have intensified price competition auctions in Brazil in 2018 and 2019, when average wind contract prices ranged from BRL 67.6-98.73/MWh (USD 16.9-24.68/MWh), as companies competed for transmission lines to enable ACL transactions.

Other factors have contributed to falling prices, a trend experienced around the world, including technological developments, restructuring of the equipment supply chain and the enabling of procurement negotiations on a global. In the case of Brazil, a trend towards purchasing O&M machinery and services from different suppliers also

appears to have an impact on costs. In addition, competition is heightened in the context of smaller auction volumes, accumulation of projects from 2015 to 2017 – when no auctions were held – and a general economic slowdown in Brazil.

As the economy picks up, demand in the ACR may increase over the next two to three years. In the interim, modernisation of the electricity sector will increasingly strengthen the free market and take advantage of Brazil's significant wind resource potential. Expansion of transmission infrastructure will enable greater integration of renewables in the matrix, while hybrid parks, batteries and new project models which mitigate the wind resource variability curve will enhance flexibility and reliability of the system.





Corporate PPAs are transforming energy markets such as Brazil, but are alone insufficient to secure the magnitude of investment required to accelerate wind installations worldwide. Developing a sustainable pipeline of projects may require other support mechanisms, such as tax credits and/or promotional schemes such as a Renewable Portfolio Standard, in addition to other enabling factors.

Easing the barriers to execution: permitting and transmission

Large, utility-scale wind projects require multiple land, construction and other permits, as well as careful management of relationships with different stakeholder groups. A sensible permitting environment needs to

be in place to ensure smooth and expeditious project timelines.

Successful procurement schemes require a stable and sufficiently large pipeline of permitted projects in order to succeed.

When too many projects get stuck behind permitting, construction and connection barriers, developers and investors lose confidence in market conditions and project risk premiums increase – adversely impacting the pipeline of new contracts and installations.

For instance, once regarded as a pioneer of the energy transition, Germany's domestic onshore wind capacity growth has been stalled by a morass of permitting, legal and administrative delays. Its installed wind capacity in 2019 was around 16 per cent of the volume installed just two years prior.

Like other energy sources, wind depends on a positive regulatory environment. In some cases, licences and permits can be issued directly by local administrations for expedience. Streamlining consenting processes for legal recourse and dispute by the public, as the UK's independent Infrastructure Planning Commission was established to

provide, can prevent extended delays brought by individuals who do not represent community opinion.

Transmission congestion forms another barrier to execution.

Following the phaseout of the federal Production Tax Credit (PTC) from 2021, grid capacity will be a key challenge for the US market. In China, easing grid bottlenecks is needed to decrease wind curtailment, particularly in the inner northern provinces of Inner Mongolia, Xinjiang and Gansu. The expansion of ultra-high-voltage (UHV) networks will enable long-distance transmission of large power loads in China, but has yet attained significant uptake by wind generation.

National, regional and local government units and regulators must be aligned on policy targets and financing needs for renewable energy deployment, in order to ensure adequate access to grid connection and capacity. Governments should take responsibility for expansion, planning and investment in transmission; these investments should not be shouldered by renewable energy generators and investors – a formula which only

works to reward energy incumbents.

Current investment trends for wind energy provide strong cause for concern: Although global installations continue to grow, overall investment is not growing fast enough. In 2019, investment in

Like other energy sources, wind depends on a positive regulatory environment

onshore and offshore wind energy globally totalled USD 142.7 billion, compared to USD 97.8 billion in 2010, according to BloombergNEF. That means wind energy investment has crept upwards at 3.85% CAGR over the last decade.

Permitting barriers and political standstill eroding market expansion in Germany

With input from: WindEurope and German Wind Energy Association (BWE)

The German onshore wind market is sputtering. Installed capacity in 2017 was a record 6.6 GW but shrank by two-thirds in 2018 to 2.2 GW. In 2019, installations continued to decline by half to 1,078 MW. A number of challenges are dampening market growth, from lengthy permitting processes to NIMBY-ism to the rise of the climate change-sceptic Alternative für Deutschland party.

With around 30,000 onshore turbines, Germany still holds the top spot for installed capacity in Europe. In 2019, wind was the dominant source in the power mix, surpassing lignite and hard coal. However, these positive notes have been overshadowed by the grinding slowdown of Germany's wind expansion.

More than 10 GW of wind projects are stuck in permitting delays, according to a 2019 survey by consultancy FA Wind. The largest barriers concern **aviation and the military**, with 4.8 GW blocked due to proximity to air control radio masts and 3.5 GW blocked due to

military restrictions. Another factor is **legal actions mounted by nature and wildlife groups**, which affect 60 per cent of the 1 GW of approved capacity in the appeal phase. As a result of these and other delays, the average duration for project permitting has nearly tripled since 2010.

Germany now **needs more designated areas for wind energy**. Administrations often lack the capacity to develop land use plans, while many existing designated areas have not accounted for the scale of technological change and are now unsuitable for modern turbines with higher hub heights.

The drag has affected project feasibility and investor confidence: 5 out of the 6 onshore wind auctions held in 2019 were undersubscribed, with only 1.8 GW of the offered 3.7 GW awarded. Two technology-neutral auctions saw the entire capacity allocated to solar projects. Facing permitting delays and cost pressures in Germany, wind developers are increasingly looking abroad.

In Q3 2019, the government presented an 18-point plan which identified hurdles for nature conservation, land designation, public acceptance and air traffic control. A vision was set for a hydrogen economy, supported by battery production and clean energy. A coal phaseout by 2038 was announced – a welcome move, albeit lacking ambition in its timeline.

But this plan, already overdue, has been slow to implement. Still under discussion is a 1,000-metre setback rule in residential areas, which hampers development in around half of German territory, including areas which already host wind farms that require repowering. This rule stretches beyond the 500-metre rule applied in other markets like Spain and France.

It is critical that the 18-point plan is actioned, with a focus on permitting. The essential conditions which enabled the wind market to rapidly expand have deteriorated amid political standstill and legal/administrative delays. Tepid

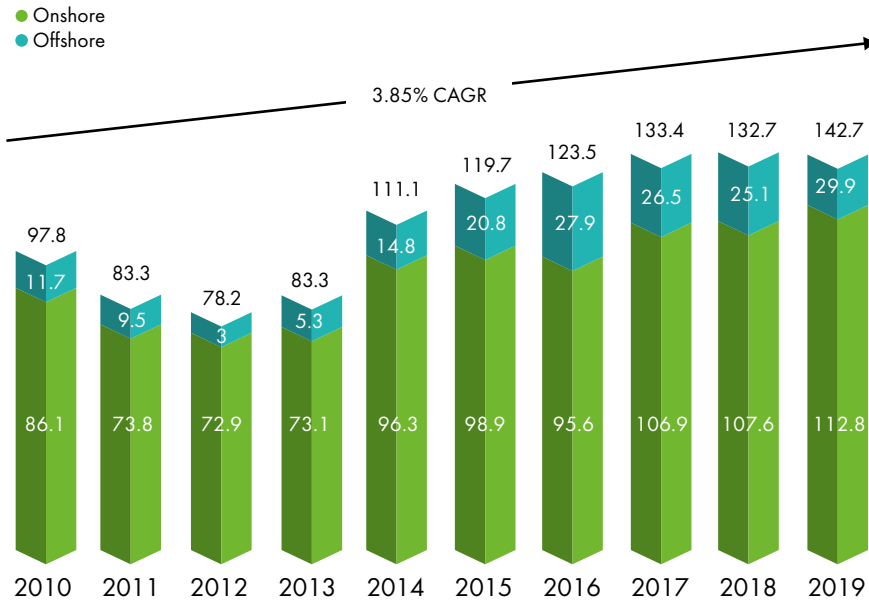
installation volume coupled with undersubscribed auctions reflect the lack of viable projects on the ground. Notably, only 180 MW of projects reached FID in 2019.

A brighter spot is the offshore market, which saw 1.1 GW of capacity connected in 2019. In late 2019, the government scaled up its 2030 offshore target from 15 GW to 20 GW – a helpful step to meet the wider target of 65 per cent renewable energy in the power mix by 2030. While no installations are expected for the next two years, tenders are planned for 2021.

The medium- and long-term view remains positive for Germany. The end of guaranteed FITs for the first generation of turbines in 2021 offers great potential for repowering. Rising industrial demand for green energy will be complemented by broader sector-coupling, electrification and hydrogen strategies. But stronger political steering and alignment between federal and state authorities will be needed to regain a leadership position in the energy transition, particularly in the context of the Paris Agreement and European Green Deal.

Slow, and even decreasing, investment in wind in the last decade is blocking the energy transition

Annual investment in wind energy 2009-2019 (bn USD)



Source: BloombergNEF Clean Energy Investment database (Status January 16th, 2020)

While this slack pace is partially due to the falling cost of wind, it is still far from enough. Investment should be rising steeply and steadily, in line with the IPCC's call for global investment in clean energy to be massively scaled up to USD 2.4 trillion annually up to 2035, from some USD 282 billion in 2019, in order to maintain a 1.5-degree pathway.

where construction, operations and maintenance requirements are more complex and higher capital investments are needed.

Excessive hurdles on the ground can significantly slow down execution, deter investment and dampen the future prospects of national wind markets. As the climate emergency intensifies and

Although global installations continue to grow, overall investment is not growing fast enough.

The world must ramp up cumulative onshore and offshore wind installations by a factor of 3.5 to 2030 and by a factor of 10 to 2050, according to IRENA's 2019 global energy transformation report. That means delivering more than 100 GW in annual onshore and offshore wind installations in the next 10 years.

governments strive to meet their nationally declared targets, new institutional and organisational structures will become necessary to streamline permitting and create a practical regulatory environment. GWEC will continue to work closely with governments to help design such structures.

Yet execution challenges in world-class onshore wind markets such as India and Germany continually impact the global growth of the wind industry. An enabling environment is equally critical for offshore wind projects,

A proactive, integrated approach to get the energy transition done

Compelling incentives for carbon reduction, sustainable pricing for large-scale installation and integration of renewables, clear and decisive processes for permitting and investment in grid capacity are among the critical components for a future energy market. Undergirding this integrated approach is long-term government commitment to a clean energy transition, with minimal policy variance or retroactive changes that can derail development of wind power.

Wavering political will in places like Argentina, Mexico and South Africa has created a debilitating “stop-go” tempo to development of the wind industry, which has deterred investor confidence. In Mexico, a sea change of political orientation has erected barriers to the electricity market deregulation drive enacted several years ago, and deflated wind power ambition at the Federal Electricity Commission (CFE).

In South Africa, a promising renewable energy program was halted from 2016 to 2017 to make room for a nuclear energy scheme promoted by the former

The next decade will determine whether we - as an industry, as citizens and as a global society - are able to carry out the energy transition in the crucial time window that remains

administration. While the market is getting back on-track – the Integrated Resource Plan to 2030 released in 2019 allocates 14.4 GW to wind – the temporary hiatus froze supply chain growth and developer momentum.

Long-term policy stability ensures that consistent and sufficient resources are dedicated to the moving components of sustainable markets, such as grid infrastructure, power sector reform, permitting capacity and roadmaps for energy generation, infrastructure planning, workforce training, industrial growth and the integration of new technologies.

These components must be addressed to correct the market flaws that slowed some markets in 2019, and which threaten to slow growth in others in coming years. Otherwise, uneven progress will

pose an increasing risk to the sustainability of the wind industry, at a time when it should be experiencing a prolonged period of expansion.

The next decade will determine whether we – as an industry, as citizens and as a global society – are able to carry out the energy transition in the crucial time window that remains. Deploying wind power on an unprecedented scale of more than 100 GW in annual installations over the next decade, at bigger volumes and in emerging markets, will be a significant factor of success in building the liveable, low-carbon world of the future.

Working together with government and communities on sustainable market design, wind power will continue to play its role as one of the main protagonists of the global energy transition.





TECHNICAL SOLUTIONS

Technical solutions driving wind market growth

Wind energy has gone from a niche to a mainstream energy source in recent decades. For example, wind energy:

- Provided 15 per cent of the EU's electricity demand in 2019
- Constitutes the third largest energy source in China
- Is known as the largest source of new power capacity in markets across the world.

However, in order to sharply increase the share of wind power in energy markets and accelerate the global energy transition, a series of step changes need to be made. These include: a continued focus on solutions that support the integration of wind and other renewables into the grid; solutions to transport large quantities of renewable energy across greater distances more efficiently; working with other technologies – such as hydrogen – to decarbonise sectors where direct electrification is a challenge; and increasing our ability to store power at times of excess supply. To achieve this, the

single renewable energy technology mindset needs to be replaced with the so-called “system approach” and the growth of cross-industry collaboration to decarbonise the economy in the most efficient way possible.

The single renewable energy technology mindset needs to be replaced with the so-called “system approach”

In last year's Global Wind Report, GWEC looked at the opportunities and challenges of new solutions that have the potential to unlock more volume while bringing increased value to the entire energy system. In this chapter, we focus on hybrid solutions and green hydrogen as two key enablers of the global energy transition.



Hybrid solutions – supporting renewable integration

Africa's first hybrid power plant

Location: Meru County, Kenya

Solution: 65MW wind, 20MW solar PV, 5MW storage

Total investment: \$145million

Developers: Windlab and The Meru County Investment and Development Corporation (MCIDC)

Expected commission year: 2022

Expected outcome: electricity to meet 200,000 households

Hybridisation, i.e. the combination of wind energy with another energy source and/or storage solution, remains a key topic in the wind and renewables industries. Hybridisation offers opportunities to increase the share of renewables in the grid while replacing fossil fuels in mature markets like Europe, the US and Australia, and high-growth markets like South East Asia. In emerging markets such as the African continent and remote areas like small islands, hybrid solutions can bring value and provide supply security by facilitating system integration, as well as enabling micro-grid/off-grid solutions.

Hybridisation as a solution combining several technologies is well underway in many markets. As a technical solution, it can help address the key challenge of

variable renewable energy: flexibility. Although its value is recognised, political support is still lacking in the current market design. Nevertheless, hybrid projects exist around the world as corporates and investors seek the opportunities which hybrid solutions can offer – from stable supply guarantee, sharing EPC, O&M and grid connection cost, to expand revenue opportunities.

What enables hybrids to be financially successful is efficient project design and project set-up, including the size of the total project, as well as the management and commercialisation of the project's power output. Further, the focus must be on the offtake agreement to capture the full output of the project and also to reflect the time of supply.

To help speed up the global energy transition, hybridisation has clear value from a system point of view by providing cost-efficient electricity, integrating more renewables into the grid (through overcoming the flexibility challenge of renewables), and



offering a better match of supply-demand profiles.

Hybrids require technical enablers, such as more economical and efficient storage solutions to bring down the cost of storage as well as digital solutions/energy management systems (EMS) to manage generation and dispatching. With these enablers, the level of market penetration of hybrid solutions is expected to grow sharply, especially in emerging markets such the African countries.

As a technical solution, hybridisation can help address the key challenge of variable renewable energy: the need for flexibility.

Green hydrogen — a key enabler of the energy transition

From grey to blue to green hydrogen

After something of a “false dawn” over a decade ago, hydrogen has grown as the “hot topic” of the energy sector over the last few years and has gained strong traction among industry and international institutions in 2019. It is expected to constitute both a disruptive technology and a key enabler over the coming decade. It’s potential to replace fossil fuels in transport and heating and to be utilised as a low-carbon raw material for industrial processes, as well as its attractiveness as a transportable store of energy combined with the opportunities it can provide for oil and gas companies moving toward low carbon models, all add up to hydrogen being an attractive proposition for policymakers and investors. In addition to its versatility, a key requirement for the energy transition is that hydrogen production is powered by renewables, producing the zero-emission fuel known as “green hydrogen”.

Since hydrogen was first used as “energy” to lift a balloon in 1783, it has been mainly produced by the

steam reforming method which emits a large amount of greenhouse gas – hydrogen produced by fossil fuels is known as “grey hydrogen.” Hydrogen produced using this method with carbon capture and storage (CCS) is termed as “low CO₂” hydrogen or “blue hydrogen.” While blue hydrogen has some attractive features, CCS technology is still largely technically unproven and an expensive proposition that faces challenges in terms of production upscaling and supply logistics. In contrast, green hydrogen produced from the electrolysis of water using renewable energy produces zero carbon emissions.

Green hydrogen - offering further market growth opportunities for wind

As we outlined in the introduction to this report, the world is in a race against time to eliminate greenhouse gas emissions. Renewables such as wind and solar will not only have to supply almost the entire power demand by 2050, but we have to find ways to decarbonise technically challenging areas of energy use such as transport (including aviation and shipping), manufacturing, and

heating. Hydrogen is an important potential low-cost storage option for large quantities of electricity over days, weeks and even months and for energy to be transported over long distances. Besides, with green hydrogen used as a fuel, renewables can provide a more significant contribution to decarbonise a range of sectors – including intensive and long-haul transport, chemicals, and iron and steel – that are difficult to decarbonise through direct electrification.

Producing hydrogen from wind and solar could provide rapidly growing benefits for the development of power systems based on wind, solar and other renewables. These include greater energy security, lower price volatility and a solution to widespread curtailment, because hydrogen is produced using excess electricity generated at times of strong winds and then used to provide flexible and dispatchable energy across the entire system.

Wind - and particularly offshore wind - is an especially relevant power source for producing hydrogen. Hydrogen thus provides



a unique business opportunity and model to advance towards a 100% renewable energy-based system. To meet this potential, wind will need to become even more ambitious in order to meet the massive volumes needed for zero-carbon heavy industries via hydrogen.

GWEC is actively engaging with a range of stakeholders and policy institutions to facilitate the integration of wind power with the fast-growing hydrogen industry and to ensure those policy frameworks create true “win-win” scenarios for both wind and hydrogen.

Photo: © voestalpine, H2FUTURE project (funded by FCH JU)

Green hydrogen — a key enabler of the energy transition

Cost is high but expected to fall when scale is achieved

The production of green hydrogen still faces considerable challenges in terms of cost and the development of infrastructure and logistics.

Green hydrogen costs in 2019 varied between US\$2.50 to US\$4.50 per kilogram, depending mostly on the cost of electrolyser according to BloombergNEF. The price will need to fall below US\$2 in order to make green hydrogen competitive with coal and to US\$0.6 to compete with grey hydrogen.

According to the IEA report *The Future of Hydrogen*, the cost of producing green hydrogen could fall by 30 per cent by 2030. This forecast is based on the declining costs of renewables and the scaling up of hydrogen production. It is critical to scale up green hydrogen projects and manufacturing to achieve the foreseen cost reductions and ensure the economic viability of

hydrogen so that it can fulfil its potential as a long-term enabler of the energy transition.

A key to meeting climate goals: offshore wind-to-hydrogen

With electrolysers in their infancy and still expensive, their potential for cost reductions is enormous.

power to energy systems around the world, with generation costs already falling to the range of €55 to €70/MWh (a 65 per cent reduction from 2015). The coupling of increasingly affordable renewable electricity with hydrogen's role as a renewable enabler could

It is critical to scale up green hydrogen projects and manufacturing to achieve the foreseen cost reductions and ensure the economic viability of hydrogen so that it can fulfil its potential as a long-term enabler of the energy transition.

Of all the renewable electricity options, offshore wind has the highest potential to produce sustainable hydrogen because of the economic competitiveness that can be achieved through its scale and technology innovations. In Northern Europe, offshore wind has shown the potential to provide significant amounts of clean

constitute a natural next step to decarbonise our energy systems further. At present, there are two types of widely explored offshore wind-to-hydrogen solutions.

In the first offshore wind-to-hydrogen solution, surplus offshore wind energy that would otherwise be curtailed - or purpose-built

offshore wind capacity for hydrogen generation - will power electrolyzers that split water molecules into hydrogen and oxygen. Green hydrogen will then be compressed and stored in a tank system, waiting to be offloaded when energy is needed.

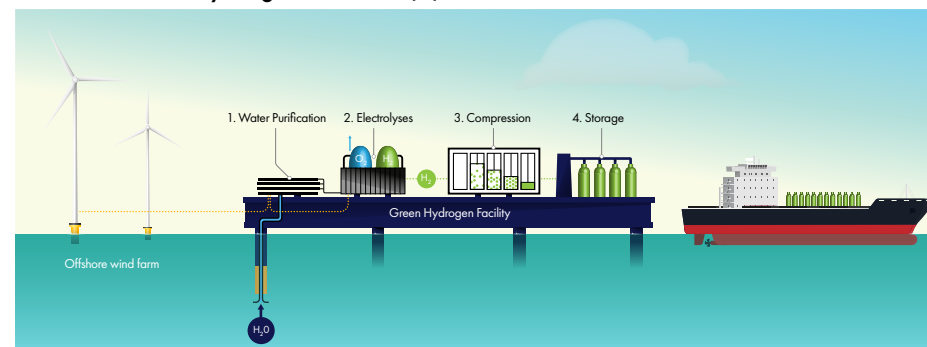
With offshore hydrogenation platform available, liquid hydrogen (LH2) can be converted to synthetic natural gas (SNG) or better known as ammonia, before ship shuttle to end-users for multiple purposes. As ocean shipping is a relatively expensive form of transportation, electrolyzers can also be deployed in coast areas connected by HV subsea cables to substations, so that the green hydrogen can be transported directly with on-land hydrogen pipelines or with trucks after compression.

Another innovative offshore wind-to-hydrogen solution aims at using excess offshore wind energy to power electrolyzers located on oil and gas platforms to produce green hydrogen from seawater. The green hydrogen is blended into the gas export line and transported to land via existing gas infrastructure. This solution already widely used by industrial gas

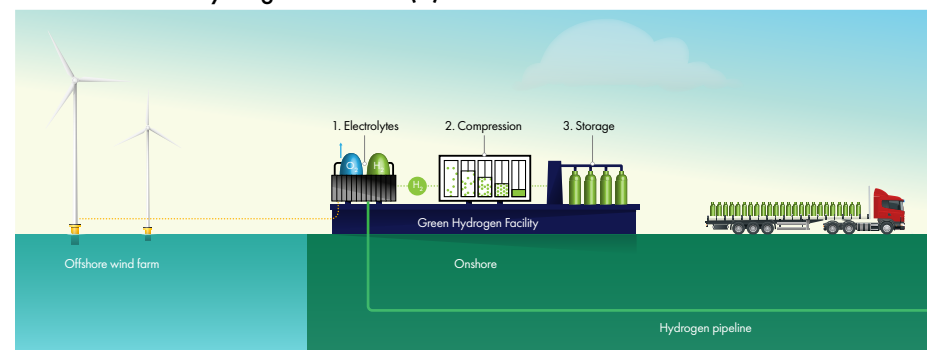
producers to supply chemical and refining industries. It is expected that up to 20 per cent of hydrogen by volume can be mixed into existing gas pipeline flows. While blending green hydrogen into existing natural gas pipelines cannot achieve 100% decarbonisation, it can still be a contributing solution in the short term as the existing natural gas supply will continue to be used to balance power systems in the immediate future and blending green hydrogen helps to partially decarbonise this flow.

From the first small-scale renewable hydrogen production facility in NREL's National Wind Technology Center (NWTTC) in March 2007, further wind-to-hydrogen demonstration projects have grown in Europe and Australia. On the following page, there are a few examples of how wind industry players adapted hydrogen into their business approaches during 2019. There is a notable diversity of actors, including leading offshore wind developers, oil and gas companies, research centres as well as governments aiming to roll out hydrogen at scale to decarbonise industries and make a substantial contribution to the energy transition.

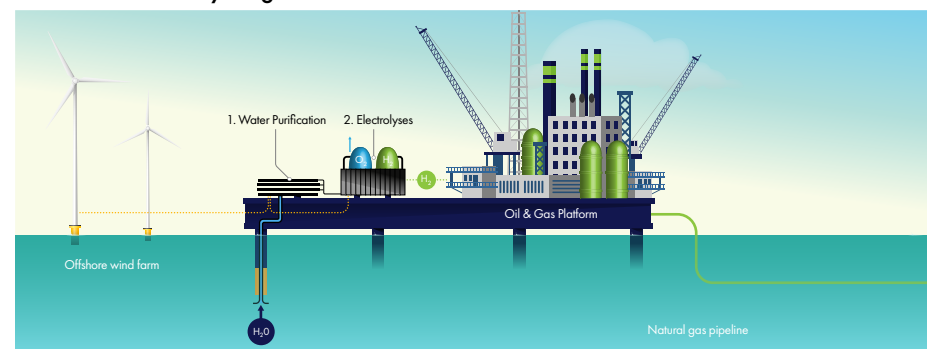
Offshore wind to hydrogen solution 1 (a)



Offshore wind to hydrogen solution 1 (b)



Offshore wind to hydrogen solution 2



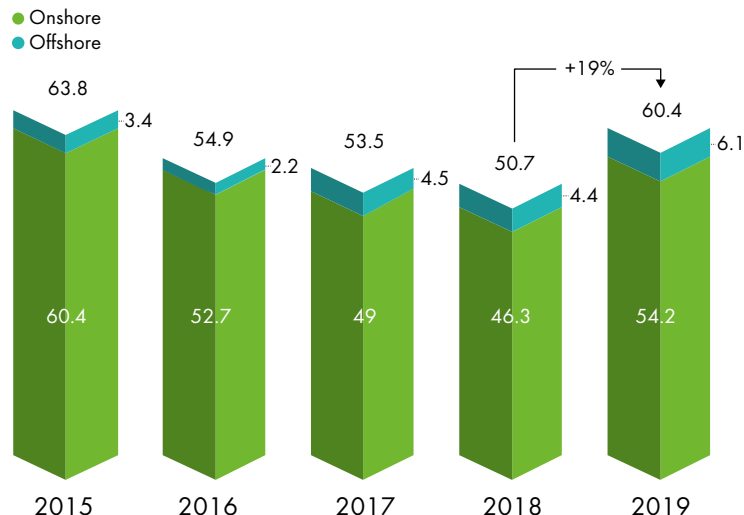
Green hydrogen — a key enabler of the energy transition

Table 1. Selected green hydrogen projects

Project and Size	Location	Year	Company Name	Status
Crystal Brook Energy Park, Australia (50-MWe)	South Australia	2021	Neoen Australia	The proposed 50 MW Hydrogen Superhub would be the largest co-located wind, solar, battery and hydrogen production facility in the world.
Dolphyn (10MW)	The UK	2023	Environmental Resources Management	In the second phase of this demonstration project, which is supported by BEIS.
HYPOR® Oostende	Ostend, Belgium	2025	DEME, Oostende Port, and PMV	The green hydrogen plant in Ostend will ultimately deliver a CO2 reduction of around 500,000 to 1,000,000 tons per year.
Hyoffwind (25MW)	Zeebrugge, Belgium	2023	Parkwind, Fluxys and Eoly	The consortium plans to take a final investment decision after summer 2020 to be able to start the construction of the installation by mid-2021.
Hydrogen Utility (15MW)	Port Lincoln, South Australia	Early 2020	Germany's Thyssenkrupp and the Hydrogen Utility (H2U)	The proposed AUD \$ 117.5 million facility will include a 15 MW electrolyser plant, a distributed ammonia production facility, and a 10 MW hydrogen-fired gas turbine and 5 MW hydrogen fuel cell
H2Future (6MW)	Linz, Austria	November 2019	Verbund (with Siemens electrolyser), APG, TNO and K1-MET	A large-scale 6 MW PEM electrolysis system is installed and operated at the voestalpine Linz steel plant in Austria
NorthH2	Eemshaven, The Netherlands	2027	Shell, Gasunie and Groningen Seaports	This will entail construction of a purpose-built up to 10GW offshore wind farm to produce industrial-scale green hydrogen
Gigastack(5MW)	The UK	2022	Ørsted with ITM Power and Element Energy	This project, also supported by BEIS, is connected to Hornsea2 offshore project.
REFHYNE (10MW)	Wesseling, Germany	2020	Shell, ITM Power	A 30MW pilot — part of a 700MW project — is expected to be up and running by 2025
PosHYdon	Netherlands	2021	Nexstep, TNO and Neptune Energy	First offshore green hydrogen pilot with existing natural gas pipeline in North Sea

MARKET STATUS 2019

New installations GW



Overview

2019 saw global new wind power installations surpassing 60 GW, a 19 per cent growth compared to 2018, and bringing total installed capacity to 650 GW, a growth of 10 per cent compared to last year.

New installations in the onshore wind market reached 54.2 GW, while the offshore wind market passed the milestone of 6 GW, making up of 10% of the global new installation in 2019 the highest level to now.

Asia Pacific continues to take the lead in global wind power development accounting for 50.7 per cent of the global new installations last year, followed by Europe (25.5 per cent), North America (16.1 per cent), Latin America (6.1 per cent) and Africa & Middle East (1.6 per cent).

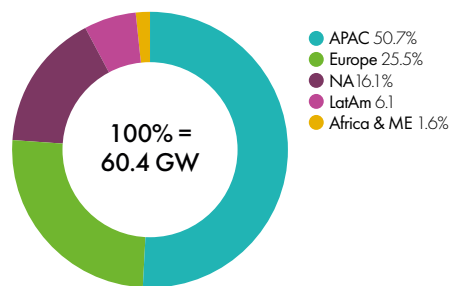
The world's top five markets in 2019 for new installations were China, the US, United Kingdom, India and Spain. Those five markets together made up 70 per cent of the global installation last year.

In terms of cumulative installations, the top five markets as the end of

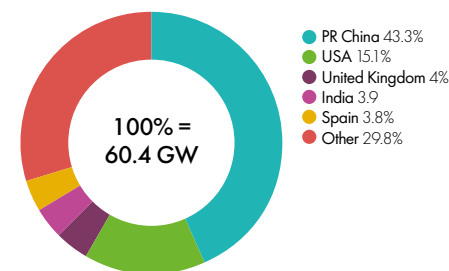
The world's top five markets in 2019 in new installations are China, the US, United Kingdom, India and Spain.

2019 remained unchanged. Those markets are: China, the US, Germany, India and Spain, which together accounted for 72 per cent of the world's total wind power installation.

New capacity 2019 installed by region (%)



New capacity 2019 and share of top five markets (%)



GWEC Market Intelligence, March 2020

Onshore Wind Market

54.2 GW of onshore wind capacity was added globally in 2019, representing 17 per cent YoY growth and taking cumulative onshore wind beyond the 600 GW milestone.

As the world's largest wind market, China grid-connected 23.8 GW of onshore wind last year, boosting its total onshore installations to 230 GW. China's onshore wind sector has gone through a crucial period of regulatory reform in the past two years. In 2018, the Chinese government introduced an auction scheme and a year later the National Development and Reform Commission (NDRC) released a new policy presenting a clear roadmap towards "subsidy-free" onshore wind. This regulation means that projects already approved until 2018 will continue to receive the Feed-in-Tariff (FiT) if they are grid-connected before the end of 2020. Starting from 1 January 2021, all newly approved onshore wind projects will reach the grid parity (currently based on the regulated price for coal power). As more than 60 GW onshore wind projects were approved before the end of 2018,

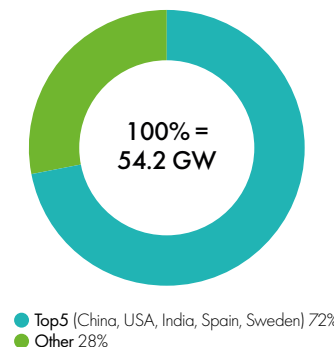
GWEC expects the installation rush, which already took place in H2 2019, to continue in 2020, potentially bringing new onshore installations in China to 30 GW in 2020. From 2021, new installations of onshore wind in China will be driven by subsidy-free projects (key driver) and distributed wind.

The second largest market in 2019 was the US. The 9.1 GW of new onshore installations in 2019 brings its total onshore to above the 100 GW threshold. The ongoing US onshore wind installation rush is primarily driven by the planned Production Tax Credit (PTC) phase-out as project developers have to chase the 2020 deadline to qualify for the full PTC value. Last December, the senate passed a tax extenders deal that extended PTC for another year. Thus, PTC qualification will remain as the main driver for new onshore installations in the US between now and 2024, supplemented by state RPS as well as the corporate PPAs market.

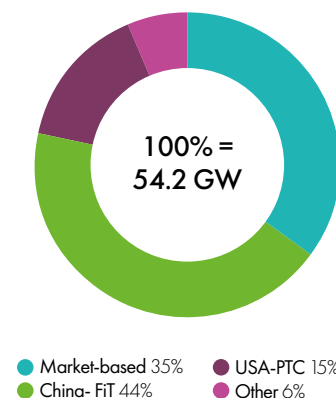
In addition to China and USA, the top five onshore wind markets were completed by India (2.4 GW), Spain (2.3 GW) and Sweden (1.6 GW).

With regards to market support mechanisms, the situation is similar to the previous year. Excluding the two largest markets, China and USA, market-based mechanisms, such as auctions, tenders, and Green Certificates were the main drivers behind new onshore wind installations in 2019. Last year, 35 per cent of new installations originated from market based mechanisms, the same level as 2018. Although onshore wind auctions in both Germany and India were undersubscribed last year, 14.5 GW of onshore wind capacity was auctioned outside China during 2019, almost the same as 2018. With China starting to bring subsidy-free onshore wind online from 2021, a new element of support for auctioned volumes globally is expected to kick-in.

New capacity 2019 and share of top five onshore markets (% onshore)



New capacity 2019 by support mechanism (% onshore)



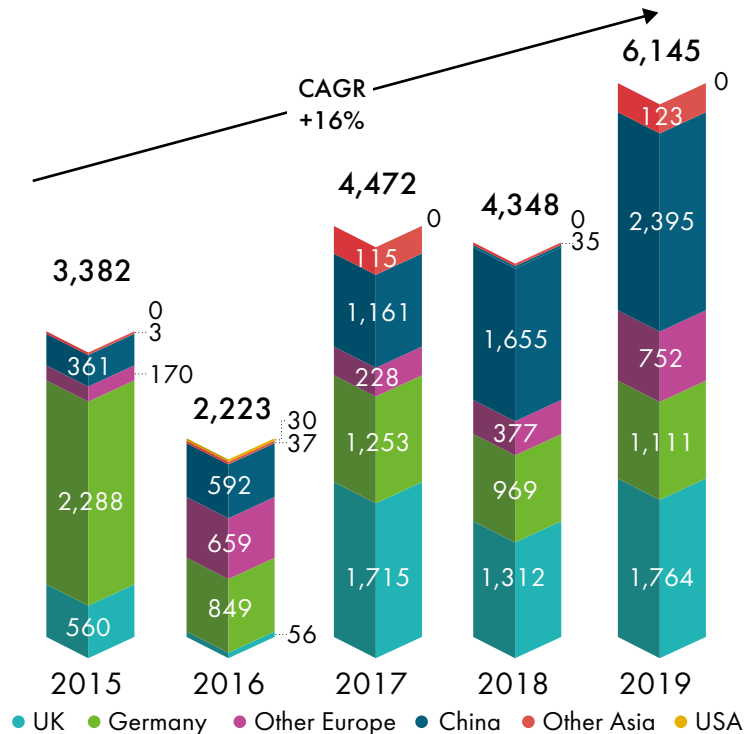
Source: GWEC Market Intelligence, March 2020

Offshore wind market

With more than 6 GW new installations, 2019 was the best year ever for the global offshore wind industry.

- China achieved a new record in 2019 and installed more than 2.3 GW offshore wind in a single year. The United Kingdom came in second place, although as the

New installations GW



The offshore wind market has grown from 3.4 GW in 2015 to 6.1 GW 2019, bringing its market share in global new installations from 5% to 10% in just five years. GWEC Market Intelligence expects the global offshore wind market to continue to grow at an accelerated pace (for details, see Market Outlook).

Source: GWEC Market Intelligence, March 2020

world's largest offshore wind market in total capacity, it also had record installations of 1.8 GW in 2019. Germany took third place with 1.1 GW of new installations.

- The results from the UK CfD Allocation Round 3 announced in September 2019 showed record low strike prices ranging from £39 to £41/MWh (in 2012 prices), which is about 30% lower than the auction held in 2017. In total, more than 5.4 GW offshore wind projects were awarded.
- In The Netherlands Vattenfall won the second Dutch zero subsidy offshore wind tender, totalling 760 MW, in July 2019 (repeating the zero-priced bids of the first round in 2018 and meaning that the project will only receive the wholesale price of electricity and no further support/payment). Those results prove how offshore costs have come down through technology innovation and economies of scale.

- The US offshore sector made great progress last year. The country's total offshore wind procurement targets increased from 9.1 GW in 2018 to 25.4 GW in 2019 after New York and New Jersey upgraded their offshore targets,

and more states released their offshore wind targets. Six states had selected more than 6 GW of offshore wind through state-issued solicitations as of December 2019 and more solicitations are expected to be issued in New York and New Jersey in 2020. The industry is now moving a phase of project construction planning and execution as more than 15 offshore projects are expected to be built by 2026.

- Development in the Asian offshore markets was also positive in 2019 – Taiwan connected its first utility scale offshore project to the grid. On top of the 5.6 GW offshore wind to be installed by 2025, a further 10 GW is planned to be built offshore from the island between 2026 and 2035. Positive steps were also made in Japan last year to accelerate offshore wind development and the first offshore wind auction will be held later this year.

2019 saw GWEC continue to provide guidance on offshore wind potential and technical development and organizing targeted lobbying activities, and we will carry out several landmark activities including the Japan Cost Reduction Study in 2020.

All regions increased new installations, except LatAm and Africa & ME

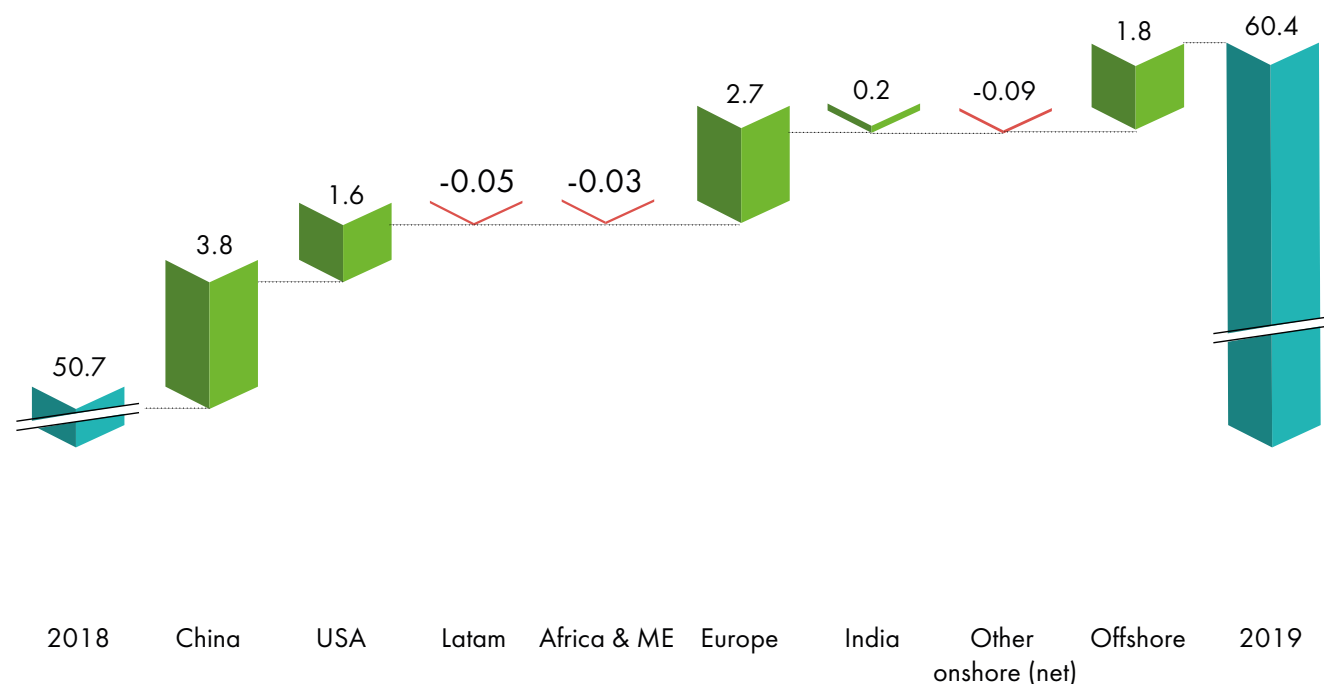
2019 saw the annual wind market grow in all the regions except Latin America and Africa & Middle East. Out of the 9.7 GW YoY increase, 1.8 GW (18.6 per cent) is from offshore wind and the remaining comes from the following major onshore markets: China 3.6 GW (36.7 per cent), Europe 2.7 GW (28.2 per cent), USA 1.6 GW (16.1 per cent).

2019 saw global new wind power installations surpassing 60 GW, a 19 per cent growth compared to 2018.

2019 was once a again a challenging year for India's market, although 8.5 per cent growth was reported. New installations in Latin America dropped by 51 MW compared to the previous year, primarily due to nearly 1.2 GW decline in Brazil, the largest market in the region. In Africa & Middle East, compared with 2018, new installation declined by 2.6 per cent (26 MW) as less capacity was installed in Egypt and Kenya bought Africa's largest wind farm online in 2018.

Changes in new installations 2018 to 2019

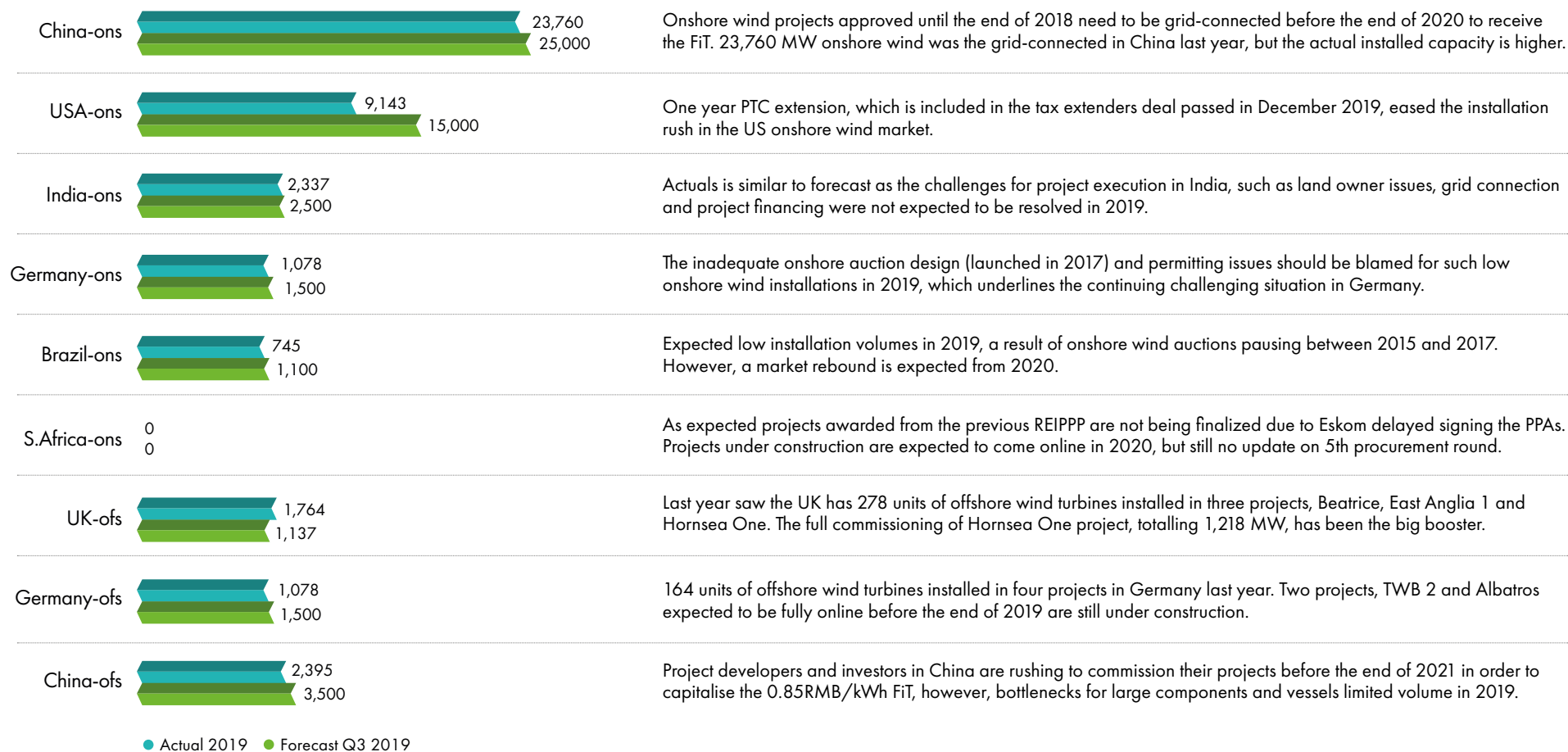
GW, onshore and offshore



Source: GWEC Market Intelligence, March 2020

Actuals 2019 vs GWEC forecast

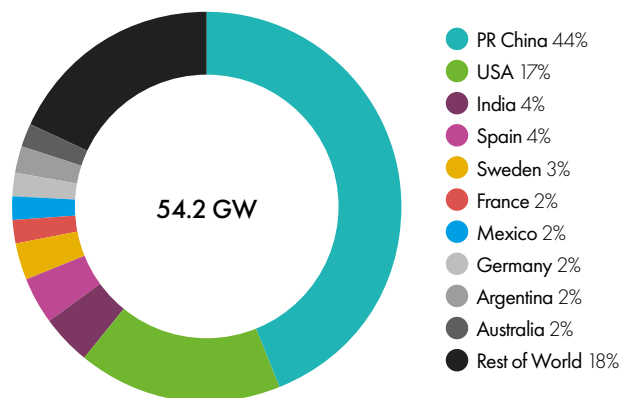
Actuals 2019 vs GWEC forecast



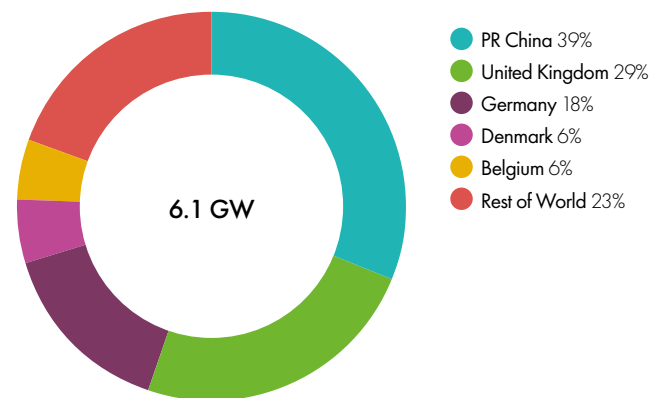
Source: GWEC Market Intelligence, March 2020

Top markets 2019

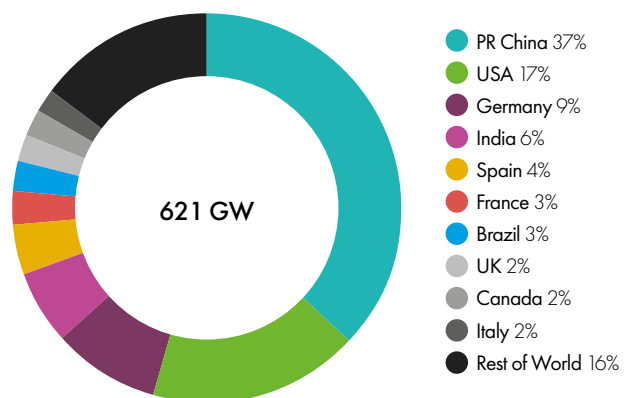
New installations onshore (%)



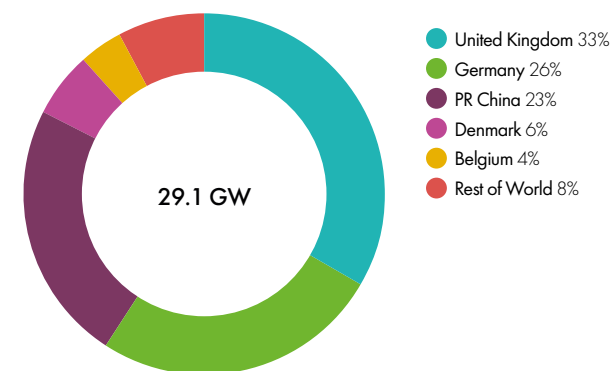
New installations offshore (%)



Total installations onshore (%)

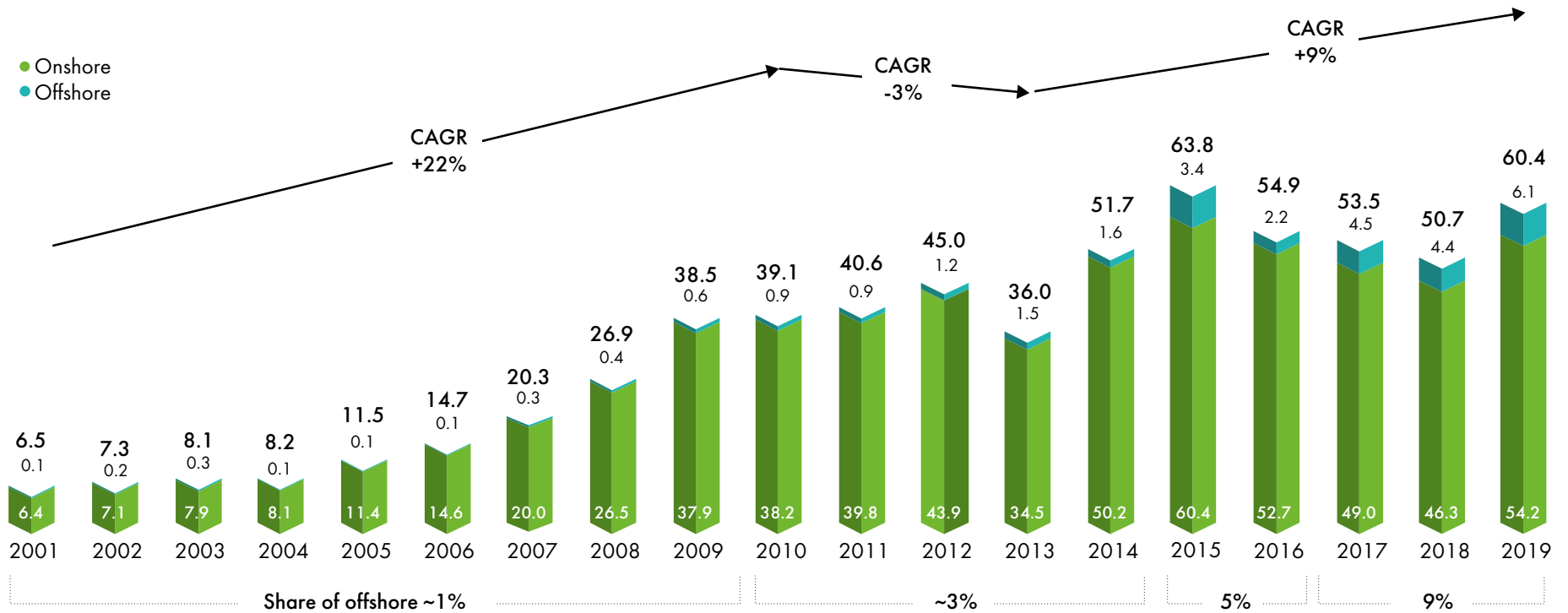


Total installations offshore (%)



Detailed data sheet available in GWEC's member only area. For definition of region, see Methodology and Definitions in the Appendix
 Source: GWEC Market Intelligence, March 2020

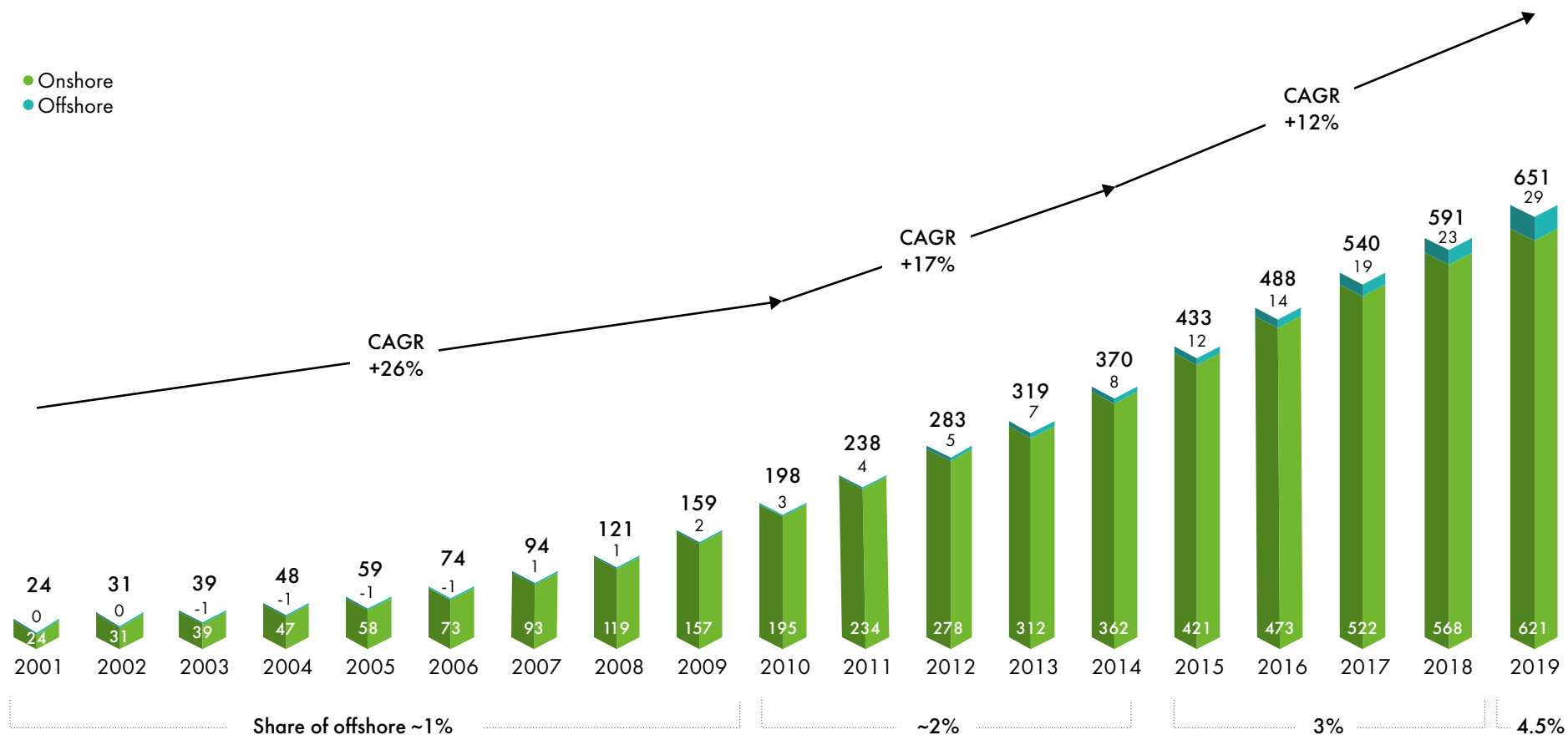
Historic development of new installations (onshore and offshore)



Detailed data sheet available in GWEC's Members Area

Source: GWEC Market Intelligence, March 2020

Historic development of total installations (onshore and offshore)



Detailed data sheet available in GWEC's Members Area

Source: GWEC Market Intelligence, March 2020

Historic development of total installations

MW, onshore	New installations 2018	Total installations 2018	New installations 2019	Total installations 2019
Total onshore	46,345	567,592	54,206	621,421
Americas	11,891	134,843	13,427	148,072
USA	7,588	96,488	9,143	105,436
Canada	566	12,816	597	13,413
Brazil	1,939	14,707	745	15,452
Mexico	929	4,935	1,281	6,215
Argentina	445	673	931	1,604
Chile	204	1,619	526	2,145
Other Americas	220	3,605	204	3,807
Africa, Middle East	970	5,728	944	6,673
Egypt	380	1,190	262	1,452
Kenya	312	338	0	338
South Africa	0	2,085	0	2,085
Other Africa	278	2,115	682	2,798
Asia-Pacific	24,468	255,937	28,094	284,024
China	20,200	205,804	23,760	229,564
India	2,191	35,129	2,377	37,506
Australia	549	5,362	837	6,199
Pakistan	400	1,189	50	1,239
Japan	261	3,652	274	3,921
South Korea	127	1,229	191	1,420
Vietnam	32	228	160	388
Philippines	0	427	0	427
Thailand	568	1,215	322	1,538
Other Asia	140	1,702	123	1,822
Europe	9,016	171,084	11,741	182,652
Germany	2,402	52,932	1,078	53,913
France	1,563	15,307	1,336	16,643
Sweden	717	7,216	1,588	8,804
United Kingdom	589	13,001	629	13,617
Turkey	497	7,370	686	8,056
Other Europe	3,248	75,258	6,424	81,619

MW, offshore	New installations 2018	Total installations 2018	New installations 2019	Total installations 2019
Total offshore	4,348	22,997	6,145	29,136
Europe	2,658	18,280	3,627	21,903
United Kingdom	1,312	7,963	1,764	9,723
Germany	969	6,382	1,111	7,493
Belgium	309	1,186	370	1,556
Denmark	61	1,329	374	1,703
Netherlands	0	1,118	0	1,118
Other Europe	7	302	8	310
Asia-Pacific	1,690	4,687	2,518	7,204
China	1,655	4,443	2,395	6,838
South Korea	35	73	0	73
Other Asia	0	171	123	292
Americas	0	30	0	30
USA	0	30	0	30

Detailed data sheet available in GWEC's member only area

Source: GWEC Market Intelligence, March 2020

MARKETS TO WATCH

As the most active lobbying body, GWEC has been playing a leading role in opening up and developing new markets for the wind industry in the past decade. Leveraging our successful stories in Brazil, Mexico, India and South Africa, GWEC is now supporting the development of the next group of growth markets in South East Asia, Latin America, Africa and the offshore sector.

To accelerate new market development, GWEC has initiated and established a series of task forces - Latin America, South East Asia, Africa, Global Offshore and most recently the Japan Offshore Wind Task Force. These groups bring together leading

developers, investors, manufacturers and institutions from GWEC members and other industry stakeholders. Each Task Force not only provides governments with guidance on the best regulatory and technical frameworks for attracting investment as well as carries out public awareness campaigns, but also builds an unparalleled network for GWEC members. To help each country to realise their wind energy potential, dedicated workshops and activities under each taskforce are held regularly.

In this year's Markets to Watch section, we selected a list of growing markets covered by established GWEC taskforces.

These markets include:

Vietnam, Thailand

South East Asia Task Force

Chile, Colombia

Latin America Committee

Kenya

Africa Task Force

USA, China

Global Offshore Wind Task Force

Japan

Japan Offshore Wind Task Force

Colombia

Colombia's wind market is now set to take off following the second long-term renewable energy auction in October 2019, which saw wind power emerge as the clear winner with 1,174 MW awarded through 15-year Power Purchase Agreement (PPA) deals.

Colombia has been slow to take off as a market despite its excellent wind resources, as stubborn market entry barriers and a lack of investment in renewable technologies by incumbent generators have delayed development over the last decade. However, pressure on the country's power system combined with a new

appreciation of wind power's competitive cost have led to a policy breakthrough over the last two years, helped by strong engagement from GWEC and the industry. Severe droughts triggered by the El Niño phenomenon in 2015-2016 raised the awareness that Colombia is highly vulnerable to climate change effects. This factor has driven national energy policy towards measures which will boost system resilience, including diversification of energy sources to complement the dominant place of hydropower.

Successful renewables tender in late 2019

After two years of planning, Colombia's first effort for a renewables auction resulted in a failed attempt to secure long-term PPAs in February 2019. As antitrust requirements were reportedly not met, the tender was postponed to the latter half of the year.

Subsequently, a successful wind and solar auction in October awarded 15-year PPAs to 7 wind projects that will provide 1,174 MW of power in La Guajira, to

come online by January 2022. Colombia's robust competitive procurement process helped achieve historically low average prices of USD 28/MWh, spurring the call for subsequent tenders and opening the electricity market to competitive green power.

The culmination of Colombia's capacity payment tender in March 2019 and the long-term contract auction for non-conventional renewable energy above, brings the total volume of wind power in development to 2.28 GW –expected to come online by 2022. Recently, Colombia's national mining and energy planning unit UPME approved the connection for 2.53 GW of wind into the grid. However, considering potential delays and pending grid infrastructure expansions, GWEC forecasts 2.2 GW of wind installations by 2024.

Colombia has high wind power potential in several areas in different regions in the country with up to 18 GW of potential in the northern peninsula of La

Guajira alone, according to a 2010 study. However, delivering this potential will require strong steering from government, which is targeting an increase of the share of non-conventional renewable energy generation capacity from 1 per cent to 17 per cent by 2030, strong investment in grid connection through the planned series of La Guajira interconnectors and others.

At the market's early stage, clearing the pathway for deployment

The challenges faced by Colombia during the early phase of creating a wind market are not uncommon, ranging from the need to streamline environmental licencing, the need for enhanced investment and planning of grid connections and integration, and the enabling of local and international project financing. It will be critical for long-term market growth to enhance clarity on renewable energy integration plans beyond 2022; adapt PPAs to international standards and strengthen the grid development strategy.



Pressure on the country's power system combined with a new appreciation of wind power's competitive cost have led to a policy breakthrough over the last two years.

Colombia

Colombia's National Development Plan targets 1.5 GW of renewable energy capacity by 2022. Nevertheless, it is critical to view necessary investments in wind power from a long-term perspective. An industrial plan which looks at infrastructure, workforce and system needs beyond 2022 will be critical to support the development of renewables projects.

Colombia has proven its capability to redesign and adapt the auctions system to so called non-conventional renewable energy (wind and solar). It is crucial for the long-term success of the

auction scheme that PPAs are aligned to international standards, for instance by denominating contracts in USD instead of the Colombian peso in order to lower currency risk for foreign developers and lenders. Such measures will help to increase the bankability of wind power projects and mobilise foreign investment.

Lack of grid capacity has been identified as a critical bottleneck in renewable energy markets around the world. At the start of Colombia's growth curve for wind power, a comprehensive long-term plan for transmission infrastructure will ease the way for efficient integration of

increasing volumes of renewable energy. Interconnection with neighbouring power markets is another channel for growth, drawing upon the success of the Interconexión Panamá – Colombia that will join Colombia to the Central America electricity market through SIEPAC, as well as Colombia-Ecuador transmission corridor.

A market primed to take off

Colombia is expected to become a powerful wind market in Latin America, due to its strong wind resources, political stability and energy transition ambitions. It is already playing a leading role in the Renewable Energy for Latin

America and the Caribbean (RELAC) initiative to achieve 70 per cent renewable energy by 2030 in the region.

Wind energy is increasingly viewed as a means to foster positive competition in the power market, lower emissions and strengthen the generation matrix, given the country's climate-related challenges and depleting fossil fuels reserves. Colombia will now need to lay long-term foundations for a sensible regulatory, financing and infrastructure environment, in order to ride out the wave of success of its first tender.



Chile

Leading the decarbonisation drive in Latin America

Chile continues to signal a healthy outlook for wind energy, with vast technical potential and strong policy support to grow wind volume and phase out coal-fired generation. In 2019, wind energy capacity expanded by more than 18 per cent, with new installations of 526 MW. Chile now has 2.15 GW of wind capacity in operation, a further 1 GW of capacity under construction and more than 6 GW of approved wind projects.

On the policy front, a decisive shift to diversify energy sources has been spurred by a growing public consensus on Chile's vulnerability to climate change. A decade-long 'megadrought' has transformed once-arable land in central Chile into desert and

blunted the reliability of hydropower plants, making the switch to wind and renewable energy a rational call.

Chile is the first Latin American nation to declare a complete coal phase-out, announcing a plan to retire 1 GW of coal power by 2024. It has also made regional low-carbon commitments with the Renewable Energy for Latin America and the Caribbean (RELAC) initiative, pledging collective target of 70 per cent renewable energy use by 2030.

These and other growth drivers are positioning Chile to exceed its clean energy target of 20 per cent by 2025 five years early, according to Chilean renewable energy association Asociación Chilena de Energías Renovables y Almacenamiento (ACERA).

Auctions driving wind market growth

As one of the first countries in Latin America to liberalise its energy sector and introduce centralised auctions, Chile is a leader in implementing innovative energy market mechanisms. Accordingly, its technology-neutral auctions are based on forecasted power demand across hourly and quarterly time blocks, instead of capacity allocations.

In the 2017 auction, 2.2 TWh/year was allocated across 1.7 TW/h in hourly blocks and 500 GW in seasonal (three-month) blocks. This model allows variable clean energy sources to bid for blocks which match their resource profile; for instance, wind energy affected by seasonality can benefit from bidding for quarterly blocks, while hourly blocks favour solar PV. The

outcome of the Chilean auctions has been remarkable, allowing renewables to compete on a more level playing field with fossil fuels and still achieving cost-competitive prices (averaging USD 32.5/MWh in 2017).

A power auction for 2020 was delayed by six months the National Energy Commission (CNE) in February 2020, owing to a dip in GDP growth and energy demand following the social unrest which took place late 2019. The ongoing of civil protests have prompted investors to begin withdrawing debt financing and selling assets in Chile. The auction is set to take place in December 2020 for 5.6 TWh of electricity contracted through 15-year PPAs beginning in 2026, with the potential for greater allocation following an update on electricity demand.

Chile

Policy drivers including a coal phaseout

In 2019, Chile's government announced a plan to shut down eight coal-fired power plants by 2024, and decommission all remaining plants by 2040. While the speed of the total phaseout will depend on the economic, social and environmental impacts of the initial shutdown, the policy is a strong demonstration of public commitment to incremental decarbonisation and carbon neutrality by 2050.

Capitalising on Chile's wind energy potential is not just a political ambition, but a necessity

A further signal of commitment to Chile's system-wide approach to sustainability is a green tax law which came into force in 2017, taxing emissions from stationary atmospheric CO₂, SO₂, NO_x and particulate matter (PM) sources. Chile is pioneering this carbon

pricing mechanism in Latin America, with political buy-in from government and strong stakeholder involvement during the development phase. Successful outcomes from the green tax will, however, require Chile to step up its capacity-building in the regulatory and public sectors and develop adequate quantification, monitoring and inspection tools.

Installations may be constrained due to social unrest and grid bottlenecks

Wind energy installations are now challenged by transmission congestion and ongoing national social unrest. Civil protests across the country, which triggered an eleventh-hour move of COP25 from Santiago to Madrid in December 2019, continue to smoulder amid deep-rooted discontent over economic inequality and cost of living. An upcoming constitutional referendum in April 2020 will be a critical moment to recover unity and reset dialogue with civil society.

The 753-km Cardones-Polpaico transmission line commissioned in

June 2019 was an important step to delivering more robust and reliable power infrastructure. While this connection has eased congestion, the country's northern grid continues to struggle with curtailment and providing adequate connection points for new projects.

Considering the construction timelines for grid infrastructure and related approvals, the government needs to provide a long-term plan to minimise bottlenecks for integration of new renewables, which could include an expansion mechanism under the current transmission law.

Although Chile produces a mere 0.25 per cent global carbon emissions, it is one of the most vulnerable countries to climate change, according to the IEA and World Bank. Capitalising on its tremendous wind energy potential is not just a political ambition, but a necessity. As social unrest stabilises, the continued support for clean energy will position Chile as a source for wind power growth in Latin America.



Vietnam

Wind is primed to become an optimal source for this energy-hungry market

With a coastline of more than 3,000 km and an average wind speeds of 8m/s-9m/s in the south, Vietnam's potential to develop and generate wind power is substantial. In two reports both by the World Bank Group, Wind Resource Atlas and Going Global: Expanding Offshore Wind to Emerging Markets, a

energy portfolio to prevent energy shortages.¹ The shift of energy policy focus from low electricity prices to options that support rapid energy capacity deployment which is in turn, supporting the incorporation of more renewables.

By the end of 2019, Vietnam has a total cumulative installed wind power capacity of 487.4 MW, which includes 99 MW of intertidal

Vietnam's government is looking at all options to address accelerating energy demand and diversify its energy portfolio to prevent energy shortages.

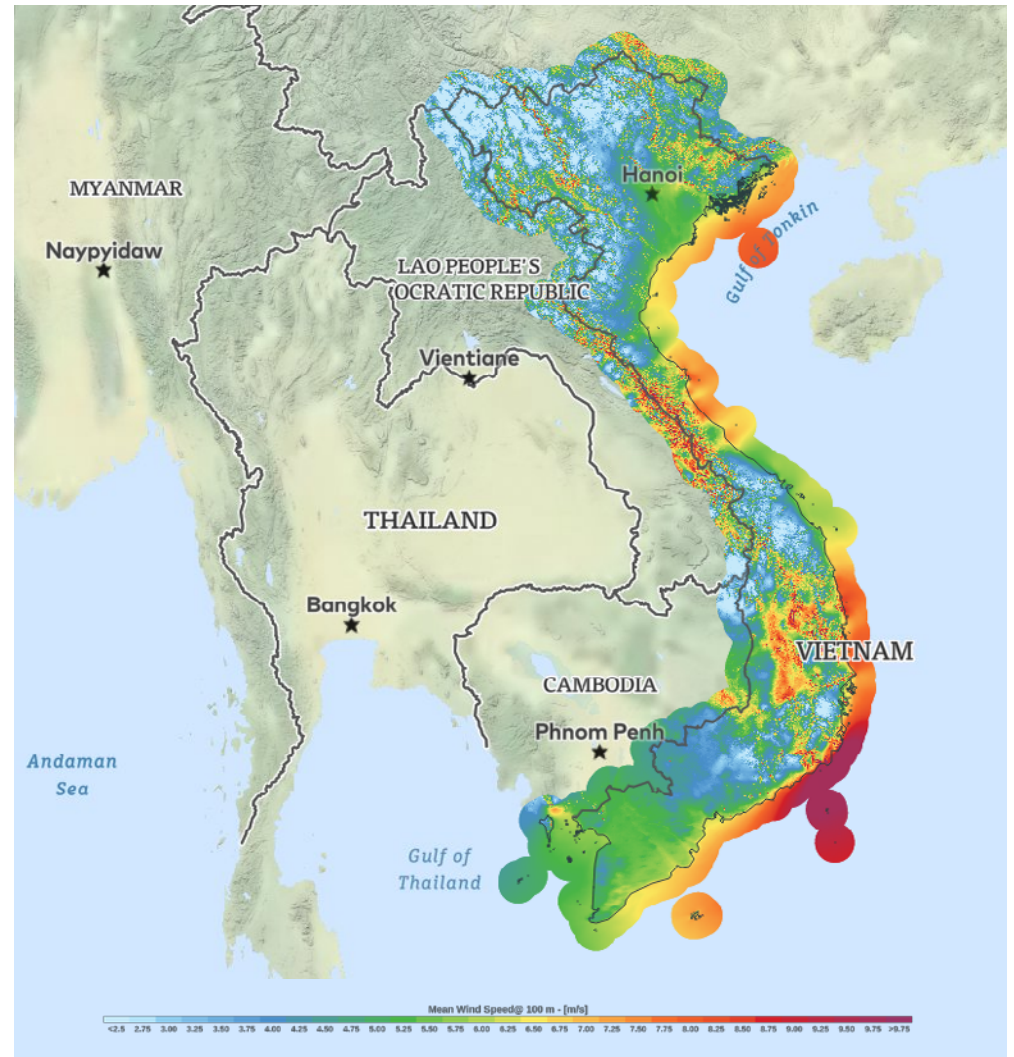
whopping 24 GW of onshore and 475 GW of offshore wind technical capacity was identified across Vietnam.

With a current rate of around 11 percent electricity peak demand growth per annum, one of the highest in the region, Vietnam's government is looking at all options to address accelerating energy demand and diversify its

projects, the first of its kind in the ASEAN region. Due to strong flows of foreign and domestic investors into Vietnam's wind sector, the market is predicted to install approximately 4 GW of wind capacity by 2025.

1. <https://vietnamnews.vn/economy/522698/pm-urges-ministries-to-avoid-power-cuts.html>

Onshore and offshore wind speed in Vietnam



Map obtained from the Global Wind Atlas 3.0, a free, web-based application developed, owned and operated by the Technical University of Denmark (DTU). The Global Wind Atlas 3.0 is released in partnership with the World Bank Group, utilizing data provided by Vortex, using funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: <https://globalwindatlas.info>

Vietnam

Near-term wind energy boom is being boosted by the 2021 Feed-in Tariff deadline

The current burgeoning wind market has been driven by a Feed-in Tariff (FiT) of USc 8.5/KWh for onshore, which was increased by 9 per cent in September 2018, and the introduction of the offshore tariff of USc 9.5/KWh, at a time when neighbouring markets have lowered or removed FiTs for wind energy.

The government's decision to increase the wind FiT in 2018 (but with expiry in 2021) was part of its efforts to rapidly add more power capacity. The market is now driven by the FiT cut-off date of 1 November 2021 and the market is seeing a plethora of wind developers and investors rushing to commission their projects before the deadline to capitalise on the increased FiT rates. In addition, there are also other support mechanisms in the form of tax exemptions, such as import, corporate and land tax exemption, as well as an exemption from Environment Protection Fees.

Key Challenges and Recommendations

Despite the bullish mood, the wind industry is still facing competition from subsidised coal. The biggest obstacle for wind is the high cost of capital and lack of financing for projects, with persisting risk factors in relation to the PPA continuing to deter international developers and lenders. While the cost of wind power in Vietnam is already competitive with thermal power, post-2021 growth could be limited by the FiT expiry and curtailment challenges unless Vietnam takes a proactive approach to ensuring continued momentum and that transmission investments are handled strategically.

To create an attractive market for wind developers, the following key items would support the growth of the onshore wind sector in Vietnam:

Ensure policy stability in the long-term energy plan

The future of FiT for wind after November 2021 remains unclear, which has created a lot of uncertainty and in turn has halted development of projects that are

deemed in risk of missing the November 2021 deadline.

There has been a lot of speculation about the future design of an auction based system after the FiT ends. The transition from the widespread use of FiTs to an auction system has been positive and proven to be a viable option for mature markets, as it has helped lower the levelized cost of energy (LCOE) of wind through heightened competition and price transparency. While auctions demonstrate the price competitiveness of wind, based on lessons learnt in Germany and India, GWEC argues that there should be a transition period between the soon-to-expire FiT and the introduction of auctions to avoid a sharp drop in the level of wind power installation in Vietnam post November 2021.

A clear and transparent approval process would encourage confidence for investors

Permitting is an independent challenge for many emerging wind markets including Vietnam. Currently, the approval process is confusing, time-consuming and



circuitous, which has often delayed approvals or resulted in companies abandoning projects. A transparent and replicable project-approval process will help bring down costs and encourage more firms to develop and invest in the country.

Vietnam

Replace this paragraph with: The recently issued Resolution No. 21-NQ-BCSD by the Ministry of Industry and Trade's (MOIT) Party Committee (on the principles and procedures for newly proposed projects applying for inclusion in the master plans) is a good example. Now, the approval process is clearer and more selective in terms of energy sources, power generation technologies and characteristics of specific projects such as location, grid connection plan, development progress and scale, among other factors.

Develop a more attractive Power Purchase Agreement (PPA) for renewable energy

The current PPA prevents non-recourse financing for wind projects in Vietnam which makes raising capital difficult. In 2019, Circular No. 02 revised certain provisions in the model PPA such as providing partial clarity to the termination payment

clause as well as stipulating the procedure for negotiation and execution of PPAs for grid-connected wind power projects in Vietnam. The revision demonstrates Vietnam's commitment to streamlining the regulatory process that will open doors to capital investment at the levels needed to build a dynamic and mature renewables industry in Vietnam. Further improvements can be made that includes government guarantees, PPA termination clause, arbitration and curtailment rules to lower the risk factors and attract more international developers and investors into Vietnam.

A bankable PPA is essentially a long-term offtake agreement that provides an adequate and predictable revenue stream that will enable repayment of debt. Improving the bankability of a wind PPA will instil more confidence in lenders and investors to extend financing into wind projects. This is expected to attract more interest from foreign investors in Vietnam's wind industry and provide a greater pool of financing options to lower

the cost of wind projects development.

Transmission and distribution grid investments are critical

With over 17 GW of solar applications under the FiT leading to congested queues for grid access for wind projects, developers will continue struggle with Vietnam's underdeveloped power grid capacity and the risk of non-compensated curtailment under current rules. Strengthening the national electricity grid and prioritising wind energy's value to the system in terms of supply profile will be vital to accelerate renewables deployment.

Capturing the potential of offshore wind

With the technical potential for fixed and floating offshore wind in the country estimated at 475 GW of capacity, offshore wind is primed to become an optimal source of power reserve for Vietnam's energy system. The first offshore/near shore wind farm in the Mekong Delta region, the 99 MW Bac Lieu wind power project, first came online in 2013. Since then, there has been a growing

industry appetite to develop offshore wind power in Vietnam.

Considering the various advantages of offshore wind, such as a high capacity factor, scalability, and predictability flexibility, GWEC insists that offshore wind in Vietnam should not be underestimated of its ability to bring in local and foreign investment, create local and sustainable jobs and supply chains, lower its carbon emissions and drive Vietnam to play a leading role in the energy transition in South East Asia.

Conclusion

This is a watershed moment for Vietnam – the country has clearly recognised the need to diversify its energy portfolio and now needs to take action to strengthen its enabling environment, create an attractive post FiT procurement system and reduce risk around issues such as involuntary curtailment with the power system. A strong political commitment to continued regulatory reform will be necessary to ensure steady growth of wind energy in Vietnam's power system, to offer the prospect of a more competitive, cleaner, and more secure energy pathway.



Thailand

Wind market at a crossroads after a remarkable 2019

As the second-largest economy of South East Asia – a hub of steady economic growth and population growth, Thailand is poised to play a significant role in the success of the energy transition. Over the past three decades of urbanisation and increasing demand for electricity, Thailand has explored the role of wind to diversify its energy sources, turning the country into the current leader in terms of total wind installed capacity in South East Asia. However, while wind power can offer Thailand a cost-competitive solution to the future energy mix, a lack of a clear roadmap for future procurement is restraining its contribution to Thailand's sustainable future.

2019 saw respectable progress for Thailand with new wind installation of 322 MW bringing the total wind installations to 1,532 MW – half of the 3 GW target set by the government for 2037. Commissioning of Energy Absolute's 250 MW Hanuman wind project (consisting of five wind farms) was responsible for the lion's share of the total capacity.

However, wind developers interested in Thailand have adopted a “wait and see” approach due to poor policy support from the government. Increasing price competitiveness of onshore wind resulted in the government removing FiTs for wind in 2018 and forcing new wind projects to be price competitive against traditional energy sources (2.44 thb/kWh) if they want to secure a PPA from the government - and this is challenging for sites situated in low wind speed regions.

‘The market responded to the changes with a sharp decrease in wind projects being brought forward for PPAs after the significant drop in the FiTs, and this is likely to persist until satisfactory clarifications on new tariffs are announced. This policy is contrary to the government's intention to increase the share of renewables in the total energy mix of 2037 to 29.4GW - or 33 per cent of the national electricity generation capacity, as highlighted in the Alternative Energy Development Plan (AEDP) 2018.’

Thai Wind Industry still optimistic of future growth

While wind power development is expected to slow in the next five years compared to the previous five years, Thailand is on track to easily fulfil its conservative target of 3 GW by 2037 considering the country already has more than 1.5 GW of cumulative wind power capacity by the end of 2019.

The recent public hearing of Thailand's Power Development Plan revision included an indicative target of 90MW/year between 2023-2025, with possibilities of upward adjustments of the target based on the performance of the industry.’

For a country with technical wind potential of 13-17 GW, an increasingly competitive wind LCOE and domestic proven reserves of oil and gas are expected to deplete in less than a decade,¹ GWEC's view is that Thailand has an opportunity to include at least an additional 7 GW of wind power backed by supportive regulation in the upcoming revision of Thailand's Power Development Plan (PDP 2018 - 2037). The revised PDP will be critical to retain confidence in

investors and developers at this uncertain stage for Thailand's wind development.

Pushing ahead is the Thai government's ambition to achieve what it calls “Thailand 4.0”, an economic model that promotes innovation, technology, and R&D to drive the country to a more prosperous future. Ideas such as a blockchain-enabled P2P energy trading system has piqued the interest of private investors for Thailand's plan of breaking down the currently oligopolistic energy market regulated by ERC, that maintains EGAT as the sole buyer of electricity. With clear regulations tied into the plan, it will bring in more investment and facilitate domestic innovation in the renewable energy sector with new business models to achieve decarbonisation and decentralisation.

1. IRENA, Renewable Energy Outlook, Thailand, 2017



Thailand

Furthermore, Thailand has cooperated with the Asian Development Bank (ADB) on several renewable energy projects. The issuing of Thailand's first green bond with support from the ADB will not only facilitate more private investment into renewables

directly but also create more confidence in Thailand's renewable energy potential.

In the long term, it is expected that with higher dependency on imported LNG, Thailand's carbon profile, and affordability issues – as costs are passed on to end consumers – will lead to adjustments in future energy plans and lead to the incorporation of more onshore wind.

Key challenges and recommendations

Gas is at the centre of Thailand's power system

Today, the fundamental issue for Thailand is the reliance on domestic natural gas that goes to the heart of government policies. With over 67% of electricity produced from natural

gas, the Thai government prioritises gas for the security of supply and cost reasons and gives this strategy pre-eminence over issues of sustainability and environment. Thailand is pragmatic about its energy use, and is looking for alternatives to the current matrix, but is not willing to countenance any perceived risk to growing energy consumption that is vital for the growing economy. Thus, it is crucial that the wind sector is able to strengthen its policy advocacy and show how large-scale wind together with other renewables sources can provide a reliable and cost-effective alternative to Change this paragraph to: Today, the fundamental issue for Thailand is the reliance on domestic natural gas that goes to the heart of government policies. With over 67 per cent of electricity produced from natural gas, the Thai government prioritises gas for the security of supply and cost reasons and gives this strategy pre-eminence over issues of sustainability and environment. Thailand is pragmatic about its energy use, and is looking for alternatives to the current matrix, but is not willing to countenance any perceived risk to growing energy consumption that is vital for the growing economy. Thus, it is crucial that the wind sector is able to

strengthen its policy advocacy and show how large-scale wind together with other renewables sources can provide a reliable and cost-effective alternative to gas.

Complex and restrictive permitting and regulatory environment

The legal framework for permitting – especially with respect to and the nearest buildings to them – is not well coordinated. Firstly, the unclear definition of "house" in the current regulation has led to high project risk due to the uncertainty of which building is a house and which one is not. Secondly, as most land plots in Thailand are small, based on the regulation of the Thailand government, there is not enough space to set up wind turbines. The distance between wind turbines and the highway should be determined according to the traffic density by adapting the international standard to be more practical. Clear policy and legal frameworks on land use are essential elements to enable long-term commitment and investment into renewables.

Requirements to implement local partnership structures

It has been 3 years since the ruling by the Supreme

Administrative Court of Thailand that agricultural reform land cannot be used for wind farms. This has been a long-standing challenge to wind farm developers in Thailand, as it restricts the availability of land for potential developments. Discussions between industry and various government bodies are needed to find a compromise that will incentivise the development of wind energy in Thailand while at the same time protecting the interests of rural communities.

Conclusion

With several wind projects commissioned in 2019 and investment of approximately THB 120,000 million, GWEC maintains a business as usual outlook of 250 MW of new installations over the next 5 years for this pioneering market which introduced renewables to South East Asia. With the right policies, GWEC is confident that Thailand can create an accelerated momentum for its renewable energy transition, with onshore wind playing a significant role in enabling Thailand 4.0 and moving towards the low-carbon society of the future.



Kenya

Kenya – A double-edged demonstration effect

Kenya's economy is the biggest in East Africa, with strong growth drivers. The same is true for its renewable energy sector, a key pillar of the country's development and industrialisation strategy.

Kenya currently has 335MW of installed wind capacity, with an additional 350MW forecast to come online by 2024. As one of the countries on the continent that stands out as having more attractive wind than solar resource, Kenya is poised to retain a leading role in wind energy in East Africa. Still, 'kwa ground vitu ni different' (a Swahili phrase roughly translating to 'things are different on the ground'), as critical lessons from 2019 reflect the current challenges to wind power growth in Kenya.

Strong headwinds for clean energy

Kenya has robust fundamentals for a healthy wind market: geopolitical stability, electricity access around 75 per cent, GDP growth hovering around 6 per cent, high penetration of financial institutions and

availability of private capital. These factors culminated in the successful grid connection of Africa's largest wind farm, the 312 MW Lake Turkana project in the country's north, in 2019 – the largest private investment project in Kenya to date.

Ambitious clean energy targets are also steering growth. The government is targeting a 100 per cent renewable energy mix for power generation by 2020, drawing largely upon geothermal, wind and solar energy, and 23 GW of renewable capacity by 2030. Power consumption is forecast to rise significantly under the Kenya National Electrification Strategy (KNES), which aims for universal electrification by 2022, creating strong demand for additional deployment of wind power.

While two large coal plants in Lamu County and Kitui County are still due to be commissioned in 2024 and 2034, respectively, they have attracted widespread public criticism. The African Development Bank, a key backer of the Lamu project, pulled out of its investment in 2019.

The state's long-term development roadmap, Kenya Vision 2030, will drive new infrastructure and

industrialisation projects. This will in turn support regional integration and transmission buildout for the power sector. However, drought conditions through mid-2019 have slowed down industrial activity and growth and may delay the commissioning of larger infrastructure projects.

A slowdown of grid infrastructure buildout could create bumps in the road for the wind sector, as adequate grid capacity and transmission lines are needed in Kenya to sustain investment and execution of wind projects.

Lessons from Lake Turkana project

While Lake Turkana is a major flag in the sand for Kenya's renewable energy sector, it also highlights critical challenges in project execution. Disputes over land acquisition and ownership caused delays in the project's early stages, which was followed by a 15-month delay for grid connection. The construction of a new transmission line was dogged by allegations of mismanagement and attracted public criticism as power from the completed wind farm had to be purchased by the state without being evacuated to the grid.





Now fully commissioned, Lake Turkana is a testament to the ambition and scale of wind power in Kenya, but serves as a reminder of the extant roadblocks in consenting and grid capacity. On the one hand, the project highlights utility-scale wind farms as a solution to rising power demand in African markets; on the other hand, a tumultuous development and construction

process elucidates the challenges on the ground.

Already, more than 1 GW of wind capacity has been awarded under Kenya's current FiT regime. But state off-taker Kenya Power is seeking to renegotiate these tariffs with power producers. Combined with issues of grid availability and land permitting, the prospect of lower remuneration may prove to

slow down the installation rate for wind projects. In order to minimise investment risk, these negotiations must be conducted in a transparent manner.

Looking further ahead, the government is considering a transition to competitive bidding. An energy auction scheme will only be successful if the roadblocks in transmission and

permitting are resolved. Lowering these barriers will also allow wind to pick up opportunities to replace more costly generation projects, under Kenya's Least Cost Power Development Plan.

As a positive signal, off-taker Kenya Power and Lighting Company was refinanced in 2019, in what is being viewed as a case study on how DFIs can strengthen the role of



local banks and enable access to cheaper and longer-term finance for utilities.

Capitalising on the promise of Kenya's wind market

Kenya's regional leadership is demonstrated through the Kenya-Ethiopia interconnector, which completed construction in August 2019 and aims to be operational by 2020. This project represents a

significant step forward in terms of regional integration and cross-border trading, as it will form the backbone of the Eastern Africa Power Pool. Furthermore, the Ethiopia-Kenya-Tanzania-Zambia interconnector projects aim to establish links with the Southern Power Pool by 2021.

Another showcase project is central Kenya's 80 MW Meru

County Energy Park, Africa's first large-scale hybrid project. The USD 150 million project will include 20 wind turbines and 40,000 solar panels and is being developed as a Public- Private Partnership.

Despite these promising developments, the Kenyan government is still developing a coal masterplan and exploring

plans for oil production from 2022 onward and importation of gas from Tanzania. Given the competing interests in Kenya's energy landscape, it is imperative that the industry builds on the progress of Lake Turkana – and that government and industry learn from its setbacks to improve an enabling environment for wind power in Kenya.

US Offshore

Picking up strong momentum as projects advance

The US offshore wind market has picked up strong momentum since the 30 MW Block Island Wind Project came online in Rhode Island in December 2016. Despite a complex regulatory scene based on differing rules across the offshore states, large scale projects are advancing, and developer appetite has been at fever pitch.

According to NREL, the US has a technical resource potential of more than 2,000 GW of offshore wind capacity, nearly double the nation's current electricity use.

On the federal level, the Bureau of Ocean Energy Management (BOEM) is responsible for managing development of the offshore resources in the Federal waters. In 2009, Department of the Interior (DOI) announced final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which provide a framework for issuing leases, easements, and rights-of-way for OCS activities that support production and transmission of energy from

sources other than oil and natural gas. Since the regulations were enacted, BOEM has auctioned 15 active commercial leases for offshore wind development that could support more than 21 GW of generating capacity. European developers, such as Ørsted,

The US has a technical resource potential of more than 2,000 GW of offshore wind capacity, nearly double the nation's current electricity use.

Iberdrola and Equinor, have been the big winners, dominating U.S. offshore wind leases. BOEM is now in the planning stages for leasing areas off the coast of New York, South Carolina, California and Hawaii and expects to hold lease auctions for new California and New York Bight lease areas in 2020.

Figure 1. East coast offshore wind project and lease areas



Source: BOEM, AWEA, January 2020

US Offshore

On the state level, the East Coast cluster consisting of Maine, Connecticut, Massachusetts, New York, New Jersey, Delaware, Maryland, Virginia and North Carolina is driving strong demand for offshore wind energy. To date, more than 10 states have offshore projects in different stage of development to date, of which six states have offshore wind procurement targets through either legislation, conditional targets, or executive orders. The recently increased offshore wind targets in

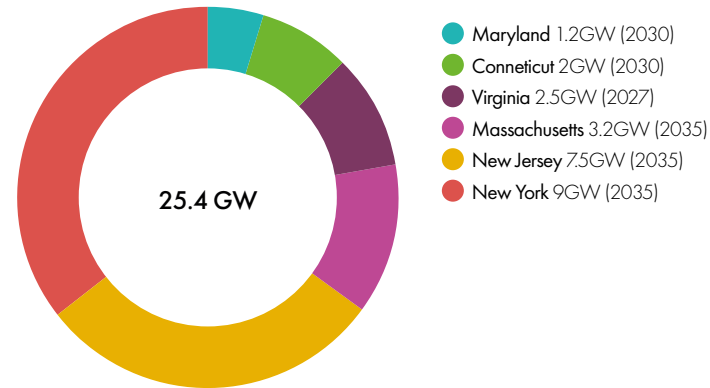
Developers expect 15 offshore wind projects, totalling 10,603 MW, to be commissioned by 2026

New York and New Jersey together with the 2030 offshore wind targets released in Connecticut and Maryland in 2019 have brought the country's total offshore wind procurement targets from 9.1 GW in 2018 to 25.4 GW in 2019. (see figure 2)

According to AWEA, six states had selected nearly 6,300 MW of offshore wind through state-issued solicitations as of December 2019. The top four states in terms of the total volume of solicitations are: New York (1,696 MW), Massachusetts (1,604 MW), Connecticut (1,108 MW) and New Jersey (1,100 MW). The state-level solicitations are expected to continue in 2020. For example, New York State Energy Research and Development Authority (NYSERDA) filed a petition in January 2020 with state regulators to initiate a regulatory proceeding for the authorization of a second largescale wind solicitation for at least 1 GW of offshore wind. NYSERDA also plans to issue solicitation in the middle of this year for another 2.5 GW of offshore wind.

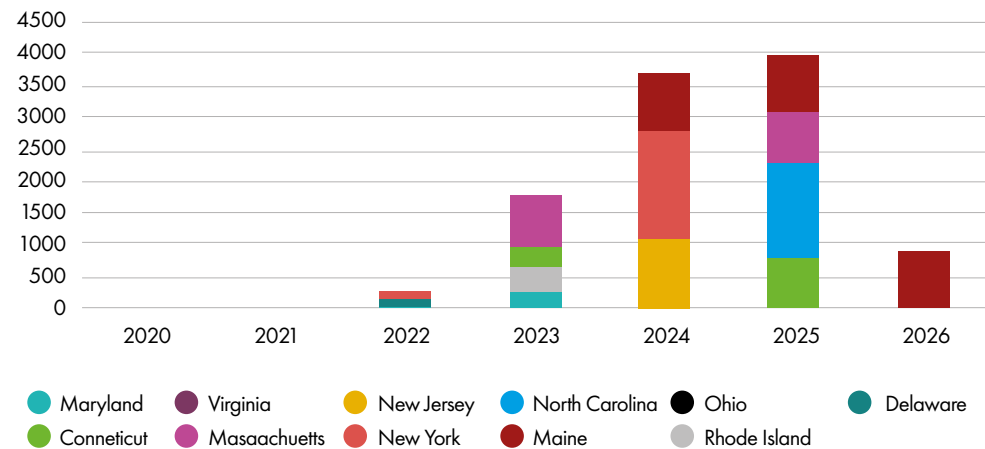
AWEA Q4 2019 market report shows as of December 2019 the US offshore wind pipeline totalled more than 26 GW in federal lease areas issued to date. According to GWEC Market Intelligence, out of this pipeline, developers expect 15 offshore wind projects, totalling 10,603 MW, to be commissioned by 2026.

Figure 2. Established offshore wind development targets by state (GW)



Source: GWEC Market Intelligence, March 2020

Figure 3. xpected annual offshore wind installation by state, 2020-2026 (MW)



Source: GWEC Market Intelligence, March 2020

US Offshore

Out of the 10,603 MW offshore wind capacity, 25 per cent is likely to be built in Virginia, followed by New York (17.2%), Massachusetts (15.2%), North Carolina (14.0%), Connecticut (10.5%) and New Jersey (10.4%). With regards to the project ownership, more than 70 per cent of the capacity to be delivered by 2026 is controlled by European developers, of which Ørsted is taking the lead (2.5 GW). The Danish utility is closely followed by Avangrid Renewable, a subsidiary of Spanish Iberdrola (2.3 GW), Equinor (816 MW), CIP (804 MW), EDPR (402 MW) and Shell (402 MW).

As of the end 2019, offshore developers have selected or announced preferred turbine suppliers for nine offshore projects. Thanks for the Dominion Energy's 2,640 MW project off the coast of Virginia, Siemens Gamesa is so far the largest winner with 4,366 MW order backlog in the U.S., followed by GE Renewable Energy (1220 MW) and MHI Vestas (804 MW). SGRE's SG8.0-167, GE's Haliade X-12MW and MHI Vestas' V164-9.5 MW turbines are popular models selected for those projects.

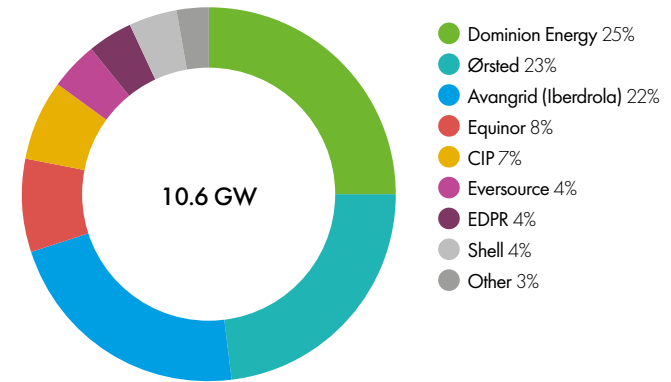
Several challenges need to be addressed to accommodate the growth

Even though the activity level is accelerating along the East Coast, commitments and investments in the supply chain including vessels, ports infrastructure, and workforce are now needed to fulfill timelines and meet ambitious targets. Individual states have defined programs, including tax incentives and research grants to attract investments. The challenge here is to define a collaborative approach to set up an efficient supply chain across the individual states.

Investments in grid infrastructure are also essential to keep on track to fulfill timelines. A third-party study suggests that 600 to 1,200 miles of grid have to be built for projects in New England and New York State. Such an immense investment cannot be handled by a single state, calling again for intense collaboration among the different stakeholder groups.

Slow processing by BOEM of proposed offshore wind projects may delay the ramp-up in earnest of an industry that promises

Ownership of US offshore wind projects announced to be built by 2026



industrial growth along with new manufacturing and employment across the US while reducing carbon pollution. Further delay to the approval of the FEIS (Final Environmental Impact Statement) for Vineyard Wind 1, the first truly large-scale - by global standards - offshore project in the US, is an example. For future commercial lease sales, engaging stakeholders - including federal, state and local agencies, fishing communities, and the public - throughout the processes is essential.

Last but not least, the Senate passed a tax extension deal last

December, which extended the Production Tax Credit (PTC) for one year. The 1.5 cents/kWh PTC (60% of the original PTC value) or 18% ITC in lieu of the PTC (60% of the original 30% ITC value) is available for projects that commence construction in 2020 and switch on operation by 2024. The local industry worked hard to try to secure a long-term extension of an investment tax credit (ITC) to ensure sustainable offshore wind development, but only a one-year extension was signed.

China Offshore

The rising star in Asia with great growth potential

China surpassed the UK as the world's leading offshore market in new installations in 2018. The country's target of 5 GW grid-connected offshore wind by 2020 was already reached in 2019, following new installation of 2.4 GW of offshore wind that year. Currently, China has a cumulative installed offshore wind capacity of 6.8 GW, making it the third-largest in the world.

With a coastline of over 18,000 km, China has more than 1,000 GW of technical potential for offshore wind at the hub height of 90 meters. Currently, there is no long-term of national offshore wind target in China, but ambitious official targets have been set by coastal provinces: Guangdong plans to build 30 GW offshore wind by 2030, followed by Jiangsu (15GW), Zhejiang (6.5 GW) and Fujian (5 GW). Other coastal provinces namely Liaoning, Hebei, Shandong, Shanghai, Guangxi and Hainan, also have their own offshore wind development plans, although their targets are much lower than the four leading provinces.

The market is in transition from Feed-in Tariffs (FiT) to auctions

On 21 May 2019, the Chinese National Development and Reform Commission (NDRC) released a new policy presenting a clear transition plan for China's offshore wind. According to this regulation, offshore projects approved before the end of 2018 are eligible for a FiT of CNY 0.85/kWh if the project is fully grid-connected before the end of 2021. Offshore projects approved in 2019 and 2020 have to go to competitive auction, with the price cap set at CNY 0.80/kWh and CNY 0.75/kWh respectively. On 23 January 2020, Chinese central government announced to stop subsidizing offshore wind from 2022 onward, but subsidies provided by provincial government are encouraged to provide continuity in support for offshore wind development.

Figure 1. Key provinces in China's offshore wind market

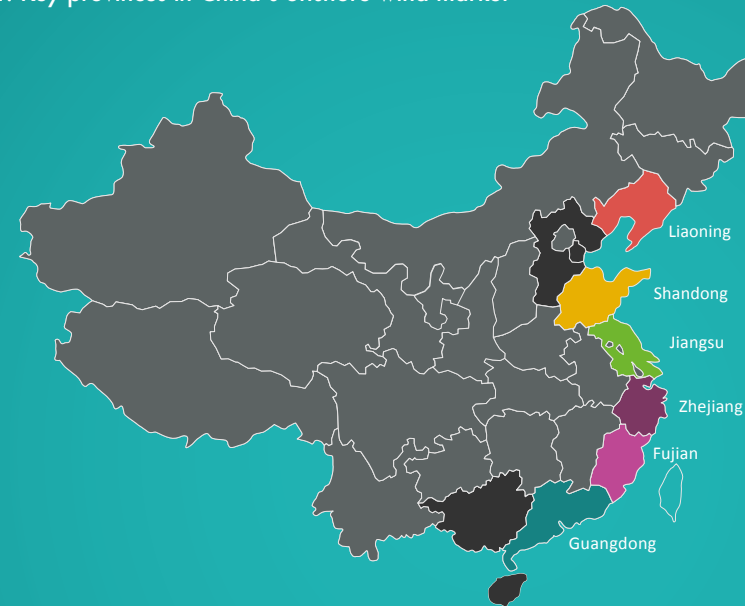
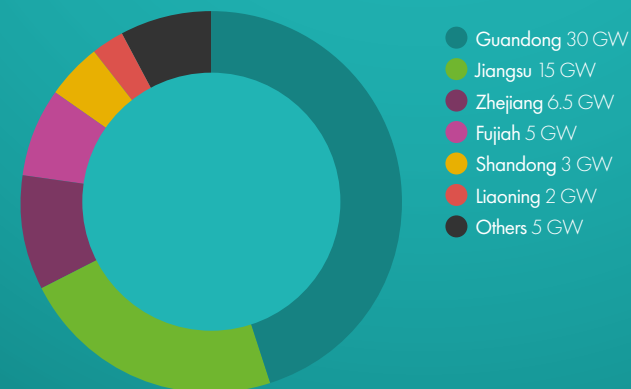


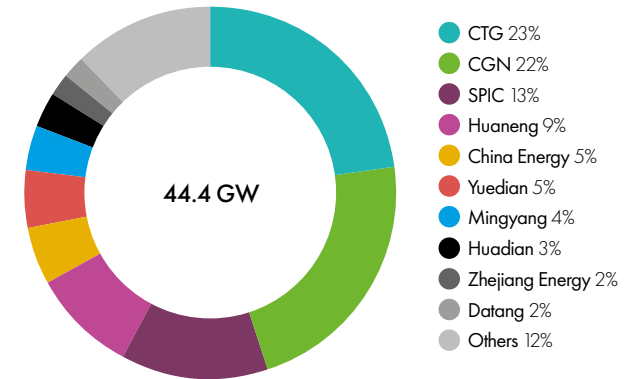
Figure 2. Provincial offshore wind targets for 2030



China Offshore

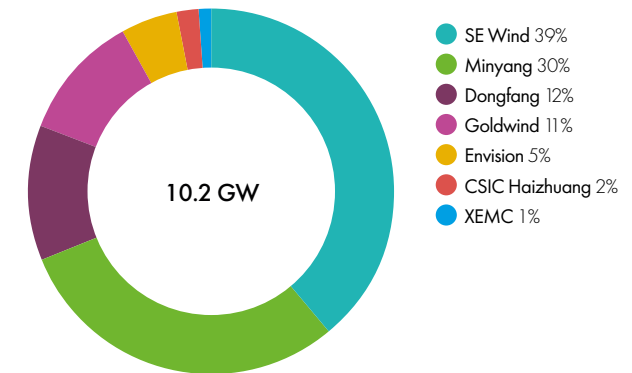
Driven by policy changes, more than 40 GW offshore wind projects had been approved by national or provincial governments before 2019, of these, half are located in Guangdong the other half mainly shared by Jiangsu, Zhejiang and Fujian. At present, the Chinese offshore wind market is dominated by Chinese state-owned energy companies, although French utility EDF and Norwegian giant Equinor entered the market last year by teaming up with CHN Energy and SPIC respectively.

Approved offshore projects in China by developer



Source: GWEC Market Intelligence, March 2020

2019 offshore wind bidding results by turbine manufacturer



Source: GWEC Market Intelligence, March 2020

China Offshore

In response to the strong offshore wind growth potential in China, it is not only local turbine manufacturers who have established production bases in coastal provinces to accommodate the demand. Foreign supplier GE Renewable Energy has also started building a factory in Jieyang, Guangdong, from where its Haliade-X 12 MW turbines will be rolled out from 2021. In reference to announced wind turbine order intake, the current market is controlled by Shanghai Electric (SE Wind) and Mingyang. These two local suppliers hold a combined market share of nearly 70 per cent.

Short-term installation rush dampened by bottlenecks on the supply chain

As of the end of 2019, China has more than 10 GW of offshore wind projects under construction with another 30 GW already approved and ready to be built. At present, project developers and investors are rushing to commission their projects before the end of 2021 in order to capitalise on the 0.85RMB/kWh FiT. For example, Guangdong province alone plans to get

grid-connect 8 GW of offshore wind before the deadline.

This ambition, however, looks unachievable at present, as the local offshore wind supply chain, particularly for the large size offshore wind turbine, has not been completely established yet. Availability of large components such as blades, main bearings, and offshore cables as well as the turbine installation vessels has become the bottleneck limiting the potential volume of offshore wind to be grid-connected before 2022.

Considering such challenges, GWEC Market Intelligence believes that only 7.5 GW offshore wind is likely to be connected in 2020-2021, but this level of additions will still make it possible for China to replace the UK as the world's largest offshore market in cumulative installation.



Japan Offshore

Market at crossroads as government faces key regulatory decisions

Japan's offshore wind market has taken its time to develop, with the first pilot projects going into the water back in 2003. In the years following the Fukushima nuclear accident in 2011, there was renewed activity with both fixed and floating foundations being deployed. To date, no commercial scale projects have been installed and the development of a viable market structure is emerging at a very slow pace. Now, however, with the government expecting to award contracts to the first wave of developer led projects some time later this year, and preparation for full scale bidding rounds based on designated offshore wind areas to follow, the market is finally nearing an inflection point.

There are still strong challenges to be overcome as the market takes form, including Japan's long term renewable energy target, avoiding an over-cumbersome environment and licensing framework, ensuring a level playing field for international companies and avoiding high cost, and the

management of powerful stakeholder interests.

However, there is a strong sense of growing momentum at both a policy level and in terms of business, and many of the leading global players have now formed joint ventures with local Japanese companies and/or set up local operations. The coming period will be crucial, as the wind industry seeks to work with government to create a strong sector based on large volumes and competitive prices, rather than a small sector which could remain an expensive niche within Japan's wider energy picture. In February 2020, GWEC and the Japan Wind Power Association set up a new Japan Offshore Wind Task Force representing the leading private sector actors, and this Task Force will play a key role in working with the government in the coming year, as well as produce a detailed Cost Reduction Study which will identify the different price scenarios and investment and industrialisation opportunities for the country based on different volume projections.

Japan's offshore development until now

The feed-in tariff (FiT) for wind power was approved in Japan in

June 2012, but the tailor-made offshore FiT was not available until March 2014 when the Ministry of Economy Trade and Industry (METI) approved the ¥36/kWh (€0.28/kWh) FiT for offshore wind. Despite the rate being the highest available anywhere for offshore wind, Japan only has 65.6MW of offshore wind power, including five floating turbines totaling 19MW, by the end of 2019. Responsible factors for the slow uptake of offshore wind include Japan's over-complex Environment Impact Assessment (EIA) system and market uncertainty.

It takes four to five years to pass through Japan's strict environmental assessment process, and there has been a lack of clarity and coordination between different government bodies, with industry calling for a "one stop shop" approach. From October 2012, any new wind farm greater than 7.5 MW is required to apply the legalised EIA permit. Developers need to spend millions up front to advance the EIA process before knowing whether they will qualify for the FiT, which creates considerable investment uncertainty. As of January 2020, 14.8 GW of offshore wind projects are in the EIA pipeline.

Current Offshore Wind Power Projects in Japan (Both fixed and floating type)

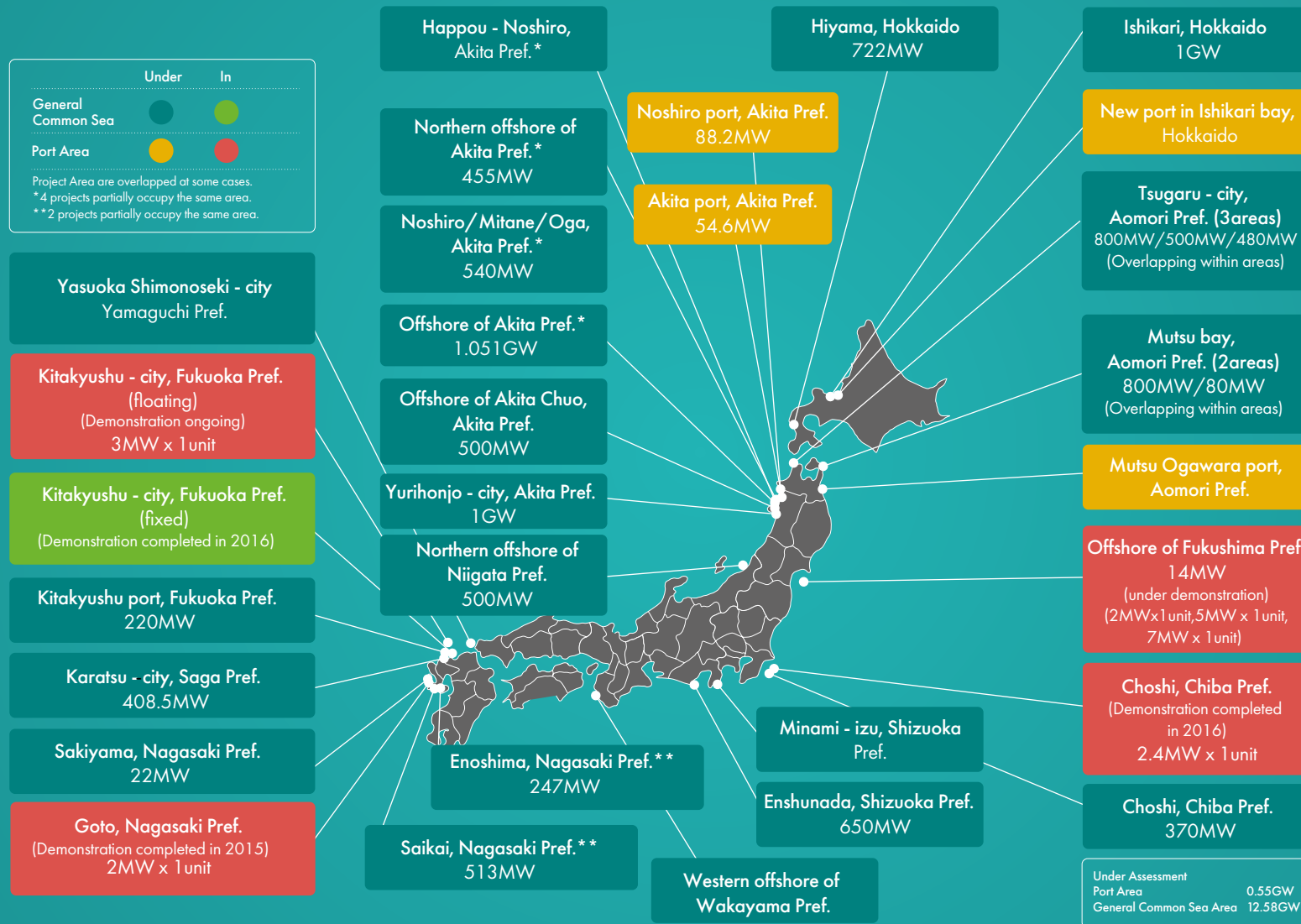




Photo: Courtesy of Principle Power. Artist name: Dock90

Japan Offshore

Positive steps to accelerate offshore wind development

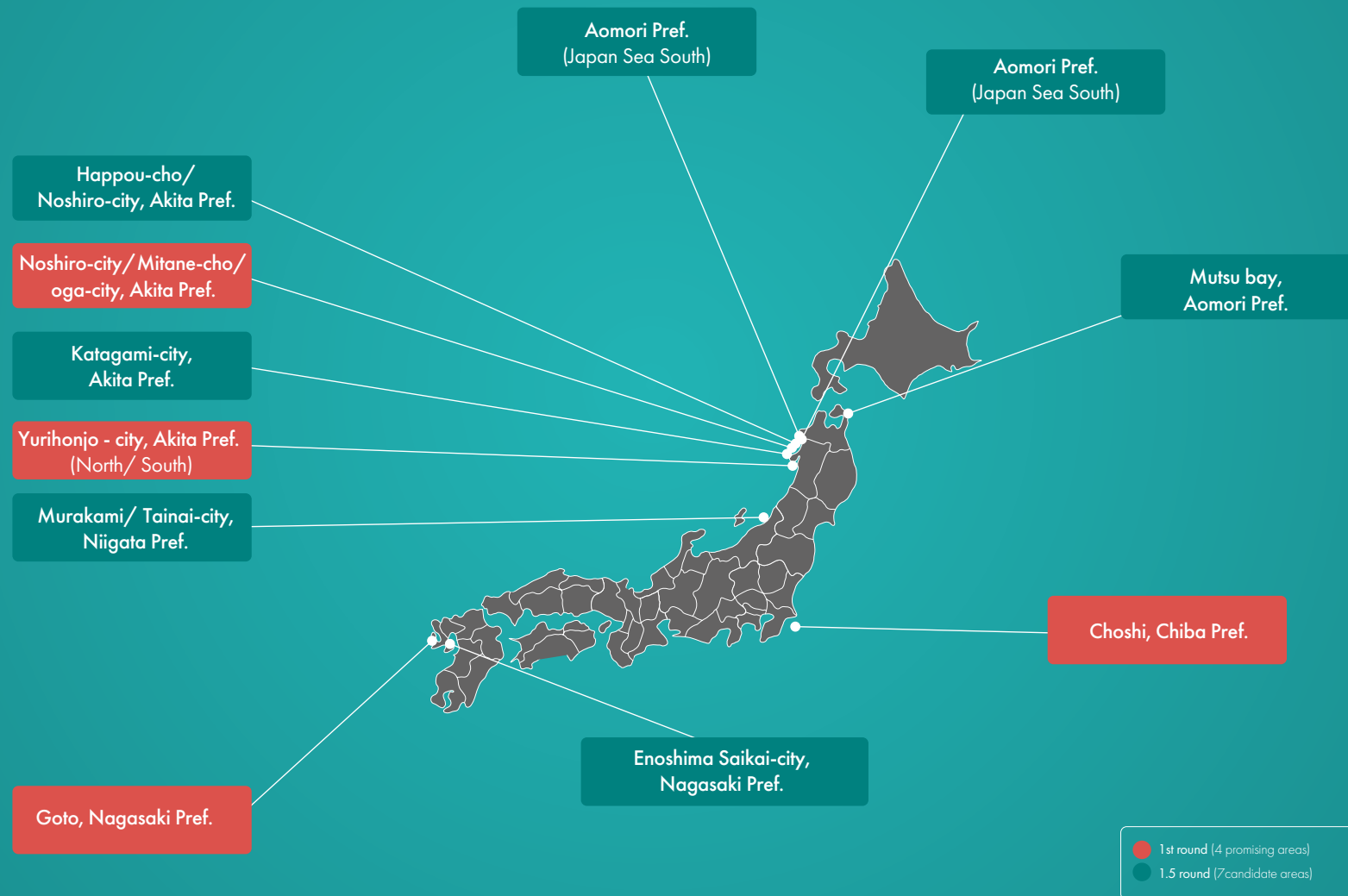
To address the challenges, the Japanese government has been streamlining the offshore wind development regulatory framework since 2017 when the MLIT (Ministry of Land, Infrastructure, Transport and Tourism) amended its Port and Harbor Law to promote offshore

wind power development at port associated sea areas. Further legislative progress was made in 2019 through an act promoting marine areas for renewable energy generation, and the announcement of 11 offshore wind promotion zones. Four of these zones (Goto in Nagasaki, Choshi in Chiba, Yurihonjo in Akita, Noshiro in Akita)

are nominated as promising areas where local residents have agreed to cooperate to develop offshore wind projects, with Goto selected as the first zone dedicated to the promotion of offshore wind. According to JWPA, the Goto floating offshore wind project (2MW x 8 turbines) conducted by Toda Co. is expected to receive the

first official approval from METI & MLIT in mid- 2020. In addition, MLIT has also amended Port and Harbor Law to allow developers and constructors to use port quays for offshore wind power development from October 2019 and the first offshore wind auction is expected to be held during the summer of 2020.

Round 1 Candidate Promotion Areas (Announced in July 2019)



Japan Offshore

Building the local offshore wind supply chain

Although the Japanese government has hesitated to announce a long-term offshore wind target and still maintains existing commitments with the nuclear and coal industries (which are, however, considered unrealistic by most analysts), the wind industry still expects to develop and gain contracts for around 1 GW worth of offshore wind projects each year (comprised of three or four promotion areas, with 300-350 MW each). If supply chain industrialisation can be achieved, this would bring Japan's total offshore wind capacity to about 10 GW by 2030, a target that has been proposed by JWPA to the government.

The creation of a more positive regulatory environment has drawn the attention of large local utilities including Tokyo Electric Power Company (TEPCO), which signed a memorandum of understanding with leading offshore wind developer Ørsted to work jointly on offshore wind projects in both Japan and abroad. Local and international suppliers are also entering the

offshore wind value chain. For example, Tokyo-based construction companies Penta Ocean has taken delivery of Japan's first offshore wind turbine installation vessel (OWTIV) in 2019 and another three OWTIVs are expected to be delivered in 2022 by local companies including Shimizu, Kajimay, Yorigami, Obayashi and Toa by 2022. International partnerships, such as Van Oord & Japanese NYK and Northern Offshore Group & NYK, have also been established to capitalize on the emerging opportunities in foundation and turbine installation as well as wind farm operation in Japan. However, it is worth mentioning that the Japanese government may need to find a new strategy to revive its local offshore turbine manufacturing industry as two local turbine OEMs Japan Steel Works (JSW) and Hitachi have decided to discontinue their new turbine production business in recent years. However, Mitsubishi Heavy Industries through its MHI-Vestas joint venture is taking a keen interest in the development of the Japan market, along with its international rivals SGRE and GE Renewable Energy.

In March 2020, MHI Vestas gained its first firm order in Japan, to supply turbines to the 139 MW Akita Noshiro offshore wind project owned by a Marubeni controlled subsidiary, while in November 2019, it signed a preferred supplier agreement to supply turbines to the 220 MW Hibikinada offshore wind farm. MHI Vestas has confirmed that its V174-9.5 MW was selected as the preferred turbine for this project.

Conclusion

2020 is expected to be an important year for the offshore wind sector in Japan with the awarding of contracts for the first wave of commercial projects, and the announcement of the framework for further competitive bidding rounds. To coincide with the release of the major cost reduction study, JWPA and GWEC will host the Global Offshore Wind Summit – Japan in Kitakyushu City on 1-2 October 2020.

Emerging Offshore Markets

From the perspective of GWEC Market Intelligence, it is important to highlight the development for offshore wind in newer markets. Even if actual installations will not happen immediately. The four selected markets, Vietnam, India, Brazil, and Australia, are representative of markets with high offshore wind potential but varying political support to date. Still, in all four markets there is an awareness that offshore wind can provide an at scale, cost-competitive and efficient solution for these countries.

GWEC Market Intelligence is monitoring activities in 46 markets on a regular basis to document the opportunities and progress of taking offshore wind global.



Vietnam

Development stage
100MW Bac Lieu intertidal, built 2016

Numerous intertidal projects in development

Two further offshore development projects, Phu Cuong 400 MW due to FID in 2020

Political support
Political will but policy lacks clarity as yet

Challenge
Creating a long term roadmap for offshore wind, which is in hand

Next milestone
PDP8 is in preparation for later in 2020



India

Development stage
Studies undertaken for a 1 GW project in Gujarat

Tamil Nadu region is new focus

Political support
Target is 30 GW by 2030

Political will exists

Challenge
With very low prices for onshore wind and solar PV, it is difficult to make the case for offshore wind

Next milestone
Government is considering how best to proceed



Brazil

Development stage
EPE Brazilian Offshore Wind Roadmap, Feb 2020, provides policy advice to MME

6 offshore wind projects totalling 9.7 GW being considered for environmental licences

Political support
Interest in offshore wind to diversify renewable energy sources

Challenge
Embracing offshore wind into policy

Next milestone
Stakeholder event and policy workshop



Australia

Development stage
Site surveys underway for a 2 GW project

New trade association, Offshore Wind Australia

Political support
NOPSEMA appointed offshore wind regulator

No political will so far

Challenge
Massive bushfires have raised need to combat climate change, which is still to be converted into political will

Next milestone
Policy formation

A scenic landscape featuring wind turbines on a rocky hillside in the foreground. The middle ground is dominated by a vast, undulating sea of white clouds, illuminated by the soft, golden light of a sunrise or sunset. The sky above is a gradient of warm colors, from orange near the horizon to a pale yellow at the top. The overall atmosphere is serene and clean, representing renewable energy in a natural setting.

MARKET OUTLOOK – 2020 TO 2024

Global wind energy market to grow on average by 4 per cent each year (pre COVID)

The market outlook for the global wind industry remains positive. The CAGR for the next five years is 4 per cent..

GWEC Market Intelligence expects that over 355 GW of new capacity will be added. That is nearly 71 GW of new installations each year until 2024.

At the beginning of the five-years forecast period, the market growth will continue to be driven by government support mechanisms, such as FiT, PTC, auction programs and national or state level renewable targets.

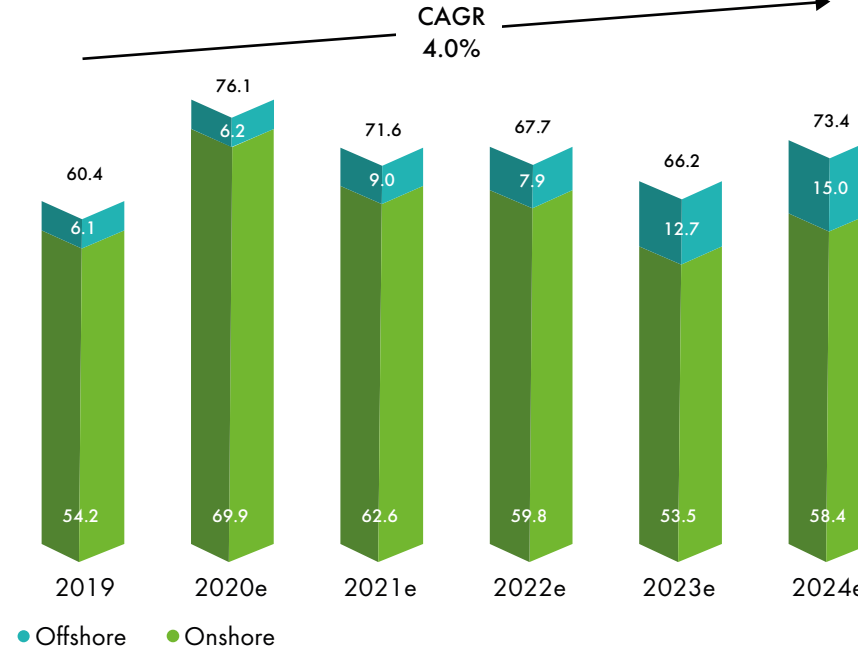
2020 is likely to see a new installation record, considering the ongoing installation rush in the world's two largest markets, China and the US, driven by the phase out of government support mechanisms and the incentive to chase 100% PTC value respectively.

From 2021 onward, although the PTC will remain as the main driver for installations in the US where the one year PTC extension which passed the senate last December is most likely to generate a new rush in 2024, the rest of world is expected to operate based on tenders or on other market mechanisms.

In Europe, Latin America, Africa & Middle and South East Asia, market-based mechanisms including the wind-only, hybrid, technology-neutral auctions will continue to dominate, but issues related to the market design in countries like Germany and India have to be resolved in order to allow accelerated growth.

With wind increasingly improving its cost-competitiveness, the bilateral agreement (e.g. in the form of corporate PPAs) will not only maintain momentum in matured markets like the US,

New installations outlook
GW



GWEC's Market Outlook represents the industry perspective for the expected installations of new capacity for the next five years. The outlook is based on input from regional wind associations, governmental targets, available project information and input from industry experts and GWEC members. An update will be released during Q2 2020. Detailed data sheet is available in GWEC's member only area

Brazil, Mexico, Chile, Argentina and the Nordic markets, but also make breakthrough in growing emerging markets over the coming years as barriers to access are removed (as in the case of South-East Asia).

In China, starting from 2021, the subsidy-free era is going to kick-in for onshore wind, faster than

anyone could have expected.

Following the sharp drop of the LCOE and the speeding-up of the global energy transition, the investment climate for offshore wind has become very positive. With a CAGR of 19.5%, more than 50 GW offshore is likely to be built in the next five years.

Outlook by region

Offshore wind

The size of global offshore market is expected to grow from 6 GW in 2019 to 15 GW 2024, bringing its market share in global new installations from today's 10% to 20% by 2024. In Asia, China is set to become a big contributor in the next five years, followed by Taiwan and Japan. In the US, the first utility scale offshore installations (>800 MW) are expected towards 2023

when offshore wind will become a truly global business.

Africa/ Middle East

Steady volumes, around 1.45 GW/ year, are expected to be delivered from Africa/Middle East in the next three years (2020-2022), and the annual market size is likely to double, primarily due to increased volume from South Africa, the largest market in Africa, and

expected installations from Saudi Arabia in Middle East.

Asia excl. China

With challenges related to project execution and market design expected to be addressed in the next 2-3 years, India will continue to be a large driver in this region. Vietnam is a market to watch in South East Asia considering its near-term installation rush, improving policy environment and growing economy and power demand. More volume could be unlocked if governments in places like Indonesia and the Philippines follow through on recent positive policy pronouncements.

level of 11-12 GW in the next five years. Increasing growth is also expected from European markets exclude from the EU-28, such as Turkey and Russia as governments continue to execute their auctions and tenders.

Americas

In Latin America, it is a mixed picture in terms of government support and economic stability on the country level, however, a stable annual installation of 4 GW is possible, chiefly driven by the recovery of Brazilian market and the demand from the private market. For the next five years, the PTC will remain as the main driver for the US market, although corporate PPAs and state-level RPS will continue to drive growth.

China

2020 is going to be the best year yet for Chinese onshore wind as more than 50 GW awarded projects are chasing the grid-connection deadline of 31 Dec 2020 in order to qualify the previously approved FIT. Installations from 2021 onward will be mainly driven by subsidy-free onshore wind, but new installations are unlikely to go down somewhat until the previously approved project pipelines run their course.

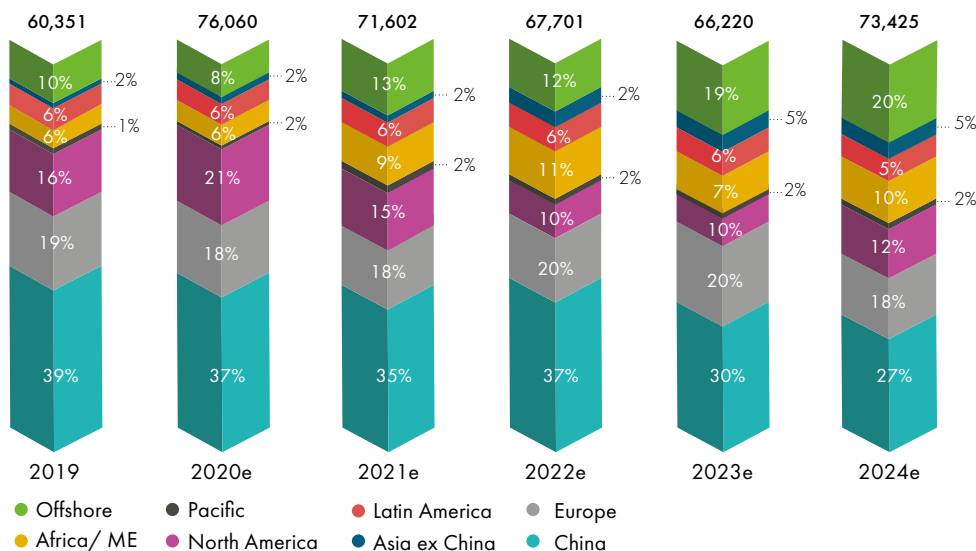
Pacific

The majority of demand in this region in the next five years will come from Australia, although small scale project work including repowering is expected from New Zealand. New solutions like hybrid projects and microgrids will continue to generate opportunities in this region while improving renewables integration.

Europe

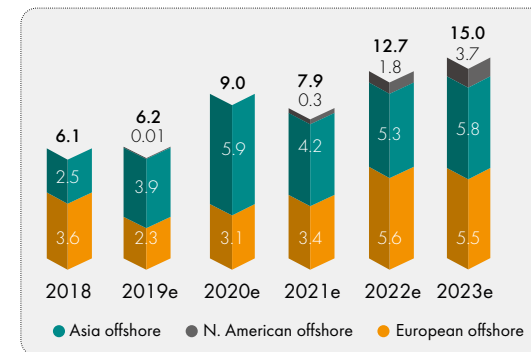
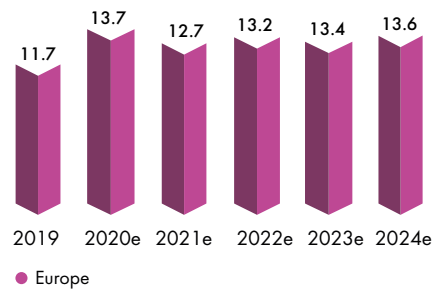
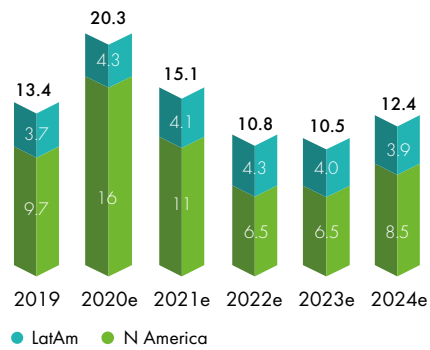
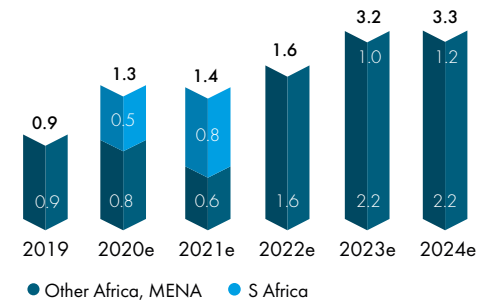
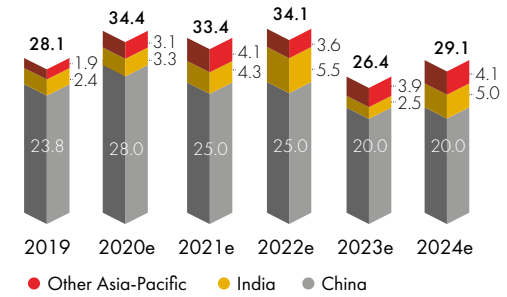
As an established market, the EU-28 onshore market is expected to remain stable with annual installations expected at a

New installations outlook by region (MW and per cent, onshore and offshore)



Detailed data sheet is available in GWEC's member only area

Regional onshore wind and offshore wind outlook (New installations GW)



APPENDIX



Global Wind Report - Methodology and Terminology

Data definitions and adjustments

GWEC reports installed and fully commissioned capacity additions and total installations.

New installations are gross figures not deducting decommissioned capacity.

Total installations are net figures, adjusted for decommissioned capacity.

Sources for the report

GWEC collects installation data from regional or national wind associations, alternatively from wind turbine OEMs and industry experts.

Historic installation data has been adjusted based on the input GWEC received. The 2019 Global Wind Report shows the accurate current and historic data.

The five years market outlook is based on GWEC Market Intelligence's internal analysis as well as the inputs from regional or national wind associations and GWEC members.

Definition of regions

GWEC has adjusted their definition of regions for the 2018 Global Wind Report, specifically Latin America and Europe.

- Latin America: South, Central America and Mexico
- Europe: Geographic Europe including Norway, Russia, Switzerland, Turkey, Ukraine

Used terminology

GWEC uses terminology to the best knowledge. With the wind industry transitioning certain terminology is not yet fixed or can have several connotations. GWEC is continuously adapting and adjusting to these developments.

Acronyms

CAGR	Compound Annual Growth Rate
FIT	Feed-in-Tariff
FY	Financial Year
GC	Green Certificate
GW	Giga Watt
LCOE	Levelized Cost of Electricity
MW	Mega Watt
OEM	Original Equipment Manufacturer
PPA	Power Purchase Agreement
PTC	Production Tax Credit
RPS	Renewable Portfolio Standard
TSO	Transmission System Operator

About GWEC Market Intelligence

GWEC Market Intelligence provides a series of insights and data-based analysis on the development of the wind industry. This includes a market outlook, country profiles and policy updates, deep-dives on the offshore market among other insights.

GWEC Market Intelligence derives its insights from its own comprehensive databases, local knowledge and leading industry experts.

The intelligence team in GWEC consists of several strong experts with long-standing industry experience.

GWEC Market Intelligence collaborates with its regional and country member wind association as well as with its corporate members.

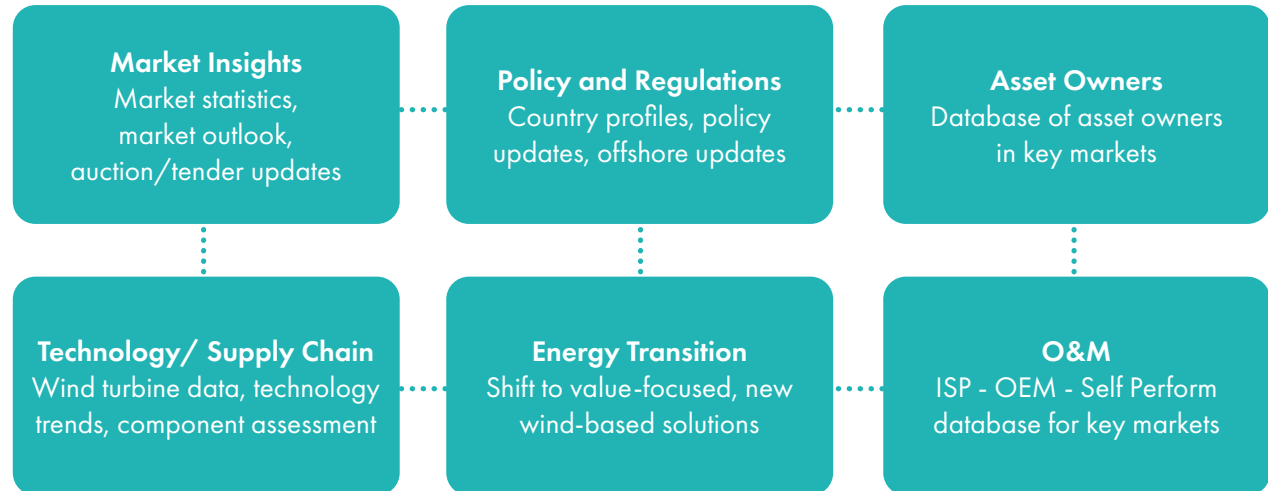
How to access GWEC Market Intelligence

- Corporate GWEC-Members
- Wind energy associations
- Non-GWEC Members

Subscription

Contact Feng Zhao feng.zhao@gwecnet

GWEC Market Intelligence Areas



GWEC Market Intelligence created a Member only area to provide more in-depth market intelligence to GWEC's members and their employees.

[Click here to get your login](#)

Reports	Frequency
1. Wind Energy Stats/ Market Data	
Wind stats 2019 (and historic)	Annual
Global Wind Report	Annual
Wind Energy Statistics (wind energy penetration rate, jobs)	Annual
2. Country Profiles/ Policy Updates	
Country Profiles Onshore/Country Profiles Offshore	Quarterly / Ad-hoc
Ad-hoc policy updates	Ad-hoc
3. Market Outlook	
Global Wind Market Outlook for next five years (Q1 and Q3)	Semi-Annual
4. Supply Side Data	
Global Wind Turbine Supply Side Data Report (by market, by technology, by turbine size and numbers)	Annual
5. Auction/ Tenders	
Auction Trends and Learnings	Annual/Quarterly
Global Auction Results (database)	Annual/Quarterly
6. Offshore Wind Market	
Global Offshore Wind Report	Annual /Quarterly
Market Entry Opportunity (database)	Annual /Quarterly
Global Offshore Project Pipeline (database, in-operation and under-construction)	Annual /Quarterly
Global Offshore Turbine Installation Vessel Database	Annual /Quarterly
7. Components Assessment	
Gearbox (Q4 2019), Blade (2020), followed by other components	Special report
8. Wind Asset Owners/ Operators	
Ranking of Wind Asset Owners and Operators Globally (Onshore & Offshore)	Annual
9. O&M	
O&M service provider database (ISP - OEM - Self-perfrom)	Annual
10. Energy transition, Digitalization, Hybrids	
Position papers/ studies - Value shift, Corporate PPAs	Special report
Government support to wind and other ("true cost of coal")	Special report
New Solutions, GWEC policy recommendations	Special report



It is time for greater gender diversity in the wind industry.

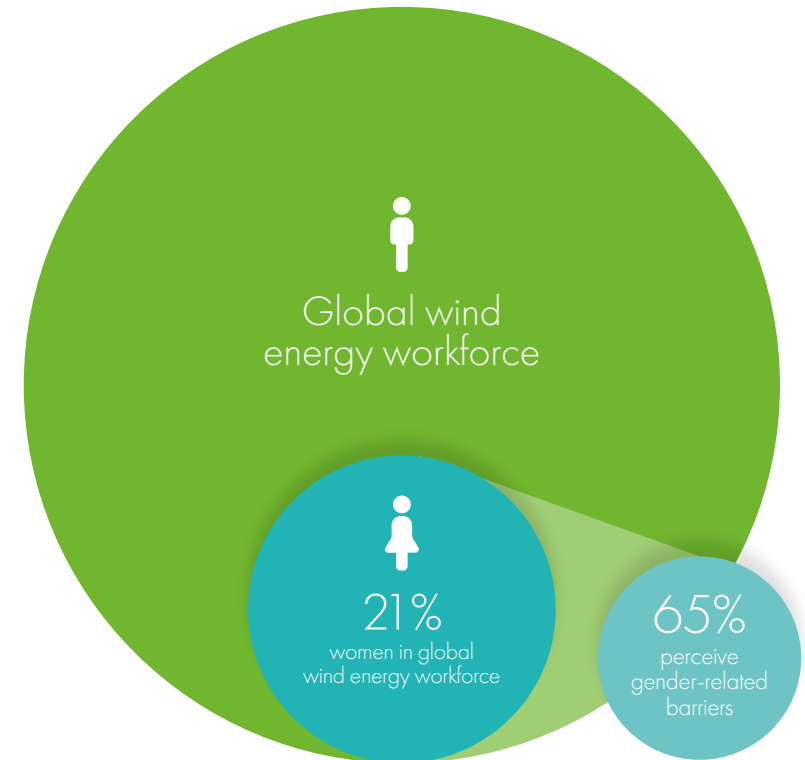
There is more urgency than ever to align political, financial, economic and social resources to create a greener world in the decade ahead. A chief concern will be how to harness the skills and talent needed for this mission.

In 2019, The Global Wind Energy Council (GWEC) and the Global Women's Network for the Energy Transition (GWNENET) jointly launched the Women in Wind Global Leadership Program. The

program is designed to accelerate the careers of women in the wind industry, support their pathway to leadership positions and foster a global network of mentorship, knowledge-sharing and empowerment.

Find out more and join us:
<https://gwec.net/women-in-wind/about-the-program/>

 @WeAreWomenInWind



Women make up 21% of the global wind energy workforce, and 65% of them perceive gender-related barriers in the sector

Source: 2019 study by IRENA and Women in Wind, with nearly 1,000 respondents from 71 countries

Jointly organised by:



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