Onshore Wind Market Review

SDCL

About the research

The report is intended to provide insight in the prevailing market conditions, trends and drivers in the Onshore Wind industry for market participants as well as potential market entrants.

The report is structured top-down. It firstly discusses the dynamics of the Onshore Wind Industry from a global perspective. Subsequently, the report touches upon regional differences and resulting implications. Lastly, it profiles major markets across the Americas, Europe and Asia Pacific, where a holistic view of the state of the onshore wind industry in is provided, highlighting the growth opportunities, demand drivers, challenges and local outlook of the industry. The countries included in this report were shortlisted based on the size of their Onshore Wind installed capacity in the last ten years.

Macroeconomic data has been sourced from multilateral institutions such as the International Monetary Fund (IMF) while industry specific data has been referred from accredited industry bodies such as the International Renewable Energy Agency (IRENA) and International Energy Agency (IEA). This has been supplemented by news articles and reports from industry associations, trade journals and national statistical agencies.

The report is an outcome of a collaboration between by Sustainable Development Capital LLP ("SDCL") and its research partner Alchemy Research and Analytics and was completed between May and September 2020.

We would like to thank the following executives for their contribution in preparing the report:

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Introduction

If there would have been a fortune teller in 2019 predicting an empty Piccadilly Circus on a beautiful day, people spending days on end inside their homes, buyers of oil being paid to take the oil from producers in the US and delays on many renewable energy projects, this fortune teller would be told to have lost her mind. Nothing could be further from the truth.

Now, fast forward to today, there is a new normal. Governments, companies and people have been finding ways to cope with disruptions in their economies, supply chains and personal lives. Flexibility, adaptability and change management have become important virtues in light of ongoing uncertainties.

But there has also been good news following the radical changes in 2020. This year has already marked a sharp reduction in Global CO2 emissions. According to the IEA, for the full year, CO2 emissions are expected to reduce 8% versus 2019, which is the lowest level since 2010 and the largest reduction ever recorded. The reduction in energy demand as result of the global pandemic primarily affects hydrocarbons and nuclear, while renewable energy demand continues to grow. Besides that, the business cases of large hydrocarbon producers are eroded by low hydrocarbon prices, which accelerates their move into the renewable energy space. BP for instance, announced a 40% reduction in hydrocarbon production and a 10-fold increase in low carbon investments by 2030. This is expected to bring additional firepower to the renewable energy sector.

Zooming in on onshore wind: due to the maturity and widespread implementation of the technology, extensive global supply chain and large efficiency improvements, onshore wind is presently the cheapest new-build power generation option. It is seen as one of the key drivers in decarbonisation efforts and the energy transition in many regions. In most of its key markets, the industry is moving to the subsidy-free model, evidencing the competitiveness of the technology. The future of onshore wind therefore remains bright.

The ongoing global pandemic impacts mainly the global supply chain of onshore wind and results in delays due to lockdown restrictions at various construction sites. In the past months, we have seen development and construction slowly picking up again following easing of restrictions.

As the full consequences of the global pandemic are still unclear at the time of writing, this report will mostly focus on the state of the onshore wind industry before the pandemic entered our lives. At the same time, we will provide insight in the expected impact of the pandemic on the outlook of the industry in major markets for onshore wind. Besides that, we discuss the underlying demand drivers, opportunities and challenges prevalent in these countries. Note that this report is part of SDCL's Annual Primer Series, which also includes reports of different renewable technologies such as Solar PV and Offshore Wind. An understanding of global industry trends and country-specific market factors are critical to success for all potential market entrants.

We hope the Global Onshore Wind Market report will provide valuable insights, and we look forward to briefing you on other renewable technologies in the coming months.

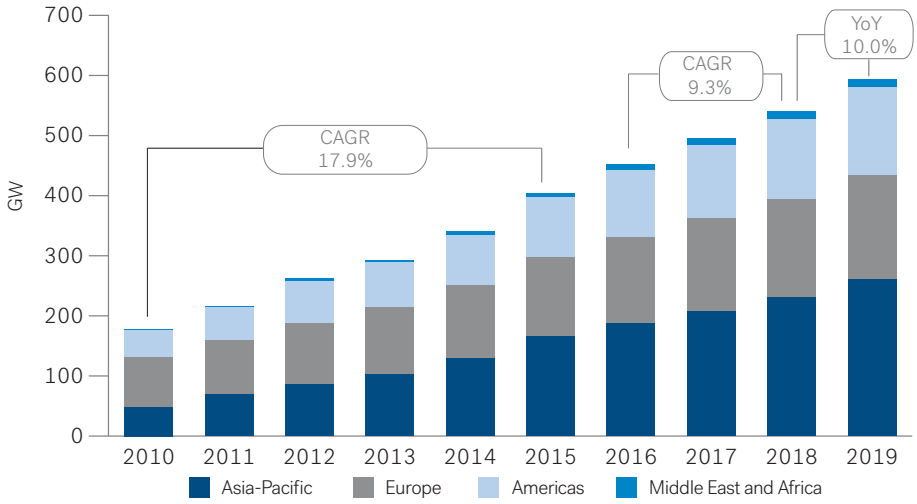
Stay safe and healthy,

Warren Pimm, CFA
Partner, SDCL

Joni Koch
Associate, SDCL

Executive Summary

Onshore Wind Installed Capacity By Region



Source: IRENA Renewable Capacity Statistics 2019

As the trend shows, the annual capacity growth rate rose in 2019 after a deceleration since 2015. Part of the decline in annual growth could be attributed to a correction as various markets transition to auction-based model, phasing out the state support.

Onshore wind is among the most mature and proven renewable energy technologies. It has an extensive global supply chain that helps bring the scale and technology for efficiency improvements. As a result, in terms of global benchmark levellised cost of energy (LCOE), onshore wind is presently the cheapest new-build power generation option. Investor confidence therefore remains high, even as the competitive edge against offshore wind narrows with time.

In the past years, the income model of the industry has changed with some major Onshore Wind markets such as China, moving away from the subsidy-led model to a market-oriented model. The European region has similarly adopted the auction-based project allocation, while an increasing number of projects are being set up on merchant subsidy-free basis. Notably, onshore wind is key to Europe's ongoing decarbonisation and energy transition, especially towards the renewable energy goals of 2030.

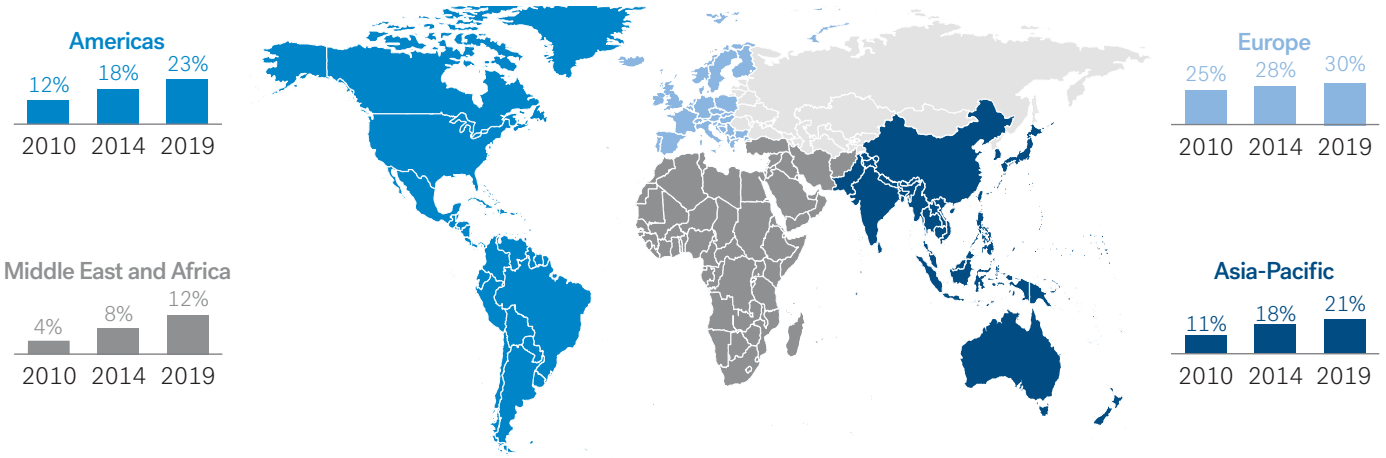
As per the International Energy Agency (IEA), onshore wind-based generation rose by about 12% in 2019. This makes it the largest non-hydro renewable energy technology in the period, with the total generation exceeding more than all other renewable energy resources combined. Despite the large growth, onshore wind capacity additions remain below the level required to achieve clean energy goals worldwide.

The annual capacity growth rate rose in 2019. This marked a break from the deceleration in incremental capacity observed during the period of 2016-2018 due to the transition from a subsidy-based model to one based on market competition. Key European countries such as Spain, Sweden and Greece drove the capacity pipeline with the adoption of the subsidy-free model. In the US, while capacity additions continue to be driven by the production tax credit, the emerging prominence of corporate power procurement contracts has been a major boost for the sector.

The ongoing COVID-19 pandemic impacts the industry, in terms of disruptions in the global supply chain. Besides equipment, project development is delayed due to the prevalent lockdown restrictions at the various construction sites. There are however signs of gradual ease in restrictions, such as in China and parts of Europe among others. While this helps developers resume project development work, the impending global economic slowdown will have wider ramifications across sectors including renewable energy. For instance, a crash in crude oil and other hydrocarbon prices (due to recessionary pressure) makes renewable energy resources, including onshore wind, a relatively weaker proposition in the energy mix.

Onshore Wind Penetration by Region

Onshore Wind share in Renewables by Region



Source: IRENA Renewable Capacity Statistics 2019

The policy-led shift in energy mix could emerge as major growth driver. This is particularly the case for Europe where decarbonisation and renewable energy targets necessitate a far bigger role of onshore wind capacity than seen so far.

Europe

Historically, onshore wind led Europe's renewable energy growth. This is reflected in the 30% penetration of onshore wind in total renewable capacity as at end-2019. Though onshore wind penetration in Europe is the highest in the world, it is still far below the required levels to reach Europe's renewable energy targets by 2030. While steps were taken towards market orientation (auction-based allocation), the region lately faces stagnation in capacity addition, with key markets such as Germany facing bottlenecks due to procedural delays.

All the same, onshore wind has a key role in Europe's emerging requirements in renewable energy. As of end-2019, about 10GW worth of capacity was financed – the second-highest capacity financed in one year as per Wind Europe. The Sustainable Europe Investment Plan, the investment segment of the Europe Green Deal (that aims binding targets on emission reductions by 2050), is expected to mobilise about €1 trillion (US$1.2 trillion) in public and private capital for various renewable energy projects.

Americas

Since 2010, onshore wind penetration almost doubled in the Americas region to 23% share by 2019. The US plays an important role in this growth. Onshore wind accounts for 39% of total renewable energy generation capacity in the US. Due to fiscal incentives, the onshore wind energy development got a major fillip. The same may continue, considering the pending legislative proposals for extension of these incentives beyond 2020, the original expiration date.

In Latin America, wind is increasingly part of the renewable energy transition, especially in countries such as Brazil which seek a reduction in dependence on hydropower. Brazil and Argentina, for instance, have conducted joint capacity auctions for wind and solar to enable rapid development in renewable energy capacities. Even other smaller markets are making the effort to tap into the wind energy market, such as Colombia where the government recently announced the target of 1.5GW renewable energy capacity.

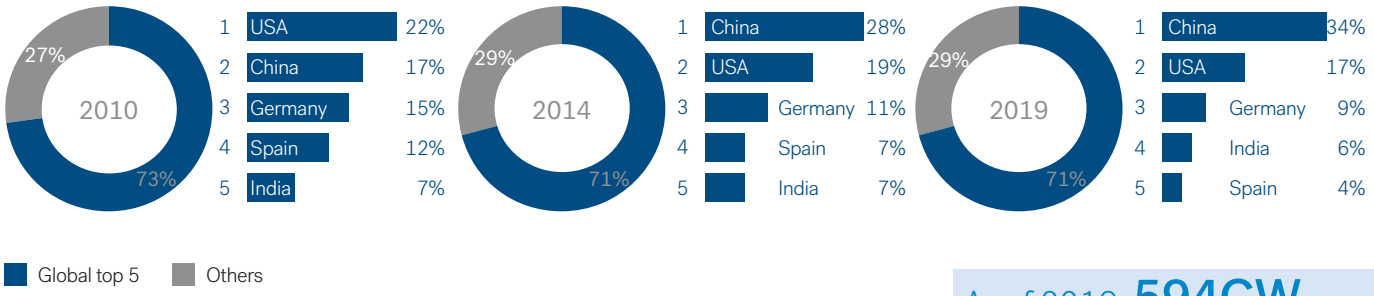
Asia-Pacific

Policy focus has also driven the rise in onshore wind energy penetration in the Asia-Pacific market. Onshore wind penetration in the region rose by over two and a half times, from 8% in 2009 to 21% in 2019. China has the predominant share in this. The country is, however, undergoing a slowdown in the capacity addition as it phases out the subsidy support in favour of an auction-based allocation process.

India is another important market in the region. The country has been actively encouraging the onshore wind power market through market allocation mechanisms such as the reverse-auction. While investor interest is high, the capacity addition has been marked by stagnation due to critical unaddressed issues in energy sector reforms as well as policy/regulatory processes.

Top countries share of global onshore wind capacity

Top Countries Share in Global Onshore Wind Capacity



Source: IRENA Renewable Capacity Statistics 2019

As of 2019, **594GW** have been installed globally, up from **341GW** in 2014.

Various leading onshore wind energy markets are in the middle of transition to a subsidy-free regime to make way for greater role of auctions and similar such market mechanisms of capacity allocation.

As of end-2019, about 60% of the total installed onshore wind capacity was concentrated between three countries, namely China (205GW), the US (104GW) and Germany (53GW). These countries have maintained the market leadership over the years, retaining similar market concentration level since 2015. The evolving growth dynamics however determine a different context and outlook in each market.

China led the global market, in terms of installed capacity, since 2011. But the capacity addition is decelerating. Annual incremental capacity peaked in 2015, at about 34GW. Since then, it reverted to an average 14-15GW that was observed between 2010-2015. Year-on-year growth rate declined from 35% in 2015 to 14% by end-2019. The country's impending phase out of wind energy subsidies from 2021 is the major factor for such correction in growth trend. The pressure is likely to persist as various entities adapt to a subsidy-free market regime.

Market transition is a theme that runs across the US market as well, the second largest after China. The country recently tabled a legislation proposal for a five-year extension of the federal production tax credit available to the wind industry. It is otherwise due for expiry by end-2020.

At the same time, the market fundamentals point to a significant increase in demand. One such key demand driver is that of direct power purchase agreements undertaken by companies. As per the American Wind Energy Association, the country's commercial and industrial companies contracted 4.4GW worth of capacity in 2019. This is close to half of the new onshore wind capacity commissioned in the same year, indicating smaller requirements for subsidy support than before.

In Germany's context, the third largest onshore wind market, the ongoing market transition appears to be stalling growth recently. By end-2019, new onshore wind capacity was at its lowest ever since the late 1990s. The challenges are largely on the policy and regulatory norms that came with the shift to auction-based capacity allocation. The timely resolution of such bottlenecks will shape the role of onshore wind in Germany's ongoing energy transition and renewable energy policy objectives.

Among other key emerging countries is India, which ranks at fourth position in terms of capacity share, after Germany. Driven by private investment, the Indian onshore wind power market has grown in importance over the years. But with lack of active policy and regulatory reforms, the capacity growth momentum shows a sharp decline.

Annual capacity growth by 2019 was half of the level in 2016 and 2017. Revival in the capacity addition will hinge upon the progress in key pending reform areas such as payment security, power evacuation capacity and market visibility of potential capacity pipeline.

Trends and Drivers

1. Growth in onshore wind generation

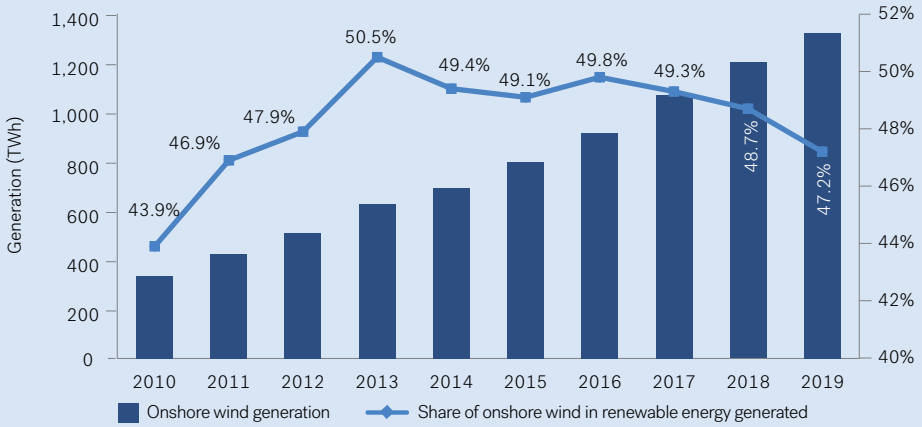
Onshore wind energy is among the most mature renewable energy technologies deployed on scale. As of end-2019, it retained its position as the largest non-hydro renewable energy technology. But the growth and technology maturity in onshore wind has also been accompanied with saturation in resource-rich locations as well as competition from other renewable energy technologies in offshore wind as well as solar photovoltaic power. The impact can be observed in the long-term trend of onshore wind power generation and its share in total renewable energy.

During 2010-2019, onshore wind generation registered a compound annual growth rate of 16.5%. In this period, its share in total electricity generation rose consistently, from 1.5% in 2010 to 4.9% in 2019. However, when comparing the share of onshore wind generation to total renewable energy generation, other renewable energy sources have shown steeper growth since 2013, resulting in a decline in the share of onshore wind in the renewable energy mix.

In the same period, a progressive reduction in levelised cost of energy has been achieved. This was in part driven by large economies of scale, further enhanced by improvements in wind turbine systems, the balance of systems and related developments across the value chain. As a result, onshore energy has emerged as the cheapest new-build power generation option.

The trend in onshore wind energy generation reflects the industry's rapid growth and technology maturity. While the industry retains competitive leadership, its dynamics are increasingly marked by the saturation in resource-rich locations and relative growth in alternative renewable energy technologies, especially solar photovoltaic.

Onshore wind energy generation and its share in total renewable energy



Source: IEA (onshore wind energy) and BP Energy Statistics (renewable energy generation)

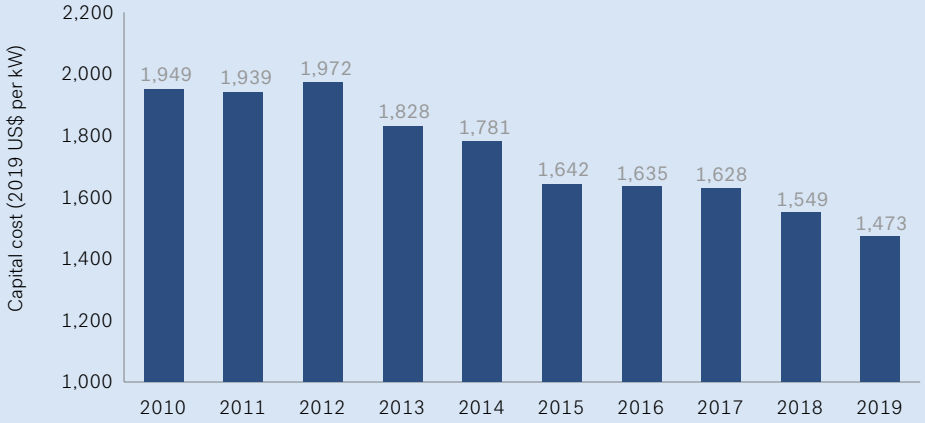
Trends and Drivers

2. Capital cost of onshore wind generation

Onshore wind energy's technology improvements play a major role in keeping costs low. The progress is observed in terms of factors such as turbine size, rotor diameter and capacity factor. All have been on a rise, reflecting the thrust on efficiency and cost control to meet market demand.

Sustained technology improvements and a robust supply chain have underpinned the declining trend in capital cost of onshore wind power projects.

Trend in weighted average capital cost of onshore wind projects

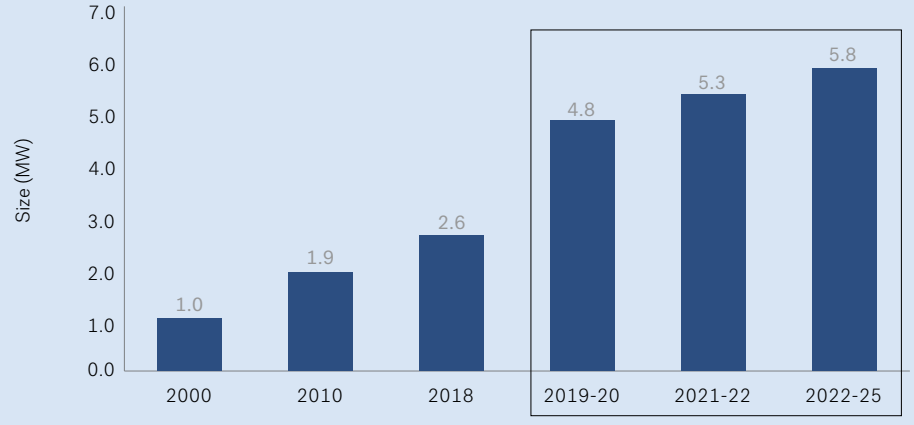


Source: IRENA

The trend in average turbine ratings shows the clear upward trend. Manufacturers are finding a rising demand for higher ratings as developers seek higher efficiencies. Recent reports for instance show that GE's 5.3MW rating turbines have lately found significant offtake. Iberdrola's upcoming wind farm in Spain will deploy a 4.5MW rating onshore wind turbine – the first of such size to be installed in the country.

In parallel to turbine size, innovations have led to taller plants and bigger rotors among others. The long-term rise in rotor size correlates directly with the average capacity utilisation factor in the onshore wind installed capacity. Larger rotor diameters imply greater sweep and are ideal for the sub-optimal locations in mature markets (since the most optimal ones have already been developed).

Global average onshore wind turbine ratings' trend and outlook

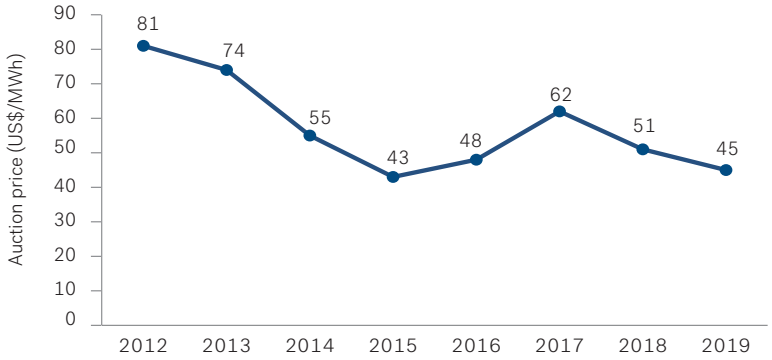


Source: IRENA

3. Onshore wind auction prices

The fall in capital costs is also reflected in lower bid prices in recent auctions. As per IEA, average onshore wind auction prices show a 44% decline between 2012 and 2019. Beyond technology improvement and cheaper equipment, competitive bids are an outcome of the policy and regulatory incentives, resource potential at the location and attractive financing mechanisms among others. There are expectations that the trend in competitive auction prices could continue further. IRENA's estimates for instance suggest a further 18% decline in price discovery by 2021.

Announced average onshore wind auction price by commissioning date



Source: International Energy Agency

The progressive adoption of auction as the route of capacity allocation has also helped drive subsidy-free onshore wind power projects. This is especially true for the technology-neutral auctions in the European markets. In April 2019 for instance, Denmark had its first subsidy-free onshore wind power project, based on the country's technology-neutral auction in the previous year. In November 2019, Poland had its first subsidy-free project, in the form of a 38MW onshore wind project.

Key subsidy-free onshore wind power projects under development (illustrative)

Developer	Capacity (MW)	Country	Status
EDF	110.0	UK	Planning application to be submitted by end-2020
SSE Renewables	47.0	UK	Commissioning scheduled for end-2020
ABO Wind NI	23.1	UK	Commercial operations to begin by early 2022
Hirtshals Havnefond	16.8	Denmark	Project development in progress
Polenergia	38.0	Poland	Project scheduled for completion in 2021

The policy objectives on climate change such as the European Council's 'Green Deal', make for an enhanced role of onshore wind power. In 2019, Europe had €19 billion (US$21.3 billion) worth of new wind farm investments, of which onshore wind was worth €13 billion (US$14.6 billion). The Sustainable Europe Investment Plan, as part of European Green Deal, aims to mobile €1 trillion in additional private and public capital for the renewable energy projects. It is expected that a sizable part of these investments will be in onshore wind, resulting in a clear growth outlook for Europe.

Trends and Drivers

4. Hybrid Wind-Solar Power Projects

Another major trend in the renewable energy industry is the development of hybrid wind-solar power projects. In these projects, renewable power generation from wind and solar is combined. The result is a power plant with more stable energy generation (less intermittency), reducing grid constraints. Besides that, with the cost of grid-scale energy storage declining, the business case of combining a (hybrid) power project with storage is improving. The Cost of Lithium-Ion batteries, the predominant storage technology in deployment, declined by over 87% since 2010.

It has become apparent that hybrid renewable energy projects are a faster way to scale up renewable energy penetration levels. In India for instance, 15GW of such capacity is in pipeline, of which 10GW is in progress (partly in construction and auctions) and due for commissioning by 2024. In the European context, the hybrid route of capacity is poised to rise due to the objectives of decarbonisation and the resulting flexibility needed for the energy transition. As per Wood Mackenzie's recent study, the hybrid wind-solar projects could account for the largest share of capacity in Europe's major markets including UK, Germany, France, Italy and Spain, by around 2023.

Select upcoming wind-solar hybrid projects (illustrative)

Project/s	Country	Developers	Capacity (MW)	Proposed investment	Planned commissioning
Asian Renewable Energy Hub	Australia	Consortium of Intercontinental Energy, CWP Energy Australia, Vestas and Macquarie Bank	15,000	US$22 billion	2027
Haringvliet hybrid park	The Netherlands	Vattenfall	60	EUR35 million	September-2020
Adelaid project	Australia	Iberdrola	320	US$340 million	2021
Integrated Renewable Energy Project	India	Greenko Energies	1,550	-	2024
Veddum Kær and St. Soels	Denmark	Eurowind Energy A/S	97	-	2021

Other Trends

5. Role of grid infrastructure

Tapping into the onshore wind energy potential entails a commensurate investment commitment towards the grid infrastructure backbone. As per IRENA's estimates, globally a 60% renewable energy integration (with 35% based on wind) by 2050 entails average annual investment in grid, generation adequacy and flexibility systems (such as storage) worth US$374 billion. With most of the resource-rich sites of onshore wind already developed, the incremental capacity is found in remote and often challenging locations where power evacuation infrastructure makes the difference in the business case.

China, for instance, is in the process of building the largest transmission network globally, entailing high and ultra-high voltage transmission lines. This is to address the possible curtailment of wind energy that comes with evacuation constraints. Similar steps are underway in other markets to ensure timely grid upgrades. In Texas, US, transmission line upgrades and new construction contributed to reduction in wind energy curtailment on state grid from 8%-17% during 2009-2011, to only about 1% by 2019.

A related area of focus in power transmission capacity pertains to interconnector lines. Cross-border power transfer helps complement the relative resource abundance and intermittence of renewable energy resources. A notable recent example is NordLink, a 623 km long, 1,400MW HVDC interconnection between Germany and Norway. With commissioning in 2021, it will, for the first time, allow exchange of wind power from Germany and hydropower from Norway. Similar works are underway at UK's grid, which by 2023, will have links with those of France, the Netherlands, Belgium, Norway and Denmark. Considering European region's energy transition and renewable energy targets, the total investment cost of for trans-regional transmission infrastructure between 2020 and 2050 is estimated to be in the range of EUR170 billion – EUR200 billion.

Similar focus is observed in other regions too. For instance, the Australian Energy Market Commission's priority transmission upgrades include the interconnection between New South Wales and Victoria (VNI), the construction of the NSW-South Australia Interconnector, and the Queensland and New South Wales Interconnector. In April 2019, Italy and Tunisia reached an agreement for a 600MW interconnector line, to be commissioned by 2026. A particularly ambitious project is in the middle east region, where a 3GW worth of interconnection between Egypt and Saudi Arabia is under development.

6. Equipment manufacturing

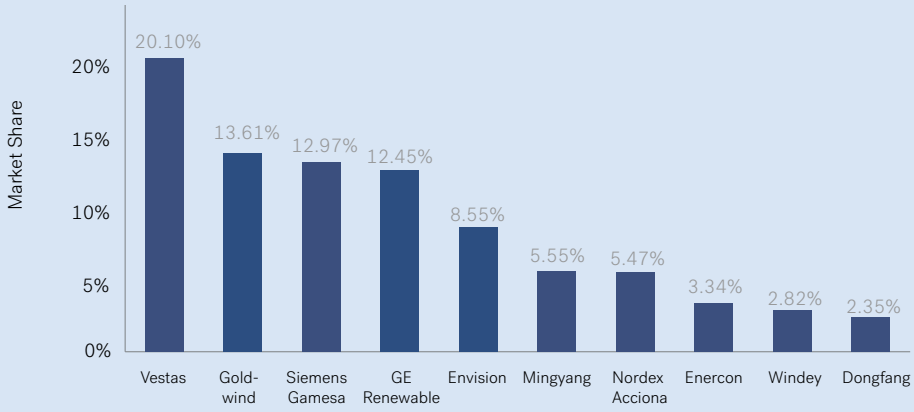
The onshore wind industry has reached maturity both in terms of technology as well as commercially. As a result, a clear trend is seen in consolidation among turbine manufacturers and suppliers. The three major merger/acquisition deals during 2015-2016, namely GE-Alstom, Nordex-Acciona and Siemens-Gamesa, changed the industry's competitive landscape drastically.

The total number of onshore wind turbine suppliers has been on a decline, reflecting the rapid consolidation under way. In 2019, there were a total 33 suppliers, against the 37 active in the previous year.

With the market transitioning from subsidy-led to auction-based business models, competition intensified for equipment manufacturers. As a result, these companies are increasingly facing pressure on prices and margins. As an example, Vestas, the market leader, saw its sales margins drop to below 10% in 2019. The same year, the German manufacturer Senvion filed for insolvency. Both market consolidation as well as pressure on margins have resulted in a shift of production to lower cost countries.

Other Trends

The top 10 onshore wind energy turbine suppliers by capacity in 2019



Source: Global Wind Energy Council

Chasing a competitive market, equipment manufacturers cater to the operations and maintenance (O&M) segment of the industry. Scale, specialisation, service and spares' guarantees as well as performance guarantees are some of the offerings that leading manufacturers bring forth in the O&M business. But they face competition from the independent service providers as well as the developers' in-house service divisions. The manufacturers' share in the O&M market declined from 70% in 2016 to 64% in 2017, and as per IRENA's estimates, it is projected to reach 54% by 2027.

7. Repowering

With improvements in wind power equipment, there is a significant scope to augment capacity of the existing aging assets. This is more so as the old wind farms occupy the most resource-rich sites. The commercial viability of this adds to the policy imperative of rapid capacity addition.

As per estimates by Wood Mackenzie, about 65GW worth of European onshore wind turbines will reach the end of designed commercial life by 2028. Between 2019-2028, an annual average of 4GW of turbine capacity could be suitable for repowering. The same report also points out that over 21GW of China's existing capacity could be up for repowering during 2019-2028.

There are signs that manufacturers and suppliers are actively looking at the business from repowering perspective. In the US, project owners repowered 2.8GW worth of capacity in 2019, more than twice that in the previous year. In Europe however, the repowering carried out in 2019, estimated at 185MW, has been impeded by procedural delays and the decline in wholesale electricity prices.

8. Corporate buyers

In recent years, the trend of private companies signing into direct power purchase agreements (PPA) with renewable energy projects, has gained traction. The catalyst driving this is the rationalisation of subsidy support, to the extent of elimination in many markets. Europe for instance, shows a rise in zero-subsidy corporate power purchase projects. By end-2019 Europe had a pipeline of 21GW capacity (including both solar PV and onshore wind) of subsidy-free PPA projects. To put this in perspective, in 2018, a total 3.4GW of renewable PPA was contracted (as per a different study). Notably, the north and West Europe are among the key focus regions for European subsidy-free onshore wind farms.

In this context, energy-intensive consumers such as those in information technology (for example, Google with worldwide data centers), metals (Steel, Aluminium, etc.) seek to hedge energy supply through a long tenure contract. The latest BloombergNEF corporate PPA price survey for H12020, shows that the lowest average price for onshore wind corporate PPA is found in Sweden (EUR30.5/MWh).

Outlook

The market outlook of onshore wind energy is being shaped by a combination of factors including policy, regulation, technology and investor appetite among others. Some of the recent developments such as the phasing out of subsidies, ambitious renewable energy targets, technology feasibility (grid-scale storage) and the competing renewable energy resources (offshore wind and solar PV) point towards the possible way ahead.

Following is a review of the major factors determining the onshore wind energy market outlook.

Policy objectives in decarbonisation and energy transition:

Globally, the power sector is in particular focus for its scope in reducing carbon emissions for climate change mitigation. Stepping up the renewable energy generation is thus key to realising the decarbonisation objectives. Studies such as those of IRENA show that accelerated deployment of wind power (of which onshore wind has the major share) plays a key role in such objectives – the projections indicate that by 2050 almost 35% of total electricity demand will be met by wind power in general, of which 29% is onshore wind.

Recently, the European Union's (EU) 'Green Deal' policy propelled the move towards decarbonisation. Aiming at a climate-neutral Europe by 2050, it entails a targeted energy transformation across all sectors including the power generation sector. As per European Commission's estimates, this will require funding worth €1 trillion, mostly to be led by the private sector. Onshore wind is poised to play the most important role in this regard. It stands out for its competitive costs, proven technology and supply chain base. As of 2019, of the €19 billion (US$21.3 billion) worth of new wind farm investments in Europe, onshore wind accounted for €13 billion (US$14.6 billion), which testifies to the strong investor appetite and growth potential.

Industry maturity and competitive pressure:

Progressively, the onshore wind energy's rising maturity level achieved over the past decade makes future cost reductions that much harder. For one, the most low-cost and high-potential wind resource sites have already been developed. The successive sites are thus the ones where generation potential is lower and entails further improvisation.

As recent industry reports such as those of Wood Mackenzie indicate, with each successive year the scope of cost savings will be marginal and will depend on control over the extended value chain. Added pressure comes from the shift from a subsidy-led market to that of auctions. In China, for instance, the onset of auctions from 2020 is expected to drive a reduction in wind turbine prices. Chinese equipment manufacturers have already begun diversifying across other businesses to mitigate the impact of lower revenues in the absence of subsidies. At the same time, they are devising strategies for turbine efficiencies (such as by larger rotors) and components' procurement to reduce costs.

Another manifestation of the onshore wind industry's maturity and cost pressures is consolidation. As per the Global Wind Energy Council, the number of wind turbine OEMs declined from 37 in 2018 to 33 in 2019. Some of the recent developments such as Senvion's exit and Suzlon's debt pressures are indications of the same. The case for consolidation appears strong for developers too, especially the leading global players seeking access to new geographies. For example, in May 2019, Spain's Iberdrola announced its entry into the French market by acquiring French onshore wind developer Aalto Power SAS.

Emerging business in renewable-plus storage and hybrid wind-solar:

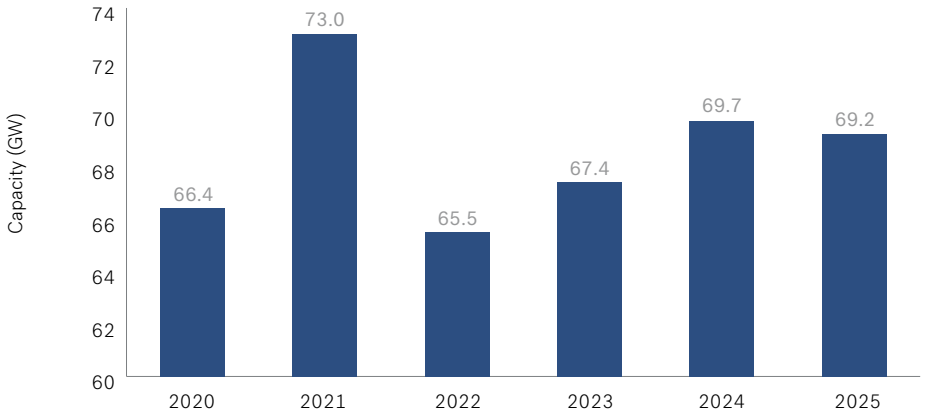
With rising commercialisation of grid-scale energy storage systems, the competitive case for onshore wind energy projects (and other renewable energy resources) changes significantly. One key result is the emergence of projects that are integrated with storage systems at the site. This has found more traction in the solar PV projects than in onshore wind so far. This could be due to many factors such as the developmental challenges associated with the estimation of wind resource and generation commitment, policy support (for instance US tax credits available to only solar-based storage), etc. Among the few and notable examples of such onshore wind projects, is the one being developed by a German renewable energy startup Energy Kitchen, involving a 95.2MW wind farm in Chile, that combines a 20MW energy storage.

Studies point to significant untapped scope in developing such projects especially in the backdrop of fewer resource sites, transmission integration challenges and competition due to auction-based allocations. In the US, it is observed as per recent industry reports, that the market for combined cycle gas-based power plants stands to be replaced with renewable-plus storage projects. This is reinforced by instances such as in California where regulators are repeatedly opting for renewable-plus storage over both new and existing gas-based power generation.

The advent of cheaper storage option is also driving the business case for wind-solar hybrid projects. For many mature markets such as those in Europe, with subsidy regime coming to an end, the existing projects are being re-engineered. Developers seek to maximise the existing grid infrastructure by co-location of wind, solar and/or storage. Also important is the fact that hybrid projects reduce the variability or intermittency associated with renewable energy, thus enabling better grid despatch. In India, this is being prioritised, with about 10GW of wind-solar hybrid capacity expected by 2024.

Outlook

Projected onshore wind generation capacity



Source: BNEF

Capacity Growth:

The pace of capacity addition is subdued due to the disruption caused by the COVID-19 pandemic. The lockdown restrictions impacted the supply chain, which makes projected capacity for 2020 far lower than previous estimates. As per the BNEF projections, the revised capacity stands at 66GW, about 12% lower than the pre-COVID projection. Much of the delayed project capacity is expected to roll over to the subsequent years. This is why in 2021 over 70GW is expected in new capacity for the first time.

The unprecedented nature of the pandemic is also the reason why various policy and regulatory authorities appear to be relaxing their norms for the developers. The German regulator, for instance, allowed extension in commissioning schedule for projects selected under previous auctions. The US market is the most important in this context, where the government is about to allow a five-year extension of the production tax credit enjoyed by onshore wind developers, that was otherwise planned for expiry by 2020. As a result, it is expected that the US market will continue to be propelled by these fiscal incentives in the next years.

For most regions, auctions continue to define the route for upcoming renewable energy capacity, and onshore wind continues to remain the most competitive option. As of December 2019, auctions in Poland, Greece and Denmark revealed competitive prices. Despite challenges in key markets such as Germany, there are expectations that the onshore wind market is likely to be driven ahead by the advent of subsidy-free merchant power projects in Europe. This is especially true for countries such as Spain where such project pipeline has shown significant expansion. Most importantly, the region's thrust on energy transition due to renewable energy targets is the major driving factor towards the adoption and integration of onshore wind energy in overall electricity consumption.

Growth in other key regions such as Asia-Pacific remains in question, not only for the impact of COVID-19 but also the policy and regulatory framework. The capacity growth in the leading market of China will be subject to the response towards the expiry of feed-in tariffs. There are industry reports which point to turbine manufacturers projecting a decline in installations during 2020 due to the phase-out of the financial support. This is expected to recover gradually as auctions drive price discovery in the onshore wind market. A slowdown is also underway in the Indian market, though for different factors. There are key issues in policy/regulatory domain that need to be addressed to attract investors as before. These include payment security for the power purchase agreements, visibility in available capacity for prospective investors and timely grid connectivity among others.

AMERICAS

United States

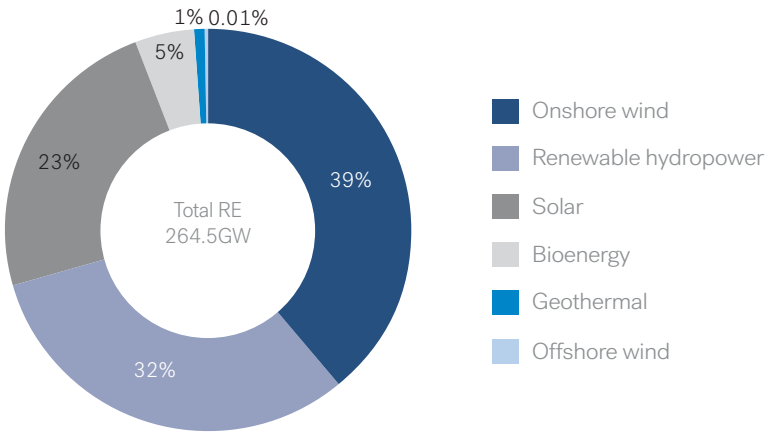
The US, with 103.6GW of installed capacity is globally the second largest producer of onshore wind energy. Texas, Oklahoma, Iowa, and Kansas account for more than 50% of US wind generation. Fiscal incentives are among the key drivers behind the country's private investments in onshore wind power.

GDP (2019E) (Current Prices)	US$21,439 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.82%
Currency	USD ($)
Country Credit Rating (S&P)	AA+
Renewable Energy capacity (2019)	264.5GW
Onshore Wind Share in Renewables (2019)	39%
Electric Power Consumption (2018)	12.9 MWh/capita
Renewable Energy Target	50% share of renewable energy by 2035 Zero carbon emissions by 2050

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

United States

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019, BNEF

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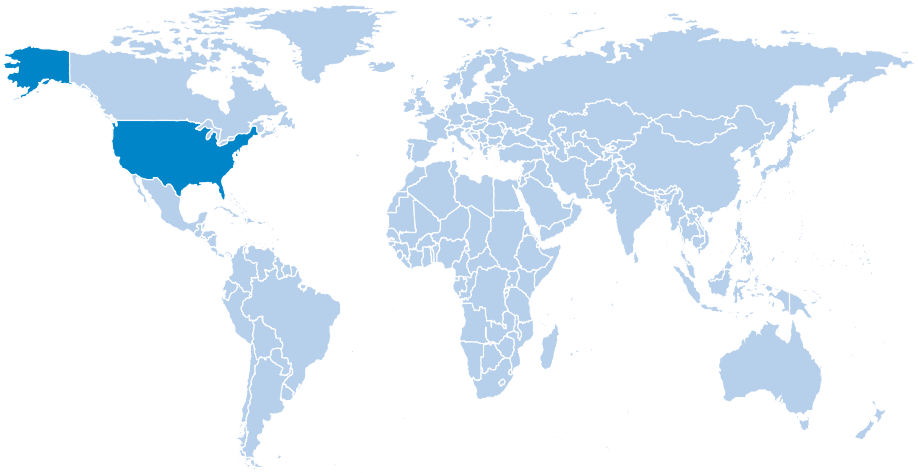
GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Cumulative installed capacity for onshore wind in the US breached the 100GW mark in 2019, making USA the only country after China to achieve this milestone. Almost 40% of the capacity was added in the last four years as demand from utilities and businesses picked up. The federal Production Tax Credit (PTC) was also instrumental in triggering a rush towards capacity buildout ahead of the previously announced deadline of 2020.

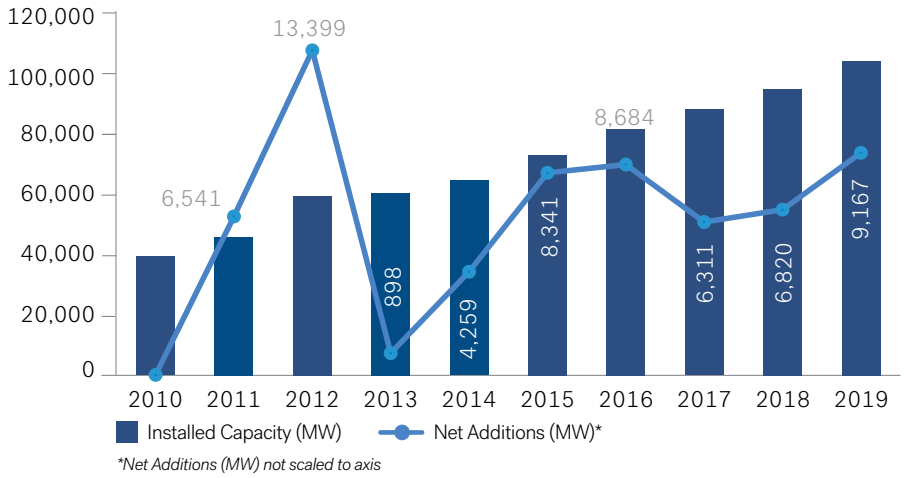
Falling wind power costs have also contributed to higher penetration levels. The benchmark Levelized Cost of Electricity (LCOE) for onshore wind has dropped by 9% since the second half of 2019 to US$44/MWh. Onshore wind has seen its most significant drop in cost since 2015 mainly due to a scale-up in turbine size, now averaging 4.1MW, and priced at about $0.7million/MW for the recently financed projects.

Prevailing market dynamics and long-term decarbonisation goals are expected to sustain expansion in renewable generation capacity, despite the current government's lukewarm attitude towards the sector. Achieving net-zero target by 2050 would require 750GW of wind capacity and 550GW of solar capacity by 2050. This implies an annual capacity addition of 24GW for each of the renewable energy resource. While this would require a massive jump in capacity buildout over prevailing levels, it is not entirely unprecedented in the country's history of infrastructure building. It is also equivalent to China's onshore wind installation rate in 2019.

Onshore Wind Capacity



Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

103.6GW Onshore Wind Capacity

- ✓ **Rise in corporate power purchase agreements**
- ✓ **Planned extension in fiscal incentives**
- ✓ **Policy objectives in expansion of renewable energy share**
- ✗ Lag in timely grid connectivity for onshore wind projects
- ✗ Federal budget cut for programs

The US added 9.2GW of onshore wind capacity in 2019 and ~40GW over the last five years. 2019 marked the third best year for onshore wind capacity addition in the history of the industry after 2012 and 2009. As per the American Wind Energy Association (AWEA), 1,927MW of wind power capacity was commissioned in the third quarter of 2019, which happened to be the highest third quarter on record for installations.

Demand Driver

The increase in onshore wind power development in the US during the past decade is majorly driven by a combination of improved wind turbine technology, increased access to transmission capacity, state-level renewable portfolio standards, and federal production tax credits and grants. The sector also gained traction from the ongoing retirement of coal-based power plants.

The major catalyst was the inclusion of 30–70GW of wind turbine capacity which qualified for the full PTC by the end of 2016 (presuming commercial operations is achieved by the end of 2020), with another 10GW qualifying for the 80% PTC (if online prior to the end of 2021) and 6.6GW for the 60% PTC (if online by the end of 2022).

Renewable Portfolio Standards (RPS) requirements continue to form a strong driver for wind growth outside of the wind-rich interior regions. As of May 2019, RPS existed in 29 states. Of all the wind capacity built in the US from 2000 through 2018, roughly 47% is serving RPS obligations.

Power purchase agreements (PPAs) constitute another growth driver for the onshore wind industry. 2019 was a record year with utilities and businesses announcing 8,726MW worth of PPAs. Wind PPA prices have trended lower on account of higher capacity factors, declining turbine prices and operating costs, low interest rates, and the production tax credit and this is likely to sustain going forward.

Market Opportunity

Policymakers are considering a proposed legislation to extend the PTC scheme at 60% till 2025. It is otherwise slated to expire at the end of 2020. If the legislative proposals are accepted, it would be a major policy boost for the US wind industry.

Existing state RPS policies will require 58GW of renewable capacity additions by 2030 equating to 520TWh of RPS-eligible renewable electricity generation. Notable increased requirements are in California and New York, which require 50% of electricity based on renewable energy sources by 2030, and Hawaii, which requires 100% from renewables by 2045.

Repowering continues to be a lucrative business opportunity. Going by the recent trends, National Renewable Energy Laboratory's estimate of a US$25 billion repowering opportunity by 2030, looks set to be overhauled. GE, a leading wind turbine manufacturer, announced in May 2019 that it has completed 4GW of repowering projects in the US in the last two years with 3GW additional opportunities lined up till the end of 2020.

Technological innovation has led to installment of larger, taller and more efficient wind turbines. The average nameplate capacity rating of turbines that became operational in 2019 was 2.55MW, up 5% from 2018 and 27% when compared to 2015. The first quarter of 2020 saw the first 4MW turbines in the US start operations. Improved siting technologies, increased use of artificial intelligence to automate O&M operations are some advancements that have provided a fillip to productivity, saving costs and generating higher returns for investors.

Challenges

The emergence of offshore wind as a competitive technology is likely to divert investment away from onshore wind, leading to a slowdown in capacity addition. As of April 2020, the US had an offshore wind pipeline of over 26GW in federal lease areas. It is anticipated that the offshore wind sector will take off from 2023 and account for half of new wind installations by the end of this decade.

Expansion in transmission infrastructure has struggled to match the rapid capacity buildout of onshore wind, resulting in grid congestion and a rise in energy curtailment. Efforts to expand the transmission infrastructure has often been mired in political opposition leading to delays or cost overruns. According to ERCOT data, an estimated average of nearly 500MW of wind generation was curtailed in January 2020 due to oversupply, which was a jump of 87% month on month and nearly three times the level in 2018. Large-scale curtailment of wind power due to oversupply against transmission capacity, is causing tighter reserve margins on the grid. Progressively lower renewable energy prices, together with oversupply adds to the lower incentives to bring in additional generation capacity in the system. This adds to the pressure in power system.

The COVID-19 has expectedly created challenges for the onshore wind industry. According to AWEA analysis, COVID-19 is putting an estimated 25GW of planned wind projects at risk, representing US$35 billion in investment.

Outlook

Currently, wind is the largest source of renewable generating capacity in the US, representing 25% of power capacity added over the last five years. EIA expects that another 14.3GW of wind capacity will come online in 2020. If realized, the United States would have about 122GW of wind capacity by the end of 2020.

Annual onshore wind capacity addition will continue apace for the next couple years, driven by the existing project pipeline before declining, unless the proposal to extend the PTC till 2025 is accepted. Wind power purchases by corporates and utilities, declining prices and supportive state-level renewable energy policies will drive demand.

Brazil

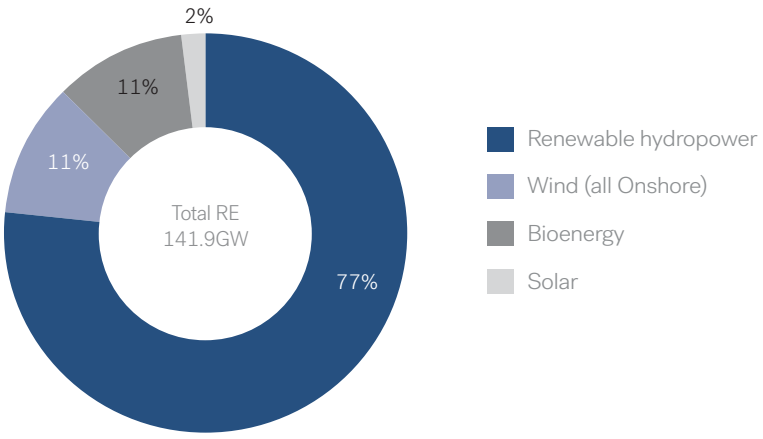
Brazil's market for onshore wind energy has grown rapidly in the last decade adding approximately 14.4GW of onshore wind capacity. The country's renewable energy auctions and government policies such as the National Climate Change Plan, the Brazilian Energy Plan, (PDE) 2029 and the Plan for Energy Expansion 2010-2019 have been instrumental in expanding the country's renewables base.

GDP (2019E) (Current Prices)	US$1,847 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	2.05%
Currency	BRL (R$)
Country Credit Rating (S&P)	BB-
Renewable Energy capacity (2019)	141.9GW
Onshore Wind Share in Renewables (2019)	11%
Electric Power Consumption (2017)	2.5 MWh/capita
Renewable Energy Target	45% share of renewables in power mix by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Brazil

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

GDP (2019E) (Current Prices)	US$1,847 bn
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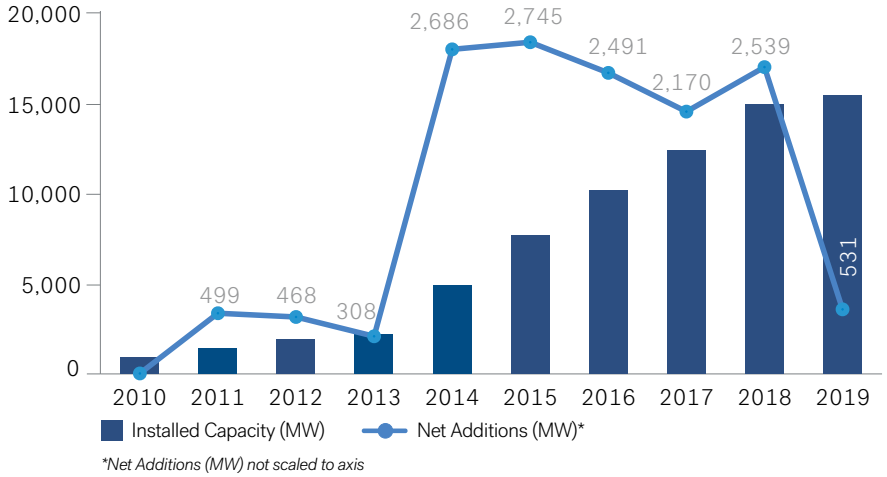
GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

With an installed capacity of 15.4GW at the end of 2019, onshore wind makes up 11% of the total renewable energy installed capacity in Brazil. It is the largest wind energy market in Latin America and is ranked seventh globally in terms of onshore wind cumulative installed capacity according to IRENA. Onshore wind accounted for ~9% of the renewable energy capacity added in 2019. The share of onshore wind is expected to surpass thermal generation and biomass by 2020, according to the Brazilian Association of Wind Energy. Brazil currently has no offshore wind generation capacity as the relative costs are still higher than competing renewable energy technologies.

Brazilian onshore wind energy generation is marked by one of the highest capacity factors in the world, at 42.7% in 2019 against global average of 34%. In North East Brazil, wind farms often exceed 80% in capacity factor, highlighting the country's wind resource potential. The ongoing power sector reforms in the country has also presented opportunities for greater penetration of wind power. In 2018, 1.9GW of wind energy was contracted for the free market, while in 2019 it grew to 2.9GW, supplanting the regulated market, which reached 1.8GW.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

The trend shows a deceleration in capacity addition, after a spike in 2014. Capacity addition particularly contracted sharply to 531MW in 2019, the lowest since 2014. Annual capacity addition of onshore wind has averaged 2.5GW in the five years between 2014 and 2018, making 2019's slowdown even more significant. Persistent weakness in the Brazilian economy has slowed the progress of the onshore wind energy sector by reducing the amount of energy contracted in regulated auctions.

15.4GW Onshore Wind Capacity

- ✓ One of the highest capacity factors in the world, 42% against global average of 25%
- ✓ Introduction of net metering power compensation system
- ✓ Plans to extend its local transmission network by additional 40,000 Km
- ✓ Revival of auction-based market mechanism in 2017

- ✗ Lack of demand and inadequate grid infrastructure
- ✗ Cut in subsidies for wind energy
- ✗ Energy price has gone down below cost price

Demand Driver

The onshore wind energy market in Brazil has been driven primarily by two factors - legislative reforms which led to the introduction of auction-based power purchase and financing reforms.

This initiative of the auction-based market was introduced in 2009 to take advantage of the 2008-09 world financial crisis that lowered the equipment cost. The aim was to encourage competition among the investors and develop onshore wind power at large scale. The introduction of the auction-based market resulted in boosting the growth of new installations in the onshore wind energy sector. The revival of the auctions in 2017 was again welcomed by the industry as the 2016 recession had brought new project procurement to a halt. The government held two new energy auctions and a transmission auction in 2017, which awarded 1.4GW of wind projects representing investments of over $2.5 billion. In 2019, 1.13GW of wind capacity was contracted in the A-4 and A-6 auctions held, accounting for ~34% of the total renewable capacity contracted.

The financial reforms came in the form of tax exemption and announcement by BNDES along with federal government initiatives like the Alternative Energy Source Incentive Program, "PROINFA". Electricity regulator "ANEEL" extended its support by allowing independent and individual producers to use renewable generation to connect to the national grid and by introducing a net metering power compensation system to offer credits on energy bills. This further strengthened the investors' confidence in the industry.

The long-term policy plans for renewable energy expansion clearly show a decrease in focus over hydropower and an increase towards wind and solar. The shift in priority can be chalked out in the difference between the 2007 Energy Expansion Plan and Brazil's Nationally Determined Contribution (NDC) under the 2015 Paris Agreement, both with a time horizon of 2030. The former focuses on the increase in the share of renewables other than hydropower to 9.1% of the domestic energy supply, whereas the latter seeks to expand non-hydro renewables to a minimum of 23%.

Market Opportunity

Abundant wind resources make Brazil one of the most attractive markets for onshore wind globally. The country has an estimated wind energy potential of 500GW, which is massive considering that the overall installed power capacity of the country currently is 142GW.

Brazil's initial focus on indigenization of wind farm equipment has also yielded dividends leading to the establishment of a robust manufacturing ecosystem. There are currently six wind turbine manufacturers operating in the country, with hundreds more engaged in component manufacturing or other parts of the value chain.

Apex-Brasil, the Brazilian trade and investment promotion agency, has targeted renewable energy as one of its priority sectors for attracting foreign investors. There are plans to push the delivery of hybrid parks, which combine wind and solar generation. Onshore wind attracted $3.45 billion in investments in 2019, representing 53% of the investments made in the renewable energy sector. It also marked a 74% increase over the investment level in the preceding year.

Challenges

Stability in the policy environment is a major challenge for investors in the wind power industry in Brazil. Lack of recent, detailed and accurate wind data, difficult access to capital, high initial costs for wind farm implementation and inconsistencies between policy instruments have held back renewable energy expansion. Wind power expansion also suffers heavily due to Brazil's complex environmental licensing regime.

The COVID-19 pandemic has had a direct impact on the growth of wind energy in the country. The ongoing crisis has induced an economic slowdown and stalled new electricity supply contracts, reducing electricity demand. All six power tenders that were expected to be held in 2020 were cancelled and the size of wind power contracts in tenders is expected to get smaller.

Grid connection is a challenge for Brazil because the map of wind potential is concentrated on poor areas with low social indices like the states of Bahia, Rio Grande do Norte, Pernambuco, Piauí and Ceará. The lack of synchronisation between development of wind farms and availability of power evacuation facilities hinders the business prospects. Typically, the bureaucratic processes along with the delayed environmental licenses hold up the planned transmission lines.

Outlook

The wind power sector is dominated by the onshore segment as the country does not have any offshore wind installations. Brazil's onshore wind capacity is expected to grow at a CAGR of 5.5% from 2019 to 2030 to reach 29.6GW from 15.4GW presently. These installations will help Brazil to achieve a balanced energy mix and reduce dependence on hydropower as it prepares to double its non-hydro renewable power capacity by 2030.

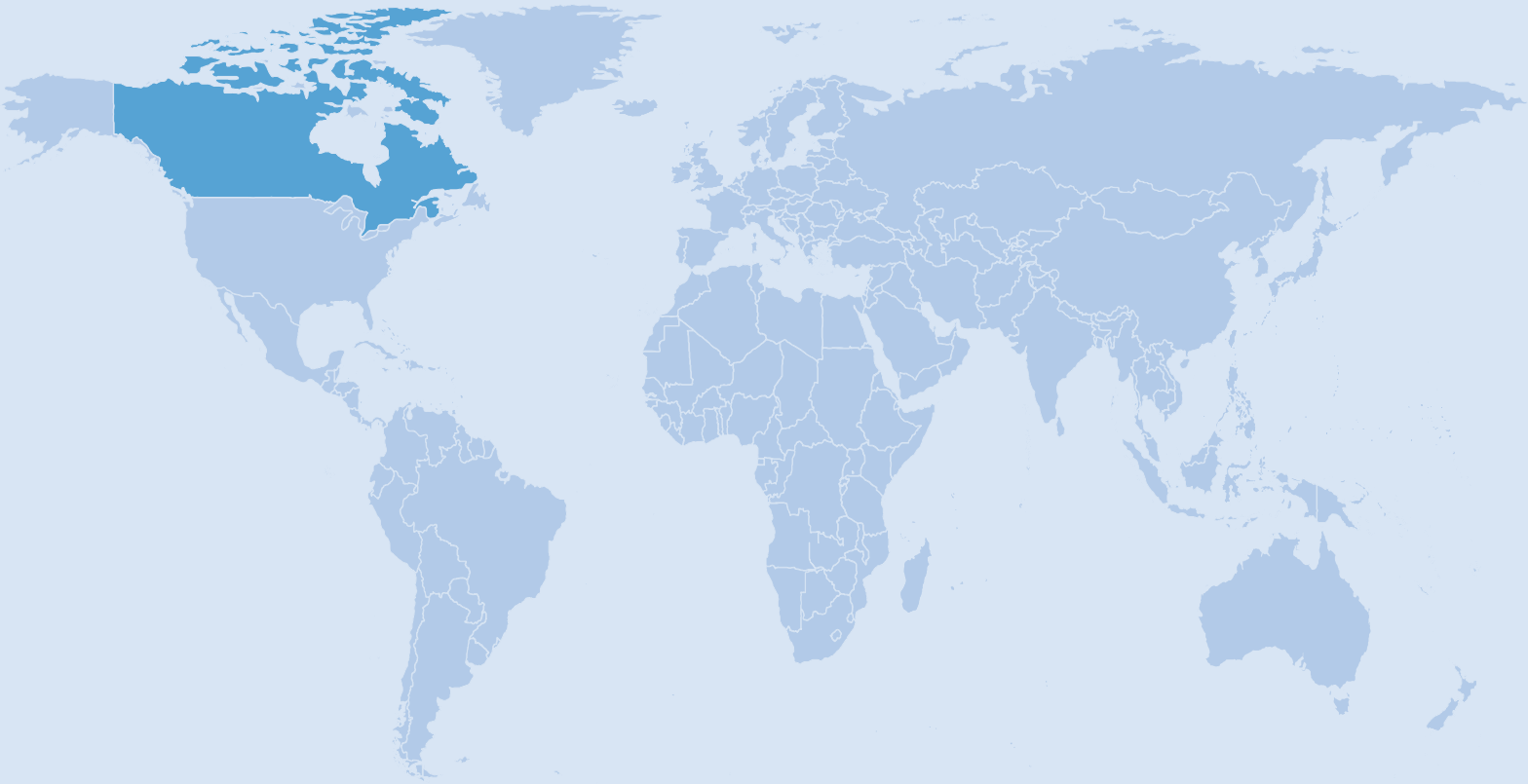
The current administration has not made any significant policy changes, but uncertainties regarding long-term decarbonization plans persist. Increasingly ambitious expansion targets for solar and wind power paired with unclear decarbonization targets has created a supply gap resulting from the relative decline of hydropower. Hydropower serves as the main pillar in Brazil's renewable energy installed capacity with a ~77% share. This energy supply gap will further increase natural gas consumption which will adversely affect decarbonization targets.

Canada

Despite the skew towards hydro, the Canadian power generation mix is in transition, with wind emerging among the fastest growing non-hydro renewable energy generation resources. Between 2010 and 2019, wind power generation registered a CAGR 16.4%, whereas hydropower grew at 0.9% during the same period.

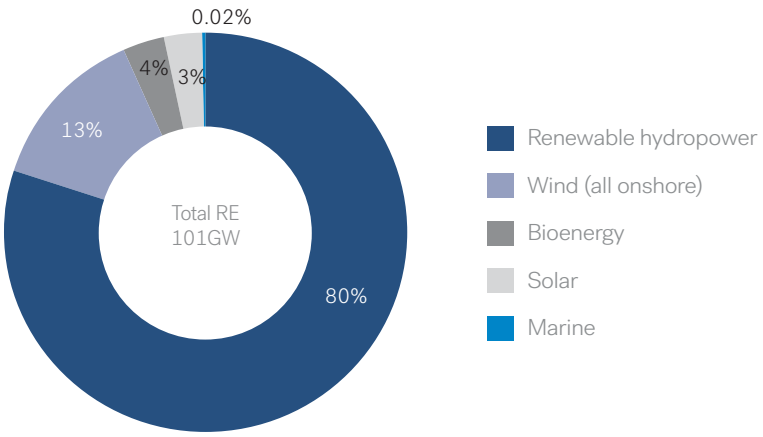
GDP (2019E) (Current Prices)	US$1,731 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.70%
Currency	CAD (CA$)
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2019)	101.0GW
Onshore Wind Share in Renewables (2019)	13%
Electric Power Consumption (2018)	14.2 MWh/capita
Renewable Energy Target	No National Target

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019



Canada

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

GDP (2019E) (Current Prices)	US$1,731 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.70%
Currency	CAD (CA$)
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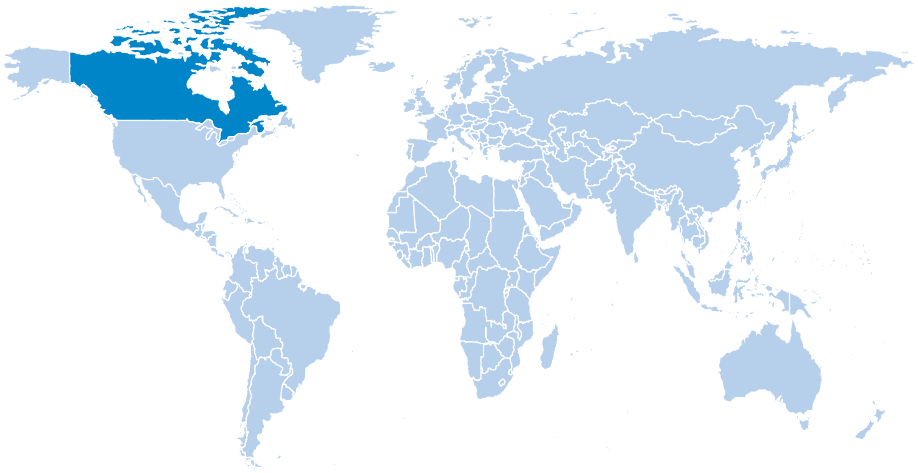
Renewable Energy Target	No National Target

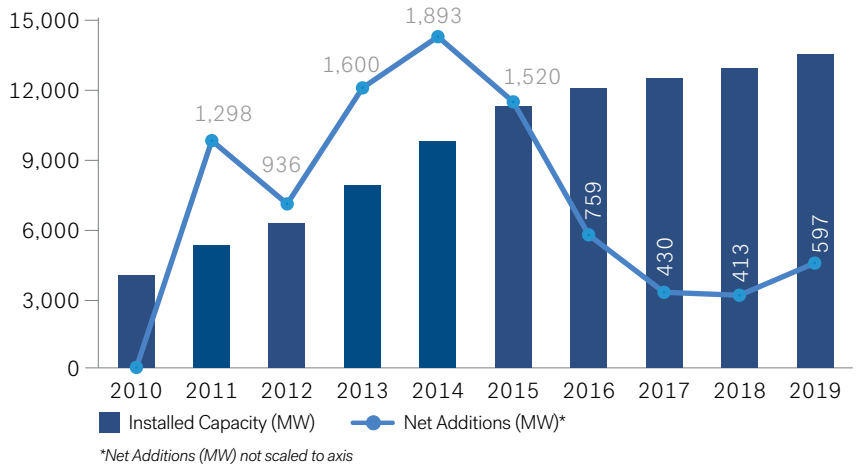
GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Progressively, onshore wind could account for a larger share of the incremental power generation capacity due to the cost, technology, the untapped potential as well as the decarbonisation policy objectives that include the retirement of coal-based generation capacities. The focus on the renewable energy industry is also contributed by the challenges in the country's oil industry that faces opposition due to environmental concerns and declining investment commitments.

Onshore Wind Capacity



Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

13.4GW Onshore Wind Capacity

- ✓ **The most cost-competitive source of new electricity generation**
- ✓ **The government aims to have completely distributed and decentralized renewable electricity generation**
- ✓ **Ambitious state-level renewable energy policies**
- ✗ No national renewable energy targets
- ✗ Sluggish electricity demand and straining grid infrastructure

As of end-2019, with an installed capacity of 13.4GW, onshore wind's share in total renewable energy capacity stood at 13%, a rise from the 11% in 2014. Geographically, about 70% of the installed capacity base is concentrated in the provinces of Ontario and Quebec, with the former leading at 5.43GW.

Capacity addition declined to 413MW in 2018 before picking up the pace to reach 597MW at the end of 2019. This is in contrast to the first half of the last decade when 1.4GW of capacity was added annually between 2011 and 2015. The slowdown can be partly attributed to a lack of national renewable energy targets. Targets determined at the provincial level led to a skewed development.

Demand Driver

The regulator's energy planning scenarios point to a huge scope of replacing coal-based power generation with onshore wind, among other renewable energy resources. In specific, the provinces of Alberta, Saskatchewan, New Brunswick and Nova Scotia have the coal-based power plants facing either shutdowns or retrofits to comply with emission norms.

As per industry estimates such as those of Wood Mackenzie's, Alberta and Saskatchewan could drive a major share of a projected 7GW in new wind capacity. Alberta's Technology Innovation and Emission Reduction Program helped drive offtake in wind power for corporate power purchase agreements undertaken towards compliance. Policy steps at other provinces are similarly driving the market for onshore wind power. Quebec adopted a greenhouse gas emissions reduction target of 37.5% below 1990 levels by 2030 and is capitalising on the province's onshore wind generation potential.

For potential investors and developers, the case for onshore wind is also strengthened by Canadian provinces' relatively high-quality wind energy resources. Recent studies highlight the capacity factors of 34% in British Columbia and 40% in Nova Scotia. Importantly, it is also observed in such studies that even with comparatively lower capacity factors, it is more beneficial for future wind plants to be located in provinces where energy can be partly utilised locally and partly exported to neighbouring US states.

The capacity allocations point to the onshore wind as the most competitive in new generation capacity. A 2017 Alberta procurement secured 600MW at a weighted average price of only 3.7 cents per kWh. Ontario's most recent competitive procurement was in 2014, but even then the result was an average 20-year price of 8.45 cents per kWh, with one contract at 6.45 cents.

Market Opportunity

In April 2020, the federal government issued a request for information towards a public procurement of wind and solar power in Alberta. Based on the outcome of this, the government plans to enter into one or more 20-year power purchase agreements with the generators or through retailers of the same. This is part of the government's push towards enabling power in federal buildings with clean energy wherever feasible by 2022. It is expected that such procurement will only rise in coming years as onshore wind becomes competitive in the wholesale power supply.

As with most of the renewable energy markets, the Canadian progressively needs more transmission capacity to accommodate the upcoming capacities, including those of onshore wind generation. In the Canadian grid context, the interdependence with the US power grid makes it even a stronger business context for investment prospects. So far, onshore wind remains under-utilised for the export opportunity. But this will change as energy curtailment due to transmission congestion becomes untenable. The Prince Edwards Island and the Government of Canada recently announced funding for a 106 km transmission line to support upcoming wind power projects in Western Prince Edward Island.

Studies on Canada's wind power potential also point to the potential complementarity with the hydropower generation capacity. The latter, already a key component of the energy exports, provides an opportunity to be bundled with the wind generation despatch to mitigate intermittency and ensure a firm generation commitment. In this process, the minimisation of wind generation forecasting errors could potentially make way for greater opportunity in the wholesale power market, both locally and in cross-border power transactions.

Challenges

The predominance of hydropower generation skews the balance in power mix for other competitive options, especially the onshore wind. This dissuades most of the potential investments. Hydropower plays a critical role in not just baseload supply but also the cross-border exports. This is unlike to change in the medium term, even though the share of hydropower generation is stagnant over the last 10 years.

Beyond hydropower, onshore wind also faces competition from natural gas in the energy transition underway. The province of Alberta is an example, where most of the coal-based power generation capacity is to be switched to natural gas-based ones instead of wind. The factors driving this, however, vary, including transmission capacity constraints, wholesale power market prices, etc.

Outlook

According to the Canadian Wind Energy Association, the country requires 55GW of installed wind power capacity by 2025 to share 20% of the total electricity generation, translating to an annual capacity addition of 7GW. It is almost 10x rise over the current level. Achieving this would entail a re-orientation in the policy and regulatory framework besides the infrastructural investments on power evacuation. As per Wood Mackenzie, it is a far moderated projection of 7.7GW worth of aggregate capacity by 2028.

Mexico

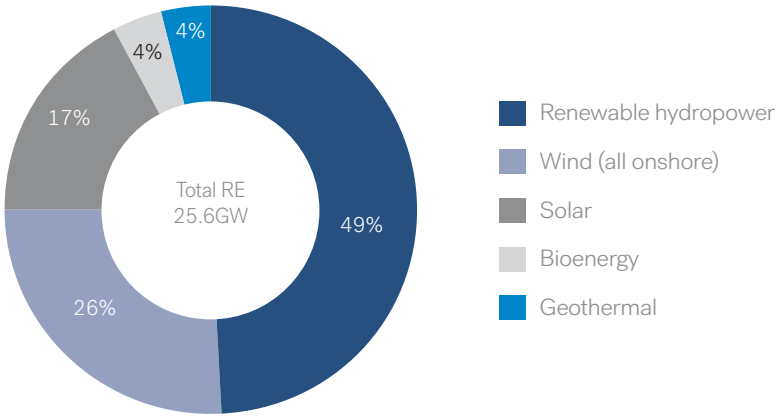
Mexico ranks second in the Latin American region for onshore wind potential. In 2019, the country had 1.7GW of capacity addition, the highest annual growth in onshore wind power generation over the last decade. This is important considering that the energy mix is predominantly dependent on hydrocarbon resources.

GDP (2019E) (Current Prices)	US$1,274 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.73%
Currency	MXN (Mex$)
Country Credit Rating (S&P)	BBB
Renewable Energy capacity (2019)	25.6GW
Onshore Wind Share in Renewables (2019)	26%
Electric Power Consumption (2018)	2.4 MWh/capita
Renewable Energy Target	35% share of renewables by 2024

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Mexico

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

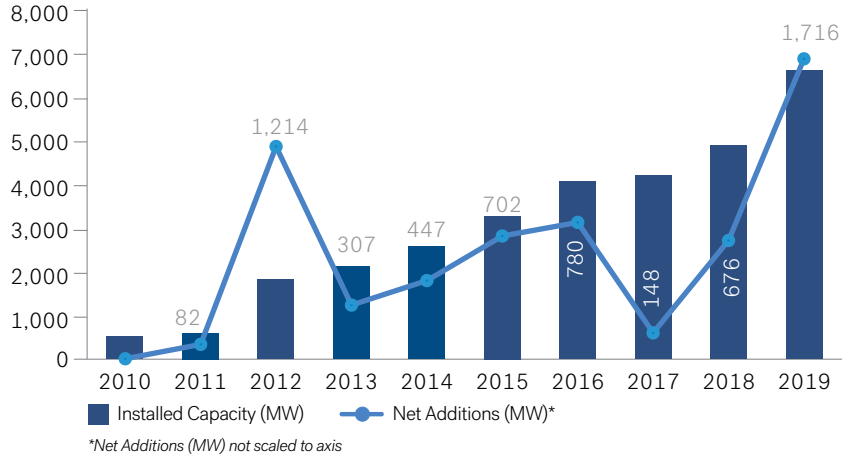
GDP (2019E) (Current Prices)	US$1,274 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.73%
Currency	MXN (Mex$)
Country Credit Rating (S&P)	BBB
Renewable Energy capacity (2019)	25.6GW
Onshore Wind Share in Renewables (2019)	26%
Electric Power Consumption (2018)	2.4 MWh/capita
Renewable Energy Target	35% share of renewables by 2024

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

The Mexican renewable energy sector grew steadily in recent years due to the reforms undertaken. The state-run energy sector was liberalized for private sector participation and competition, which helped usher private investments in the clean energy segment. Some of the key steps taken to improve renewable energy adoption include the introduction of a competitive wholesale market and the establishment of an independent system operator.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

6.6GW Onshore Wind Capacity

- ✓ **Multiple regions with high wind potential**
- ✓ **Competitive prices of wind power, enabled by power market reforms**
- ✓ **Private sector investment, especially by leading global developers**

- ✗ Slowdown in the reform process that carried significant promise earlier
- ✗ Arbitrary government decisions reversing previous policy decisions and auctions on renewable energy
- ✗ Conflicts with local communities, resulting in delay in project commissioning

Between 2010 and 2019 onshore wind capacity grew by over 12x. The trend in growth picked up since 2012 when the installed capacity rose by three-fold versus previous year. The increase was driven by a combination of enabling regulatory framework, enhanced transmission capacity and better access to financing (especially after 2008 global financial crisis) . Since then, the average annual incremental capacity is on a rise. Between 2013 and 2015, an average 2.6GW of capacity was added. In 2017, there was a sharp dip in net capacity addition driven by reforms in the energy sector, especially through liberalisation and introduction of the auction-led capacity allocation model. After a transition period, capacity additions increased again. By end-2019, this market had over 6.5GW of capacity added.

Demand Driver

Mexico's energy sector reforms constitute the single most important market driver. Mexico's energy sector reforms were implemented from 2013, when the incumbent state-owned vertically integrated power utility CFE was unbundled. This was combined with regulatory measures to enable private sector investment in power generation, especially in renewable energy sectors. Spain's leading developer Iberdrola, for instance, is among the top foreign companies which tapped into the scope made available due to the reforms. The unbundling of the state-owned utility helped spur the growth in renewable-based power generation projects especially the merchant-based projects.

Auction-based capacity allocation helped enable price discovery in the market, which shows wind power as among the cheapest resource. As part of the government's reforms, tradeable clean energy certificates were also introduced. This helped to bring additional depth in the renewable energy sector, as various users of the grid supply are required to purchase the energy certificates in accordance with regulations on the share of renewable energy in their total consumption.

Market Opportunity

About US$1.3 billion of investments will be needed for the under-construction wind farms which were allocated in Mexico's third energy auction.

Based on the reforms, Mexican energy ministry SENER committed investments towards renewable energy generation for the period 2016-2030. In this regard, wind power takes a 23% share of the planned government investment, the highest among all energy sectors, pointing to the policy emphasis in this regard. Although, the government is showing signs to refrain from the auction-based market mechanism, evident from permanently cancelling the fourth renewable auction in January 2019, there are several initiatives underway to hold private auctions in Mexico both by domestic as well as international players.

These auctions would provide an attractive opportunity to the developers who failed to participate in the cancelled fourth long-term power auction. This is likely to be a win-win proposition with developers being offered the scope to commission large renewable portfolios, while power consumers will be able to secure inexpensive clean energy.

Challenges

The government recently halted grid-connection of new wind and solar projects and imposed several other restrictions on renewable energy deployment including suspension of clean energy certificate mechanism, citing as necessary measures for managing the COVID-19 public health crisis.

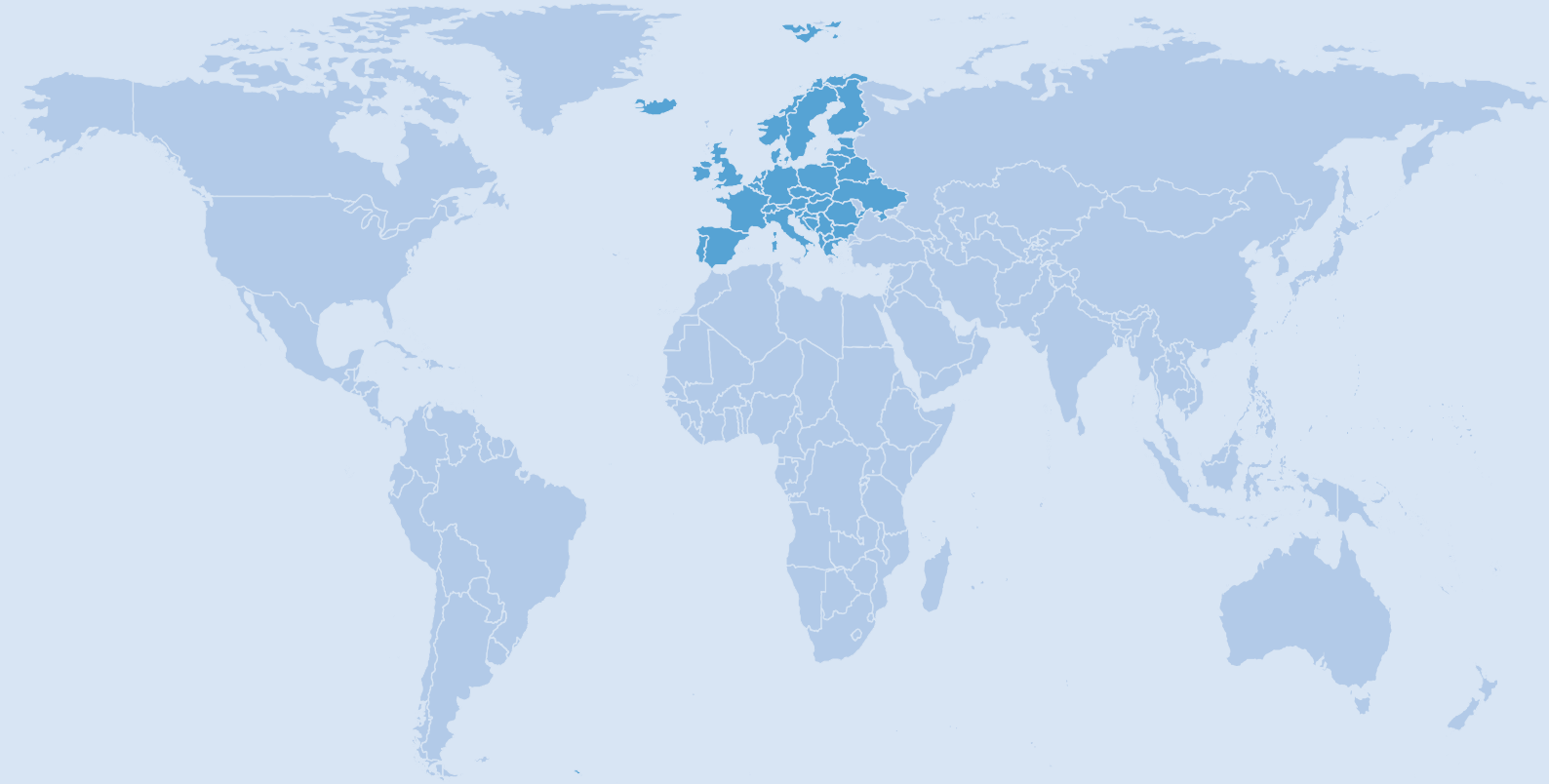
Another major roadblock for wind development comes from the failure to secure the consent of the local communities. Given that Mexico has one of the largest populations of indigenous communities in the Americas, securing their support is critical. Failure to get the local communities onboard resulted in significant delays in projects' commissioning schedules.

Natural gas accounted for about 57% of the 15GW of generation projects that held construction permits as of February 2019. Furthermore, under the current government, the majority of the investments in the short term are likely to be aligned to hydropower due to an emphasis on renovating the existing capacity base. Onshore wind, thus takes a backseat in the short-term policy horizon.

Outlook

The Mexican Ministry of Energy forecasts a growth rate of 3.4% of electricity demand for 2016-2030 period. According to the Ministry of Energy's infrastructure development programme for the National Electric System, Mexico needs to install 55.8GW of power generation capacity in the same period to meet the demand. The share of wind in the projected new capacity addition is estimated at 24%, corresponding to roughly 13.4GW.

EUROPE



Germany

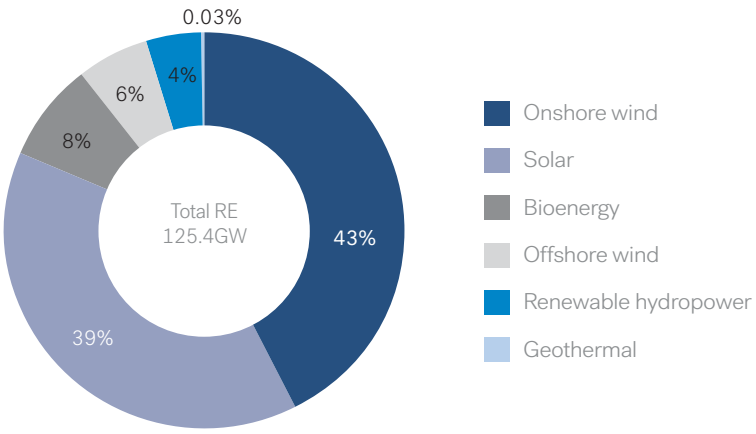
Germany retains its leadership position in the European onshore wind market, despite a slowdown in capacity addition. Bureaucratic delays have contributed to the slowdown in the onshore wind energy industry. The country's cumulative installed capacity of 53GW is the third largest globally behind China and USA, accounting for 9% of global onshore wind capacity in 2019. Onshore wind accounted for 43% of the country's renewable mix in 2019.

GDP (2019E) (Current Prices)	US$3,863 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.16%
Currency	EUR (€)
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2019)	125.4GW
Onshore Wind Share in Renewables (2019)	43%
Electric Power Consumption (2018)	6.9 MWh/capita
Renewable Energy Target	65% share of renewables in power mix by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Germany

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

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GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

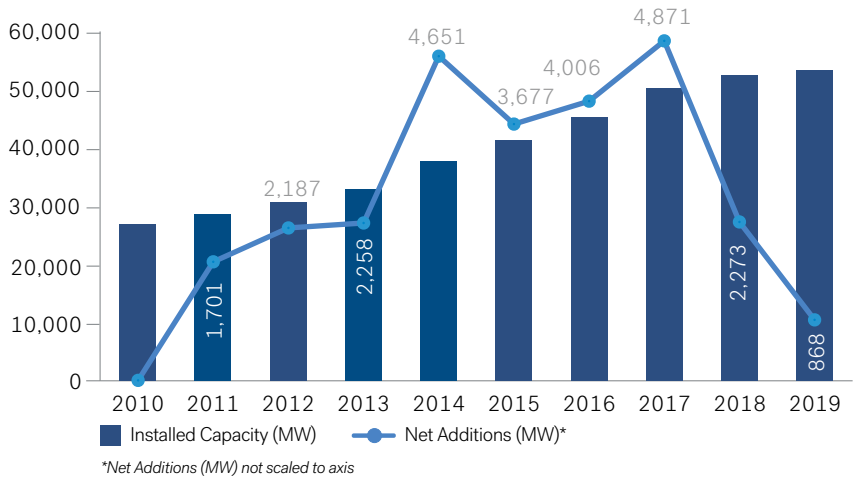
Germany spearheaded Europe's onshore wind power growth for many years. But the country's capacity addition peaked in 2017, as it faced increasing headwinds in global renewable energy market. Only 868MW of onshore wind capacity was added in 2019, the lowest in a decade. Regulatory procedures primarily contributed to the sharp contraction in project pipeline, with the number of issued licenses dropping by almost 70% in the last three years. Besides bureaucratic red tape, the mandatory minimum distances from residential areas and legal risks emanating from the lawsuits contributed to a cooling in investor interest.

In contrast, the importance of onshore wind in Germany's power market has steadily increased. Power production from onshore wind has grown as net expansion remained positive and older turbines got replaced with newer ones in so-called repowering procedures. Wind generated 118TWh of electricity in the 2019, accounting for 24% of the country's power mix, becoming the dominant source of power.

The German government's decarbonisation goals have shifted focus to the criticality of renewables in the country's power mix. It has pledged to shut down the last nuclear power plants in 2022 and phase out coal-based power by 2038. In the absence of replacement capacity, which will come from renewables and to an extent onshore wind, Germany faces a risk of major power shortage. The German government wants renewables to cover 65% of the country's electricity needs by 2030 but have pared the target for onshore wind capacity to 67-71GW from 80GW earlier, shifting the difference in capacity addition to offshore wind.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Annual onshore wind capacity addition has progressively slowed down since peaking at ~4.9GW in 2017. Annual capacity addition dipped below 1GW (868MW) for the first time in the past decade. It marks a sharp decline, being less than one-third of the average annual capacity addition of 2.8GW achieved during the past decade (2010-2019).

Most of Germany's new onshore wind auctions in 2019 were undersubscribed because there weren't enough permitted projects. Out of the 3.7GW of auctioned capacity, only 1.8GW was awarded. The challenge in securing sufficient land permits is the major reason for this. So onshore installations are unlikely to pick up much in the short term.

53.3GW Onshore Wind Capacity

- ✓ **Decarbonisation goals make onshore wind a critical part of Germany's long-term energy plans**
- ✓ **Strong base of installed capacity and manufacturing ecosystem**
- ✓ **Repowering represents a major growth opportunity**
- ✗ Bureaucratic delays on account of restrictive planning process
- ✗ Flagging investor interest evident from undersubscribed wind auctions
- ✗ Government is refocusing on offshore wind and solar PV given the legal challenges and public opposition to new wind farms

Demand Driver

The German government's decarbonisation goals remain the biggest demand driver for the renewable and particularly onshore wind industry. It is estimated that 50GW of secured capacity will be required to replace the 43GW of coal-based capacity that will be phased out by 2038 and the 10.8GW nuclear capacity to be decommissioned by 2022. The government's latest renewable energy targets have called for 67-71GW of onshore wind capacity by 2030, to help achieve the overall goal of sourcing 65% of power requirements from renewable sources by 2030. This target translates into annual additions of 1.4-1.8GW.

Despite the threat of lawsuits brought by citizen movements and environmental groups, latest surveys indicate an overwhelming support for wind power among the German population. Survey results show that 82% of respondents said the rollout and use of onshore wind power as part of the country's energy transition was very important or quite important. This level of agreement has remained broadly unchanged since 2015. Public support will be crucial to the further development of the wind power industry.

In the light of regulatory challenges, the government has tried to offer increased clarity through detailed measures across various departments. These are intended to boost local acceptance of wind farms by allowing communities to benefit more from projects, increase protection against legal challenges and better synchronize wind and grid plans.

Market Opportunity

The use of renewable energy in heating, electric mobility and industrial processes represent new areas of growth for onshore wind. The share of renewables in German heating systems has stagnated at 13-14% with only a quarter of new systems using renewable energy. This highlights considerable headroom for growth in demand for renewable power. Similarly, the number of hybrid and electric vehicles have been growing by 70-80% annually, driving the growth in charging point infrastructure.

For wind projects reaching the end of their statutory 20-year support period under the EEG renewables support program, PPAs are now becoming increasingly attractive. Around 4GW of operational onshore wind in Germany will be impacted starting January 1, 2021, while 16GW of onshore wind capacity commissioned under the 2000 Renewable Energy Act will come to the end of their subsidy support schemes between 2021 and 2025. It is a widely held view that preventing existing energy assets from going offline through innovative mechanisms such as merchant PPAs is as equally beneficial as enabling the addition of new capacity.

Repowering represents another major growth opportunity, given that many states are tightening their planning laws for wind parks, constricting the availability of land for wind projects.

Rapid investment in grid infrastructure including storage is becoming an important factor in German electricity system. Estimates suggest investments worth c.€18 billion (US$20.9 billion) could be expected in the next 5-7 years to upgrade the technology profile of the grid.

Challenges

Bureaucratic red tape has been a key obstacle to further development of the onshore wind energy industry in Germany. Lawsuits brought by citizen movements and environmental groups, aviation and military restrictions are some factors that have led to a tightening of planning restrictions on wind projects. It is estimated that the current proposed government plan to enforce a minimum distance of 1,000m between wind masts and the nearest built-up area is likely to result in a 40% reduction in available land for new turbines.

Regulatory delays have led to a 70% decline in issued licenses in the last three years with 11GW of onshore wind projects stuck in procedures as of mid-2019. This, in turn, has adversely impacted investor interest. Investments dropped to €300 million (US$335.8 million) in 2019, from €800 million (US$944.8 million) in the preceding year. Response has also been tepid at the wind power auctions. Most of Germany's new onshore wind auctions in 2019 were undersubscribed because there weren't enough permitted projects. Out of the 3.7GW of auctioned capacity, only 1.8GW was awarded. The trend has continued in 2020 with the first two of the seven planned wind auctions in the year drawing just 674MW of capacity out of the 1.2GW available.

Outlook

Germany is looking to reduce its coal-based installed capacity by 50% by 2030 and exit coal fully by 2038, which would propel the growth of the renewable energy sector in this period. Despite the downward trend in onshore wind power, Germany marked its first ever quarter with more than 50% renewables in power production in the first three months of 2020, highlighting the long-term potential of wind power in the country's power mix.

Despite the onerous regulatory process, efforts are being made to streamline the process to bring in greater clarity on regulations to restore growth in the wind power industry. Merchant PPAs, growing interest in renewable power from the commercial & industrial (C&I) segment are other growth drivers which would continue to contribute to the expansion of wind in Germany's power mix.

The revised target of achieving 67-71GW cumulative installed capacity in onshore wind seems achievable if the regulatory roadblocks are cleared. The proposal to have wind farms contribute 2% of their profits to the local government will shore up public support for onshore wind, if accepted by the market players.

Spain

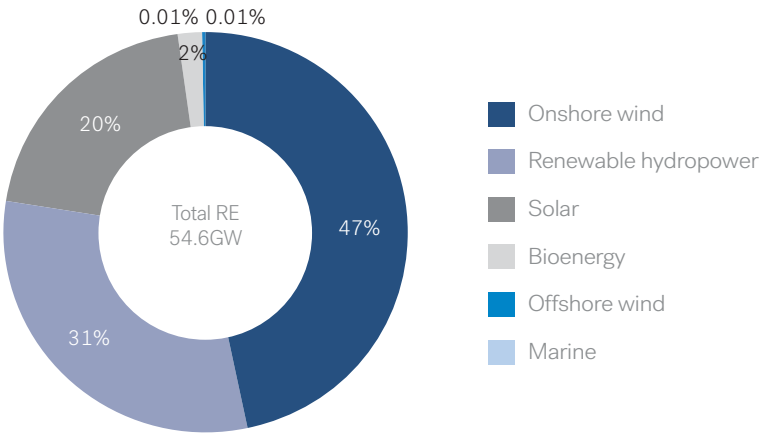
After stagnating for several years, the Spanish onshore wind industry staged a massive comeback, adding 2.1GW of capacity in 2019. This was higher than the cumulative capacity added between 2012 and 2018, propelling Spain to the top of the ranking of European countries in onshore wind installations in 2019. Spain currently accounts for 15% of Europe's installed onshore wind power capacity. The country also led the way with investments of €2.8 billion (US$3.1 billion) in new wind energy assets in 2019.

GDP (2019E) (Current Prices)	US$1,398 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.77%
Currency	EUR (€)
Country Credit Rating (S&P)	A
Renewable Energy capacity (2019)	54.6GW
Onshore Wind Share in Renewables (2019)	47%
Electric Power Consumption (2018)	5.5 MWh/capita
Renewable Energy Target	120GW of renewable energy capacity by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Spain

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

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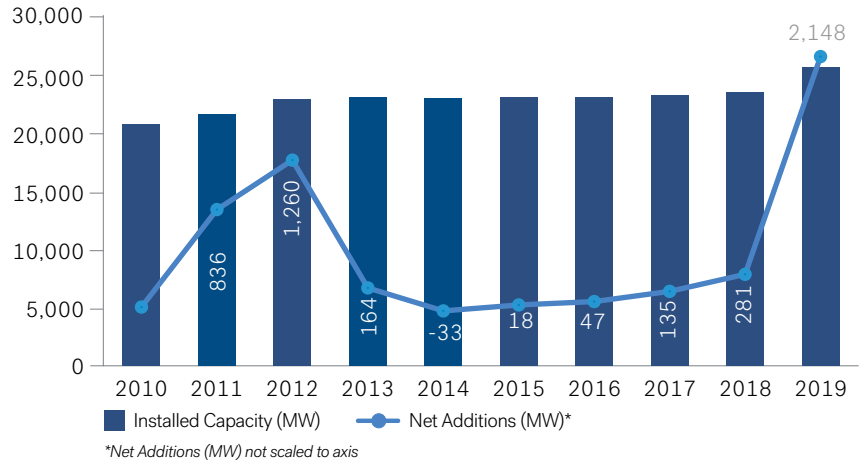
GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

2019 marked a turning point in the wind power installations in Spain, with total installed capacity reaching 25.5GW. Till around 2007, Spain's wind power market appeared to be on a rapid growth trajectory, driven largely by the feed-in tariff (FiT) system. But growth momentum was checked once reforms started in the FiT regime. This situation improved with the auctions of 2016 and 2017 needed to fulfil the 2020 objective as part of Spain's commitment to the European Union. Most of the installed capacity in 2019 came from the 4.6GW awarded in the three auctions during 2016-2017. This attracted significant investor interest and yielded a highly competitive price discovery.

Since the past year, Spain has become strongly committed to renewables. The renewable quota of Spain amounted to 54.6GW at the end of 2019 from 48.3GW in 2018, of which 47% was onshore wind power. The major driver that helped this push has been the Spanish government's significant progress towards decarbonization. Fossil fuels have recorded the lowest participation in terms of total power generation in 2019, representing 4.3% of the total power generated during the year, a sharp decline from 14.1% in 2018. Spain has pledged to shut down most of its 10GW of operational coal plants by mid-2020 under the EU's industrial emissions directive and the remaining by 2025. The government has also approved a bill to reduce greenhouse gas emissions to net-zero by 2050.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Spain is the second largest European country and fifth largest worldwide in terms of onshore wind installed capacity after China, the US, Germany and India. As per IRENA, Spain added around 2.6GW of onshore wind capacity in the last five years, of which 2.1GW was added in 2019 alone. Annual onshore wind capacity addition was below 300MW since the 2013-2018 period owing to flagging investor interest in the aftermath of the withdrawal of the FiT regime in 2012.

In 2019, there were 1,205 wind farms present in 807 municipalities, with 20,940 installed wind turbines, which covered 20.8% of electricity consumption with an output of 54.5TWh.

25.5GW Onshore Wind Capacity

- ✓ **Decarbonization commitments of the newly elected pro-renewables coalition government**
- ✓ **Growing investor interest in Spanish wind sector**
- ✗ No subsidy for wind energy development
- ✗ Uncertainty around residual wind capacity awarded in auction not being constructed

Demand Driver

Since 2012, when the FiT system was abandoned, the auctioning system has been the main driver for the growth of onshore wind capacity. The projects awarded through the auctions benefitted from a priority treatment by the administration for construction, environmental permits and grid connection. The demand is also reflected by wind turbine manufacturing activities in Spain. As per Spanish Wind Energy Association (Asociación Empresarial Eólica or AEE), Spain is the third-biggest exporter of wind turbines in the world with €2.18 billion (US$2.5 billion) wind turbine exports annually.

The big increase in capacity in 2019 could be attributed to the election of the centre-left government, replacing a centre-right regime that had little interest in renewables. The change in government has brought back focus on renewables and resulted in ambitious decarbonization goals. These are likely to impart the required policy push that will help sustain capacity addition as the market transitions towards a market-based, subsidy-free structure.

The future demand for onshore wind installation in Spain would be driven by the country's ambitious plan to cut carbon emissions to net-zero by 2050. Under this new climate law, renewable technologies and natural gas are likely to replace fossil fuels, which would require substantial capacity addition.

Market Opportunity

The Spanish Government has approved an ambitious draft climate law which seeks to switch to entirely to renewable electricity by 2050. To achieve the target, an interim renewable energy goal of 35% for final energy consumption was set in the new National Energy and Climate Plan (NECP) 2021-2030. As part of this new interim goal, the government is targeting over 2GW of annual wind energy installations by 2030. It has also approved a 2% increase in the investment required for this to €241 billion (US$280.2 billion). Once approved, the draft law could feasibly generate more than €200 billion (US$232.6 billion) worth of investments by 2030. This would provide significant opportunities for the new developers to tap the Spanish onshore wind market.

The newly elected government would also offer subsidies to renewable energy investors if they chose to abandon almost €10 billion (US$11.6 billion) worth of lawsuits against the government. During the previous right-wing People's Party administration, investors sued the government when the administration reduced renewable subsidies for the second time in 2013 to cut a power-tariff deficit. This proposed subsidy will allow investors to maintain their current profitability rate of 7.4% until 2031 which in turn would also create long term opportunities for investors.

Decommissioning of the Goroña nuclear plant and a proposed ban on new gas and oil exploration are also encouraging signs for the renewables industry. Under a new pact in February 2019 between the Spanish government and utility companies Endesa, Iberdrola, and Naturgy, the country will shut down all of its remaining coal plants by 2025 and by 2035 will have phased out its nuclear power plants. It will help realise the country's plan for a 74% renewable generation target by 2030 and making Spain carbon neutral by 2050.

Challenges

While the newly elected pro-renewables coalition government and its proposed renewable energy plan look promising for Spain's future wind energy growth, it will also need to attract nearly €200 million (US$232.6 million) of private investment over the next decade. This effort could face challenges as the COVID-19 pandemic is causing massive disruptions to the flow of investments.

The Spanish wind energy sector may face challenges to start the projects that are pending from the 2016-2017 auctions, out of a total 4.6GW of wind energy capacity awarded. There are ~2.5GW of wind projects that are yet to be commissioned. Earlier auctions were excluded from the pre-qualification check (financial and technical viability of a project). This could lead to undelivered projects.

The recent auction, while encouraging for the market, also raises concerns about the viability of the projects. As per Spain's energy ministry, all bids were on the basis of maximum discount meaning that they will receive no subsidy but will only receive wholesale price for electricity generated. The prices discovered are low and yet to be established as sufficient to yield adequate returns for developers and investors. Further, with the decline in energy demand since COVID-19 outbreak, the lower merchant prices will make it difficult for projects to be profitable.

Outlook

Currently, the electricity generation of wind power in Spain is at its peak with wind farms covering 27.6% of the electricity demand in the country so far in March 2020. The Government is targeting more than 2GW of new wind power to be connected annually by 2030.

Spain is planning to source at least 70% and striving for 74% of electricity from renewables by 2030, and 100% by 2050. The country also intends to go beyond the current EU target of 32% and reach 35-42% in total energy consumption from renewable sources by 2030. This implies that more renewable energy capacity has to be installed.

The new proposed climate law to promote wind energy in Spain indicates a clear change in the newly elected government's position about wind energy. Once approved by parliament, it will immediately impose a ban on all new coal, oil, and gas extraction projects, end fossil fuel subsidies, and make all new vehicles emission-free by 2040.

France

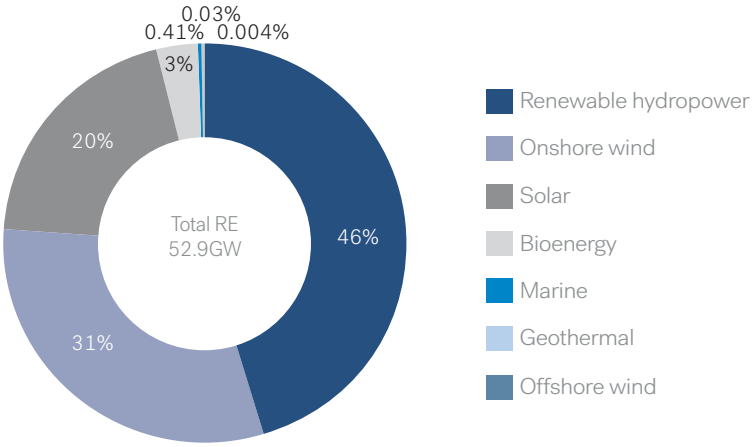
Wind is the second largest renewable source of electricity production in France after hydropower. Driven by clear targets to develop 34.7GW by 2028, France has the necessary macroeconomic fundamentals and supportive political dynamics to be one of the most attractive European markets in onshore wind energy sector over the coming years. The government is aiming at maintaining a stable and simplified legal framework for permitting of new and repowered wind farm projects.

GDP (2019E) (Current Prices)	US$2,707 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.34%
Currency	EUR (€)
Country Credit Rating (S&P)	AA
Renewable Energy capacity (2019)	52.9GW
Onshore Wind Share in Renewables (2019)	31%
Electric Power Consumption (2018)	7.1 MWh/capita
Renewable Energy Target	33% share of renewable in energy consumption by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

France

Current Renewable Energy Mix



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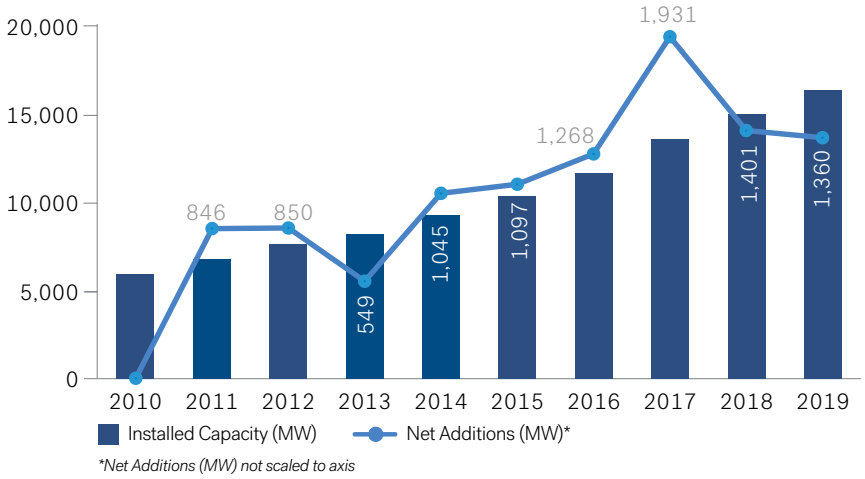
GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

France has an energy mix where nuclear power has the predominant role. About three-fourths of its total electricity came from nuclear energy in 2018. By 2035, the country aims to reduce reliance on nuclear power to 50% and shut down 14 of the country's 58 nuclear reactors currently in operation. This entails getting renewable energy generation, including onshore wind power, to manage the ensuing energy transition.

In April 2020, France submitted its 2030 National Energy and Climate Plan (NECP) to the European Commission which aims to achieve 33% renewable energy in its energy mix by 2030. This translates into 40% renewables in the power sector. To further tackle the existing problems of permitting and repowering issues, the government aims to reduce the duration of the permitting process, giving reasonable time to project leaders to develop wind farms, consider the environmental impacts of projects and focus on repowering through reutilization of wind turbines approaching operational end.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

France added approximately 7GW of onshore wind capacity over the last five years. In 2019 alone the country added 1.4GW of installed capacity which is in line with 2018 additions. The sustained rate of installation from 2013 onwards reflects the impact of recent regulatory changes such as the confirmation of the feed-in tariff (FIT) and Energy Transition for Green Growth Act. The decline in net capacity addition since 2017 is attributed to delays caused by regulatory approvals in several parts of the country for onshore wind projects. In many cases, project development work was suspended.

Lately, the opposition to new onshore wind power has risen. Both via protests by various pressure groups (civil society activists, social groups etc) and through lawsuits. The industry has not seen such level of impediments before. For instance, 70% of the building permits were under challenge before administrative courts in 2018, against 50% in 2013.

In September 2019, in response to an under-subscribed auction, French government opened the next auction to projects without necessary permits. However, without permits it is uncertain whether these projects will be commissioned.

16.3GW Onshore Wind Capacity

- ✓ **Supportive policy framework through the provision of feed-in premiums**
- ✓ **Expanding corporate PPA market**
- ✓ **Policy push towards energy transition driven by renewable energy**
- ✗ Land available in only low wind resource regions
- ✗ Regulatory restrictions on land availability
- ✗ Tendering mechanism not aligned to investor needs

Demand Driver

The French energy regulator (CRE) introduced new directives and repealed the power purchase certificate (CODOA). This helped in the implementation of an environmental authorization process that regrouped all authorization procedures for a wind energy project, therefore providing a more stable and secure regulatory framework.

French onshore wind market has been supported by a number of policies including FiT, FiP (Feed in premium) and tendering system. From 2017 onwards, the old FiT has been replaced by FiP under which a farm having a minimum of six turbines, can sell electricity directly to the market and will receive a premium under a 20-year contract. To avail this, the farms must go through a competitive bidding process. With the FiP, the electricity is sold at market price whilst at the same time the generator receives a regulated bonus.

France's 2030 National Energy and Climate Plan outlines comprehensive electrification measures where all new vehicles should be zero-emission by 2040. To support this the Government has introduced various measures including a vehicle bonus-malus depending on emission and a conversion grant for low emission vehicles.

Market Opportunity

In the coming five years France plans to tender 28GW of subsidized wind and solar projects. The final draft for the PPE 2019-2023 and 2024-2028 also sets a timetable for tenders which includes over 9GW onshore wind. This can prove to be instrumental for development of onshore wind projects in the coming years and will help to rejuvenate the interests of investors and industry operators.

The first Corporate Power Purchase Agreements (CPPA) was signed for three years in 2019 between Metro Cash and Carry and a wind farm operated by Eurowatt. Since then, there is a rising interest in CPPAs with tenures ranging from a few years to 25 years. Lately, several types of CPPAs emerged, the most promising being the sleeved CPPA for which standard contract is being developed by France Énergie Éolienne.

The French government's newly published energy plan confirmed a strong trajectory for onshore wind into the next decade. The provisional timetable foresees two tenders totaling 1.8GW in 2020 and then two per year of 1GW each from 2021.

The government would also encourage the repowering of existing sites, support citizen's participation and in 2023, make it obligatory to recycle decommissioned turbines. Further the government has pledged to increase annual spending on renewables development to €8 billion (US$9.1 billion) till 2028, from €5 billion (US$ 5.7 billion) earlier which should attract substantial investor's interest to the sector.

France has already exhausted high-wind resource sites leaving behind low resource ones. This in turn has created a need for the use of advanced low-wind resource turbines which are grid-responsive, allow for yield maximization paired with forecasting. Future deployment of turbines in these areas is inevitable and provides a clear supply opportunity for both domestic and foreign manufacturers.

Challenges

France has mostly exploited its high-wind resource sites, namely Hauts-de-France and Grand Est. The available land for installation is thus predominantly in the low-wind resource sites. A strong pipeline paired with low-wind sites installations will create considerable challenges for operators in managing cost to output ratio.

Current regulations, logistical problems and environmental policies in France have not evolved to accommodate supersized wind turbines. It is almost impossible to locate a wind turbine within less than 30km of a military radar. As a result, more than 50% of the French territory is currently prohibited to large wind turbines.

The new tendering procedure lacks in dealing with technological assessment of wind turbines. The procedure offers fixed tariff during the lifetime contract and the selling tariff is not re-evaluated during the contract's lifetime considering technological advances or other developments. These problems make the tendering procedure unattractive for the wind energy actors and procedural changes need to be implemented to sort out the issues.

Outlook

France held its fifth auction round for 1.7GW of renewable energy projects in April 2020, awarding approximately 750MW of this capacity to onshore wind projects. The wind tender was oversubscribed at an average bid price of €62.90/MWh ($67.9/MWh). The next round, which was originally scheduled for July, was shifted to November 2020 due to the COVID-19 crisis.

A report by QVARTZ states that the upcoming pipeline for announced onshore wind under the belt of major players like Vestas, Gamesa, Senvion, GE and Nordex in the coming few years consists of a combined 893MW. Therefore, it is evident that France will show continued steady growth in onshore wind deployment in the upcoming years.

Apart from new auctions, new pricing policies and the promotion of crowdfunded projects are constantly increasing the competitiveness of the French wind energy sector and promoting wind energy growth. Simultaneously, new roles like aggregators and private/power purchase agreements will also pay a crucial role in the development and security of the sector in coming years. However, the key challenge will lie in the development of a standard framework for setting the procedure of implementing a power purchase agreement.

United Kingdom

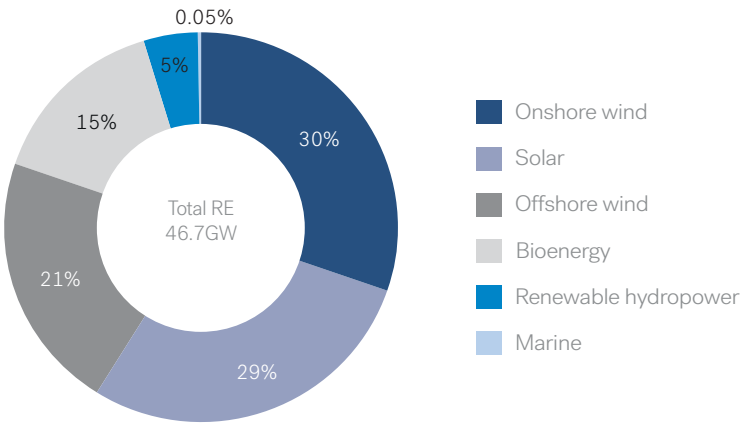
The UK has been a major wind market in Europe with a cumulative installed capacity of 24GW of wind (onshore and offshore) in 2019. Onshore wind is the cheapest option available for new power generation capacity in the UK. The government could procure new onshore wind capacity for £46/MWh (US$58.7/MWh) – cheaper than gas, new nuclear, and other renewables. This fits well with policy objectives of phasing out the coal-based power plants by 2024 and procure 70% of total power from renewable energy sources by 2030.

GDP (2019E) (Current Prices)	US$2,744 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.47%
Currency	GBP (£)
Country Credit Rating (S&P)	AA
Renewable Energy capacity (2019)	46.7GW
Onshore Wind Share in Renewables (2019)	30%
Electric Power Consumption (2018)	4.9 MWh/capita
Renewable Energy Target	Net-zero emissions by 2050

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

United Kingdom

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

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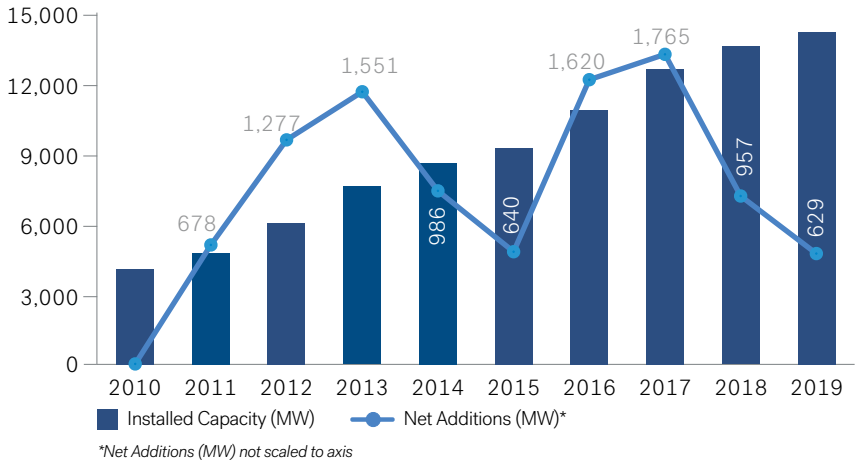
GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

The UK accounts for 8% of the cumulative installed onshore wind capacity in Europe and is placed fourth after Germany, Spain, and France. By end-2019, the onshore wind installed capacity reached 14.1GW, although the annual capacity addition decelerated.

Capacity addition peaked in 2017 and then hit a record low in 2019 after the government officially closed the Renewables Obligation scheme to new onshore wind farms in 2017. In 2019, onshore wind represented 29.9% of all renewable capacity, dipping below 30% for the first time since 2016 but retaining the highest share of total renewable capacity.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

14.2GW Onshore Wind Capacity

- ✓ **Most competitive in incremental power generation capacity**
- ✓ **Reversal of policy ban on subsidies**
- ✗ Brexit related uncertainties
- ✗ Concerns from local communities for the development of onshore wind farms

The UK added around 629MW of onshore wind installed capacity in 2019, which is the lowest in capacity added over the last eight years. All but one of those projects had previously qualified for support under the shuttered subsidy programs. Cumulatively the country added approximately 7GW of onshore wind capacity between 2014-2019, peaking at 1,765MW annual capacity addition in 2017.

Since 2002 the Renewables Obligation (RO) scheme has underpinned the economics of wind energy in the UK. In 2015, the scheme was replaced by Contract for Difference (CfD) scheme, designed to support the deployment of large-scale renewable projects (more than 5MW). Initially, the CfD scheme, however, banned Onshore Wind projects from application. As a result, onshore wind installations plunged to 629MW in 2019, from 1.8GW in 2017, the last year in which projects were eligible under old support arrangements. In total, 794 projects that already went through local planning processes, were stalled, with a cumulative capacity of 4,466MW. Once operational, these projects could generate over 12TWh a year and make a significant contribution towards reducing the energy gap of 55TWh needed by 2030 due to closure of existing nuclear plants and other ageing power stations in the 2020s.

In March 2020, the UK government decided to lift its ban on onshore wind projects participating in the CfD auctions. It is therefore expected that onshore wind capacity additions increase again in the coming years.

Demand Driver

After several years of campaigning by the green campaigners in favour of the onshore wind, the UK government has lifted the ban on the onshore wind from accessing the CfD program, which brings onshore wind to compete in a new auction set for 2021. The new auctions would allow a pipeline of shovel-ready onshore wind projects and an opportunity to compete for contracts that provide new renewable generation capacity. As per RenewableUK, the current pipeline of shovel-ready onshore wind projects stands at 3.4GW.

In June 2018, the UK Government eased restrictions and opened doors to onshore wind projects on remote islands such as the Outer Hebrides. It intends to legislate to differentiate remote island wind from other onshore wind farms so that they can compete in auctions for price support contracts. This provides a significant array of development opportunities for the onshore wind sector and subsequent industry participants.

With scale and technology efficiency, onshore wind in the UK emerged as the cheapest option in incremental power generation capacity. As recent announcements such as Vattenfall's 77MW extension project and EDF Renewables' 105MW project show, the deployment of new higher-rated turbines (over 5MW range) in the upcoming projects are increasingly competitive to UK wholesale power market prices at about £40/MWh (US$51.1/MWh). This makes such upcoming projects viable through the merchant corporate power purchase agreement route, thus obviating the need for subsidies.

Market Opportunity

There are indications that political support for onshore wind in the UK is set to change. In February 2020, the UK government unveiled a new proposal to allow onshore wind farms to compete in subsidy driven auctions under the contracts-for-difference (CfD) scheme in the next auction scheduled for 2021. This could attract institutional investors to invest in this sector as the risks related to developing onshore wind compared with offshore wind is comparatively lower. This new proposal has gained much appreciation from the renewable energy industry's trade associations.

Besides new projects, there is huge potential for repowering existing onshore wind projects. According to Energy UK, there will be many wind farms coming to their end-of-service life by 2020. There would be attractive opportunities for the investors to repower and refurbish existing turbines that are often located in the best, windiest spots.

Energy storage technology integration with wind energy is being assessed to understand the potential value of energy storage in the UK's wind energy sector to support renewable output in the future. A collaborative initiative has been driven by London-based Carbon Trust for energy storage that will help cut costs associated with integrating wind energy into the UK power grid.

Challenges

Although the UK government aims to achieve net-zero carbon emission by 2050, the lack of a detailed execution plan has failed to elicit sustained interest from investors. The newly elected Conservative government will be expected to provide more detail on their attempt to achieve such an ambitious target during the United Nations' COP26 climate negotiations in Glasgow at the end of 2020 to restore investor confidence.

Another key risk area for the UK wind industry is from local communities. The wind farm developers need to comply with strong new proposals on community consent to qualify for the auction process. Unless wind developers engage early and work closely with local communities to ensure that they have local support, wind project development will face major obstacles.

With a rise in the share of renewable energy, the dynamics of the wholesale electricity market are changing. As per the UK's National Grid Summer Outlook Report, UK's wind farms could be paid to switch off their turbines. This was reflected by the increased uptake of solar power through homes and businesses generating their electricity, and a boom in local solar farms. Also, UK's select key electricity transmission upgrades could be held up for planned EIB funding due to Brexit-related uncertainties. Such delays may affect transmission infrastructure preparedness for upcoming capacities.

Outlook

UK government's reversal of its earlier four-year ban on onshore wind farm subsidies points to an acknowledgement of the role of this energy resource in achieving the decarbonisation objectives. While the government has been focusing on offshore wind energy development as well, there is a realization that it won't be enough to meet emission targets.

As per the UK's Committee on Climate Change, the onshore wind power capacity needs to expand by about three times over the next 15 years to meet the country's climate change objectives at a feasible cost. It also helps that government surveys confirm general public support for the onshore wind farms. UK's next auctions are thus expected to drive onshore wind-based capacity, led by mostly Scotland. As per industry reports, this could be pipeline worth 4GW of capacity for auction-based bids.

Italy

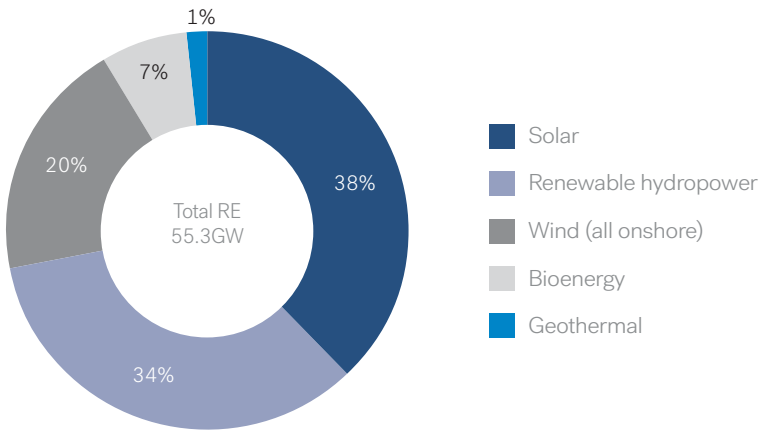
Over the years, Italy has been a major player in the onshore wind market in Europe and is positioned at fifth place in terms of cumulative installations following Germany, Spain, UK, and France. Onshore wind accounted for 19.5% of the county's renewable mix in 2019. Italy's share of onshore wind in Europe has increased from 6% in 2018 to 7.7% in 2019.

GDP (2019E) (Current Prices)	US$1,989 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	0.55%
Currency	EUR (€)
Country Credit Rating (S&P)	BBB
Renewable Energy capacity (2019)	55.3GW
Onshore Wind Share in Renewables (2019)	19%
Electric Power Consumption (2018)	5.2 MWh/capita
Renewable Energy Target	93.2GW renewable power generation capacity by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Italy

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

GDP (2019E) (Current Prices)	US$1,989 bn
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GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

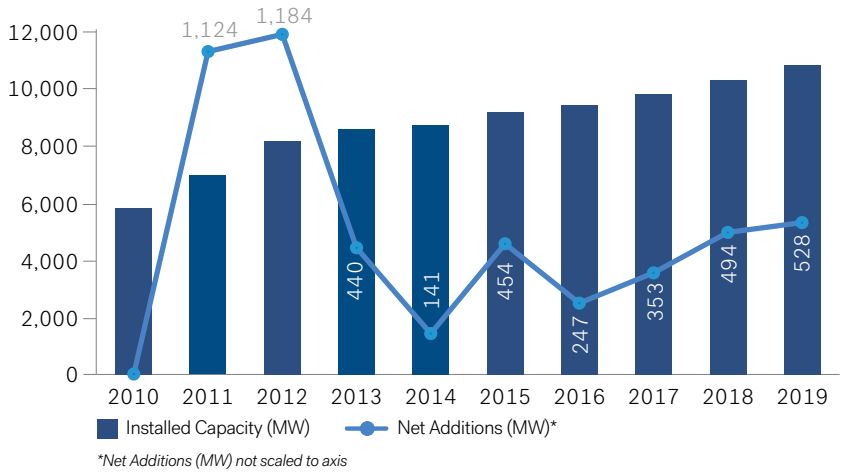
Italy's renewable energy market was decelerating since 2013. This was due to the expiry of the fifth Conto Energia feed-in tariff (FiT) programme which terminated all incentives. In 2019, the Italian Government signed a FER1 Decree that would provide new incentives of about €1 billion (US$1.1 billion) per year to renewable energy sources.

Under FER1 decree, the year 2019 marked the initiation of a seven-bidding round technology-neutral auction scheme run by Gestore dei Servizi Energetici (GSE). Capacity offered first two rounds stood at 500MW, followed by 700MW in the next three and 800MW in remaining two. The first auction was held in September 2019, comprising up to 4.8GW in new PV and wind power plants, 140MW of hydro, biomass, and geothermal plants, and 490MW repowering investments and a further 1.49GW for smaller plants.

Italy's wind and PV projects will be competing for the same incentive under its new auction scheme with project selection to be based on discount offered. Plants with a capacity more than 1MWp have direct access through a ranking system and plants with a capacity less than 1MWp must go through a reverse-auction system. This in turn could prove to be a problem for the wind industry as the installation, operation and maintenance cost for the industry is generally much higher than solar PV. However, it is expected that the levelized cost of wind and solar energy in the future may ensure a fair competition between the two technologies.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Italy added 528MW of onshore wind capacity in 2019, which is the highest in the last five years. Cumulatively the country added approximately 2GW of onshore capacity in the last five years. Capacity addition had contracted significantly after 2012 following the withdrawal of FiTs, bottoming out at 141MW in 2014. The onshore wind market in the country has been in recovery mode since 2016 with capacity addition progressively increasing every year.

10.8GW Onshore Wind Capacity

- ✓ **Provision of new incentives to accelerate expansion of renewable energy market**
- ✓ **Wind auctions have helped impart momentum to capacity expansion**
- ✓ **Strong growth potential in central and northern Italy where wind penetration is still low**
- ✗ Considerable risks associated with authorisation process
- ✗ Unfavourable legislation blocking repowering of legacy wind turbines
- ✗ Lack of unified authority to streamline the development and integration of renewable technologies

Demand Driver

Feed-in tariff (FiT) and Green Certificates were the main growth drivers for Italy's onshore wind market in 2008-2012 period. In Italy, the incentives programme is managed by the Gestore dei Servizi Energetici S.p.A. (GSE).

The proposed incentive of contracts for difference (CfD) for the auctions will help in insulating solar and wind plants from merchant and market risk and increase the predictability of cash flow. The auctioned projects will sell energy to the Gestore dei Servizi Energetici (GSE) at a "strike price," fixed on a nominal basis for 20 years. CfD will also help GSE to generate revenue reducing the risk of changes in the regulatory framework, compared to the 8% cut in the feed-in tariff applied in 2014. Although these measures will negatively affect the sponsors, it will help in stabilizing the market, reduce uncertainty and will uplift the morale of investors and industry operators. The scheme, approved by the European Commission will see up to €5.4 billion (US$6.1 billion) in incentives channeled towards PV, onshore wind, hydropower and others until 2021.

The first round of auctions was highly successful allocating 495MW in onshore wind and the 500MW tender being oversubscribed, attracting 595MW of total capacity across 26 projects. Keeping in mind the overwhelming success, the Italian wind energy association Anev urged the government to extend auctions to 2030, beyond the current deadline of 2021 calling for simpler permitting regulations.

Market Opportunity

The auctions came as a lifeline for the country's renewable expansion and are the first set of auctions for large-scale renewable energy projects since the closing of the FiT programme Conto Energia in 2013. The onshore wind market is slowly picking pace as the government focuses on providing new incentives and encourages new deployment. The government is also expecting that the scheme would facilitate the construction of new plants totaling 8GW with an estimated investment of €10 billion (US$11.6 billion).

Wind Europe expects Italy to install 3.2GW of onshore wind capacity between 2018 and 2022. A strong project pipeline and upcoming maintenance and repair requirements have supported both foreign and domestic investments. For example, in December 2019, Glennmont Partners bought a 36MW onshore wind farm in Italy. In January 2020, Enel Green Power was awarded 60MW of new renewable capacity for three wind projects, and 20MW from the repowering of already-operational wind and hydro projects. In February 2020, RWE announced the commercial operation of its largest 57MW onshore wind energy project in Italy.

Repowering of wind farms could be a major opportunity in Italy. Currently about 20% of the installed wind power capacity in Italy (approximately 2GW) is over 10 years old.

Italy's wind industry is heavily concentrated in the south and on its islands and the country's penetration wind level is way below EU average. The penetration peaks in some regions like Sicily, Apulia, Sardinia and in general in the South, while in the central regions of Latium and Abruzzo wind energy is largely underdeveloped. These untapped regions will pave the way for new installations and therefore translating to further investment opportunities.

Challenges

Onshore wind sector in Italy faces serious authorisation risks. There have been several cases under previous feed-in tariffs where irregularities were found in plant authorizations have resulted in incentive revocation. The GSE can also claim the reimbursement of all incentives already received by the project if authorization irregularities are found, which places the plants under significant risks even causing shutdown.

More than half of Italy's currently installed onshore wind fleet are about to reach the end of their operational life by 2030. Currently, repowering of wind farms is blocked by the spalma-incentivi volontario rule which forces wind farms to operate their existing wind turbines to their very end and prevents operators from replacing them with more efficient machines.

Italy lacks a unified authority which will coordinate permit decisions, simplify permitting and allow for new technology integration. Similarly, there is no support on the development of corporate renewable PPAs which can reduce the uncertainty about market volatility. While Italy has announced its intention to create a platform to negotiate long-term energy contracts, the Renewables Decree for the upcoming auctions provides no immediate measures to facilitate this.

Outlook

Overall, installations in 2020 are expected to slightly decrease due to aggressive lockdown measures inhibiting worker mobility but they will remain relatively high compared to historical levels. The year 2022 promises to be a record year, followed by an even stronger 2023 as the market gains momentum due to strong increases in expected installations. However, high uncertainty remains towards the end of the 5-year period starting 2020, particularly in onshore, where a stagnation of installations can be witnessed if the national authorities do not tackle spatial planning and permitting issues in an efficient and comprehensive manner.

In January 2019, the Ministry of Economic Development (MISE) presented Italy's National Integrated Plan for Climate and Energy 2030 which aims to reach a 30% share of renewable energy in gross final consumption by 2030 compared to 18.3% in 2017. In its draft National Energy and Climate Plan Italy has indicated its goal to reach 17.5GW of onshore wind capacity and 900MW of offshore wind by 2030. In 2030 renewables are planned to be producing around 186.8TWh of electricity, including 40.1TWh of wind power.

Sweden

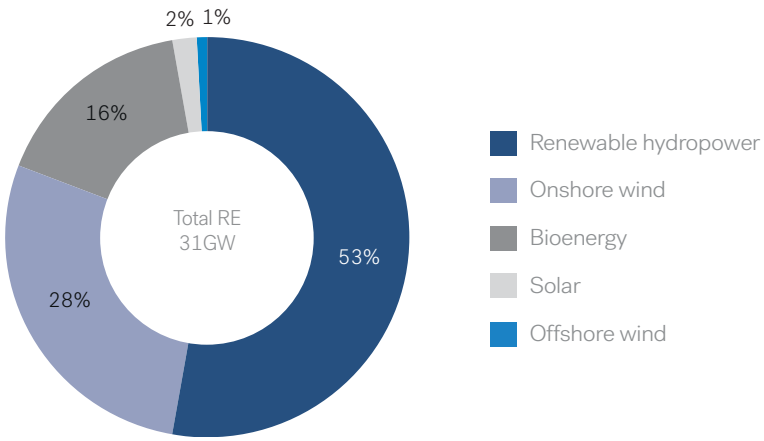
Sweden has emerged as one of the major markets for onshore wind in Europe, having installed ~1.6GW of wind capacity in 2019, the second-highest after Spain. 2019 was a record year for the Swedish onshore wind market as the country breached the 1GW capacity addition mark for the first time. At 8.7GW cumulative installed capacity, Sweden's onshore wind market is still a small one, accounting for only 5.3% of European onshore wind capacity in 2019. But there is significant growth potential as the country has set a target of increasing wind's share in the country's electricity generation to 30% by 2023.

GDP (2019E) (Current Prices)	US$529 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.73%
Currency	SEK (kr)
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2019)	31.0GW
Onshore Wind Share in Renewables (2019)	28%
Electric Power Consumption (2018)	13.3 MWh/capita
Renewable Energy Target	65% share of renewables in gross final energy consumption by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Sweden

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

GDP (2019E) (Current Prices)	US$529 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.73%
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Electric Power Consumption	13.3 MWh/capita
Renewable Energy Target	65% share of renewables in gross final energy consumption by 2030

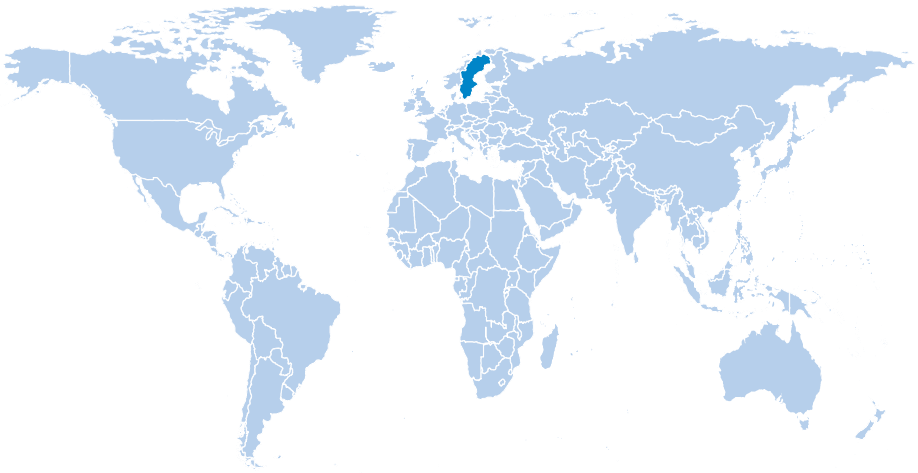
GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Sweden is one of the fastest-growing onshore wind energy markets in Europe, having installed 1,588MW of capacity in 2019, second highest in Europe after Spain. Also, 2,506MW in new wind turbine orders were placed during 2019. The Swedish Wind Energy Association (SWEA) has set a target of producing 44TWh of electricity from wind by 2023, more than double the 19.5TWh of electricity generated from wind turbines in late 2018. Sweden's policymakers see wind as an essential component of the country's energy strategy, along with hydroelectricity. There are natural synergies to be harnessed with hydroelectric reservoirs doubling up as energy storage units during periods of intermittent wind.

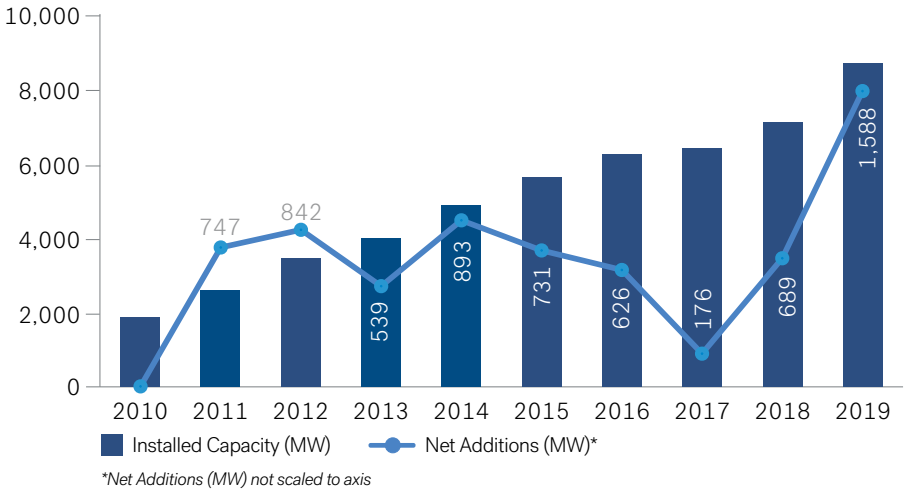
Despite strong public support for nuclear energy, the Swedish government has decided to phase out all nuclear power plants by 2040, the year when the country transitions to a 100% renewable-based electricity system. As such, Sweden has set a target of 50% share of renewables in gross final energy consumption in 2020, which increases to 65% by 2030. SWEA estimates a cumulative installed capacity of 25GW wind power by 2040, two-thirds of which will be onshore wind.

The pickup in wind capacity buildout in Sweden can also be explained by the planned phaseout of subsidies for onshore wind farms by the end of 2021. This is in line with the broader shift seen in developed markets towards a subsidy-free, merchant PPA based business model. Developers are rushing in to take advantage of the prevailing certification subsidy scheme. Beyond 2021, there might be a loss in momentum in capacity addition unless the government offers alternate policy support which will sustain growth.

Onshore Wind Capacity



Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Annual onshore wind capacity addition has progressively accelerated since 2017, with 689MW and 1,588MW being added in 2018 and 2019 respectively. Sweden was the second-largest country by onshore wind capacity addition after Spain in 2019. The country accounted for 18% of the 8.8GW onshore wind capacity added in Europe during the year. With 2,506MW in new wind turbine orders placed during 2019, the Swedish onshore wind market seems positioned to add 1.5-2.0GW annually over the next couple of years.

8.7GW Onshore Wind Capacity

- ✓ **Long-term sustainability goals call for wind power to be developed to complement the hydropower-based energy mix**
- ✓ **Strong merchant PPA market**
- ✓ **Significant export potential**
- ✗ Exhaustive permitting process that can be time consuming
- ✗ Loss in growth momentum following withdrawal of subsidy scheme in 2021
- ✗ Emergence of offshore wind as a competing technology

Demand Driver

The Swedish government's target to achieve 100% renewables-based electricity system by 2040 remains the biggest driver for the onshore wind industry. This would entail having a cumulative wind capacity of 25GW across offshore and onshore wind technologies by 2040, generating 90TWh of electricity, which is almost 5x increase over the 19.5TWh generated in late 2018. Onshore wind is expected to account for two-thirds of the electricity generated over the projected period.

The impending withdrawal of the certificate-based subsidy scheme for onshore wind projects by the end of 2021 has also triggered a wave of wind capacity buildouts. Developers and investors have hastened to set up as much wind capacity as possible to take advantage of the subsidy scheme. Sweden has lined up €2.3 billion (US$2.7 billion) for the construction of 2GW of onshore wind farms in the wake of increased investor interest.

Favourable price dynamics have been critical to the expansion in the use of onshore wind-based power. Technology developments have contributed to a 50% decline in the cost of onshore wind power in the last 10 years and wind power projects in Sweden can now be built without subsidy support.

Electricity consumption in Sweden is expected to increase, despite the development of energy efficiency technologies. The increasing use of electricity in heating, as well as the expansion in the electric vehicle market, are major drivers of electricity consumption. An overall EV share of 26% in the country implies the need for a robust charging infrastructure which will, in turn, drive demand for battery-based storage and renewable-based power. Furthermore, Sweden's abundant land availability, especially in the northern region, enables easier accommodation of additional wind power generation capacity.

Market Opportunity

Sweden is evolving into a major technology hub in Europe, with several data centre and IT companies setting up base, attracted by the abundance of cheap electricity and the predominance of renewable energy sources. Environmentally conscious companies that work towards carbon neutrality and espouse sustainability as a cornerstone of corporate policy are keen to enter into long term corporate PPAs to further their environmental goals. Google, IKEA and other large corporates have signed several PPAs in Sweden. This trend is picking up in the manufacturing space as well with aluminium major Norsk Hydro signing a 19-year PPA from the Markbygden wind farm in northern Sweden in November 2017, one of the world's largest corporate wind PPAs. The term of such agreements is normally between seven to 20 years. PPAs are expected to sustain market momentum after 2021 when the prevailing subsidy support mechanism lapses.

Sweden's energy mix is skewed towards hydropower and this can be leveraged to develop the onshore wind power industry. Wind and hydro in combination with maximized electricity import, cogeneration, and gas turbines could cover Sweden's peak power demand. But there are infrastructural limitations in terms of grid capacity and energy storage, both of which need to be expanded to capitalise on the opportunity. Repowering represents another major opportunity, especially in southern Sweden as most of the wind farms would have reached the end of their technical lifespans.

Lastly, Sweden has surplus power and is a major energy exporter. The expansion of wind power leads to large and immediate reductions of carbon emissions, through Swedish electricity export replacing fossil-based power generation in neighbouring countries. It also enables creating margins for electrification in Sweden.

Challenges

The permitting process for wind projects in Sweden is an exhaustive and time-consuming one. In total, the time taken from initial consultation to environmental permit can exceed 10 years. Legal firm Fröberg & Lundholm, appointed by the SWEA, found that 76% out of roughly 2,500 projects between 2015 and 2018 were rejected. The possibility of a military veto, as seen in the case of offshore wind, also represents a major a roadblock to the development of the onshore wind industry.

The number of ideal sites with the maximum potential for wind generation is declining rapidly as the market approaches saturation. Also, grid connections are a major challenge to the development of the onshore wind market. It can take more than two years to be notified whether it is possible to establish a connection, between the wind farm and the national grid.

Outlook

Sweden has set a target to achieve 25GW of installed wind capacity, including onshore and offshore wind, by 2040 to realise its goal of achieving a 100% renewables-based electricity system. In the short-term, the SWEA is projecting onshore wind capacity addition, increasing it to 1,899MW in 2020 and 2,158MW by 2021, before the certificate-based subsidy regime ends. The country is aiming to generate 44TWh electricity from wind, accounting for 30% of the country's total electricity production. Besides hydropower, the wind is likely to develop as a critical source of energy in Sweden.

Turkey

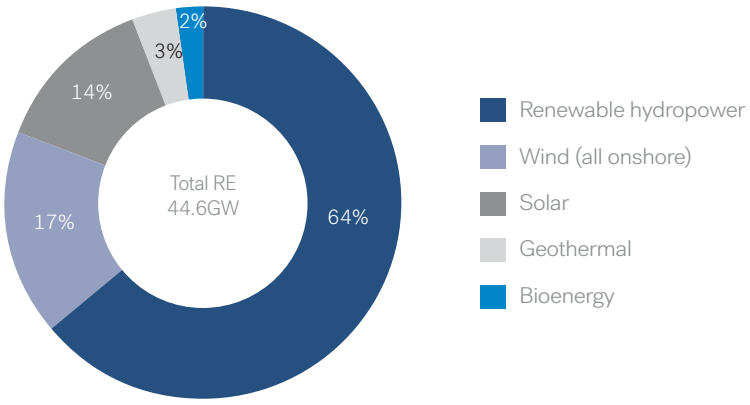
The energy sector in Turkey has experienced significant growth in the last 10 years. Although the ongoing financial and economic crisis has negatively impacted Turkey's previously flourishing domestic wind energy market, the market development is expected to pick up pace in coming years on the back of favourable reforms and increased funding help for the construction of wind farms.

GDP (2019E) (Current Prices)	US$743.7 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	2.7%
Currency	Turkish lira (TRY)
Country Credit Rating (S&P)	BB-
Renewable Energy capacity (2019)	55.3GW
Onshore Wind Share in Renewables (2019)	17%
Electric Power Consumption (2018)	3.4 MWh/capita
Renewable Energy Target	50% of electricity production from renewable energy sources by 2023

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Turkey

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

GDP (2019E) (Current Prices)	US$743.7 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	2.7%
Currency	Turkish lira (TRY)
Country Credit Rating (S&P)	BB-
Renewable Energy capacity (2019)	55.3GW
Onshore Wind Share in Renewables (2019)	17%
Electric Power Consumption	3.4 MWh/capita
Renewable Energy Target	50% of electricity production from renewable energy sources by 2023

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

With 7,591MW of installed capacity in 2019, Turkey has become the seventh-largest market for onshore wind energy in Europe. Wind energy in Turkey met 7.42% of the country 's electricity needs, with a total production of 21.508 billion kWh in 2019. Turkey's wind energy sector attracted US$12.3 billion in investments over the past 11 years and presently contributes 8% in the country's total power generation.

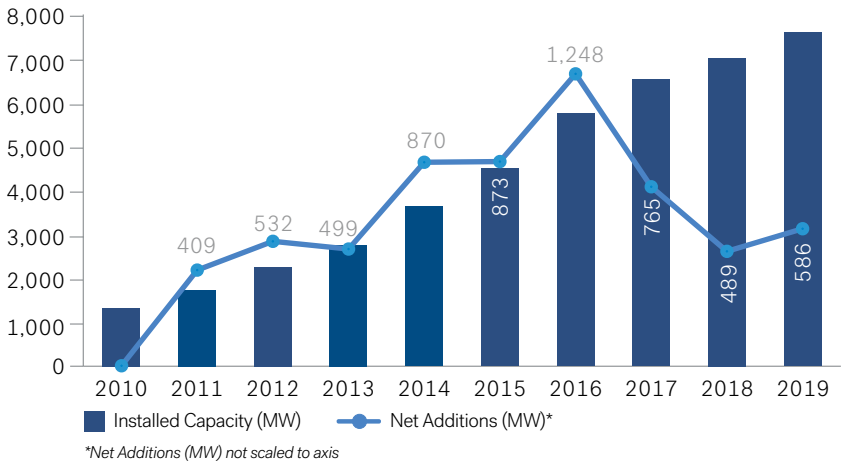
According to the Turkish Ministry of Energy and Natural Resources, the country's potential wind power generation capacity is 48GW. The area corresponding to Turkey's wind energy potential amounts to 1.3% of total surface area, thus indicating an advantageous geography for efficient wind energy use.

Turkey is increasingly sourcing renewable energy for its requirements and aims to reach 16GW of installed capacity in wind energy by 2023. As per the Turkish Wind Energy Association (TUREB), a total of US$650 million was invested in Turkey's wind energy sector to add 489MW of installed capacity in 2018.

The wind energy market has also benefitted from the country's allocation of US$23 billion for electricity distribution and privatization over the last decade. Capacity addition has moved apace despite political/civil unrest in the country.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Turkey has taken significant steps towards renewable energy adoption since the early 2000s. While the country's installed capacity in onshore wind energy was 19MW in 2002, it increased to 364MW in 2008 and ~7.6GW presently. An average of 697MW onshore wind capacity was added annually during the past decade. In 2019, annual capacity addition was 586MW, which represented a ~20% increase over previous year, though below the long-term average.

Investor interest in Turkey's onshore wind industry was evident in the country's first energy auction conducted in August 2017. In the auction system known as "Yeka", eight of the top 10 global turbine manufacturers participated. Turkey recently called another tender (YEKA Wind Energy Plant-2) for 1GW (4x250MW) onshore wind capacity with the ceiling price of $0.055/kWh. Enerjisa and Enercon each won two wind power plants with an average bid of $0.039/kWh and a 15-year power purchase contract.

7.6GW Onshore Wind Capacity

- ✓ **Financial support provided by the government to construct wind farms**
- ✓ **Goal to have at least 25GW of installed wind capacity by 2030, from ~7.6GW in 2019**
- ✓ **Allocation of $23 billion for electricity sector reforms**
- ✗ Over reliance on oil and gas imports for energy needs
- ✗ Ongoing financial and economic crisis
- ✗ Depreciating local currency has acted as a deterrent to foreign investors

Demand Driver

The onshore wind energy market in Turkey is mainly driven by legislative reforms and financial support from the government. Most significant was the issuance of new Renewable Energy Resource Area (YEKA) regulations in 2016, which seek to catalyze renewable energy development by streamlining the tender processes, opening up new land for project development and incentivizing local manufacturing of renewable generation equipment.

FiT for onshore power plants has been set at 7.3 cents/kWh for 10 years which gives long-term visibility to the investors. An additional incentive of 3.7 cents/kWh for five years is available for producers using locally manufactured components. Wind power producers also have the liberty to sell to the national power pool or engage in the bilateral power purchase agreement.

According to Turkey's Energy Exchange Istanbul (EXIST) data, Turkey's clean energy generation received around TL 5.2 billion (nearly US$760 million) in incentive payments in May 2020 through the Renewable Energy Support Scheme (YEKDEM).

Also, there is an 85% discount on the consideration for the lease, right of use or the right of easement on the state-owned land to be used for transport and transmission after prior approvals have been obtained. The discount will be allowed during the first 10 years of the wind farm being commissioned. These incentives are, however, applicable for capacities that commence operation before December 31, 2020.

Financial support also includes tax incentives in renewable investment, and exemption from VAT, Customs Tax, Resource Support Utilization Fund payments in imports.

Market Opportunity

The Energy Market Regulatory Authority (EMRA) plans to issue 2GW of preliminary licenses for wind power plants in October 2020. However, EMRA has delayed the process for six months from April 2020 to October 2020 due to the COVID-19 pandemic. The capacity is expected to create an investment worth US$2 billion. The country has set a target of reaching 16GW of onshore wind capacity by 2026.

The recent announcement from the government to run the small-scale YEKA auction for onshore wind in the first quarter of 2020 brings in new opportunities for a wider base of investors to bid for small-scale projects, each capable of generating between 10MW to 40MW of power, to be installed in close to 40 provinces across Turkey.

According to the TUREB, the government will contribute around €15 billion (US$17.4 billion) for the construction of wind farms in the next three years. This will stimulate the development of renewable energy sources, support green technologies and reduce dependence on external electricity suppliers. Investment is also earmarked for augmenting power transmission infrastructure to accommodate upcoming wind power generation. It is estimated that the wind power industry will receive US$4 trillion investment by 2050.

Challenges

In terms of legislative challenges, the FiT duration of 10 years and a FiT rate of 7.3 cents/kWh, determined by the government is lower than many other countries. This might discourage foreign investors to enter the Turkish market for new projects.

The ongoing Turkish financial and economic crisis has negatively impacted Turkey's domestic wind energy market and has caused a rise in electricity rates by almost 30% during 2019 and 307% since 2003. With the rise in price, now users have to pay around US$14 for 100 kWh. The COVID-19-driven economic slowdown since the start of 2020 led the local currency depreciate sharply, which will discourage foreign investors from local currency denominated transactions. Besides, the market faces infrastructural challenges in terms of technical difficulties in the transmission network. The current transmission capacity is not adequate to connect the entire power production to the grid.

Turkey exhibited the highest average energy demand growth of all OECD countries over the past 15 years. There is a need for baseload energy generation, that is generally met through conventional resources. This acts as a key barrier to Turkey's 2023 renewable goal of generating 50% of its electricity from clean sources.

Outlook

The COVID-19-led economic downturn since the start of 2020 hit the power sector heavily as there are concerns about the way the power sector will be exposed after the sharp decline in demand and prices of electricity. However, the share of renewable energy resources in Turkey's total electricity demand will increase, particularly, solar and wind, as power plants that operate on natural gas and imported coal may fail to have a business case.

The FiT and incentive related to local equipment have been extended till 2020 but how this support mechanism will be regulated after 2020 is still a big question. Most developers are currently holding off because non-Turkish commercial banks are waiting for the normalization of the economy and for the government to define the post-2020 auction scheme.

The European Bank for Reconstruction and Development (EBRD), a staunch supporter of the project in Turkey and the region, reiterated its commitment to continue funding Turkish renewable projects. In January 2020, EBRD approved a US$37 million financing deal for the development, construction, and operation of an additional capacity of 72MW to the existing 28MW Kiyikoy wind farm.

Poland

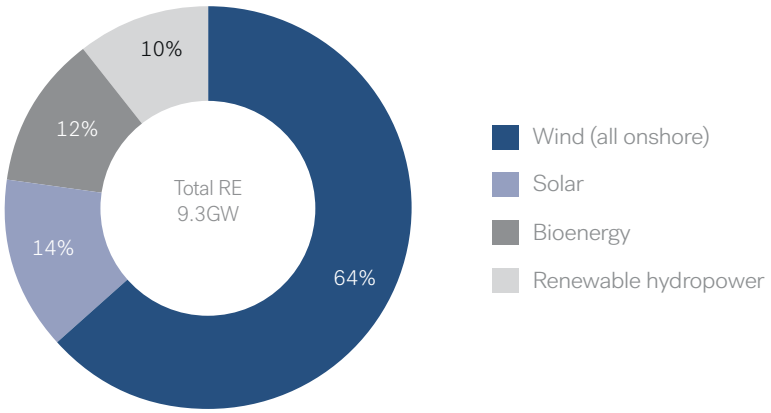
Poland witnessed a resurgence in the onshore wind industry in 2019, ending the decade on a strong note. The country held the largest European dedicated onshore wind auction ever with a total volume of 2.2GW. Poland added ~151MW of onshore wind capacity in 2019, marking a return to growth after two years of negligible capacity addition. The country has 5.9GW of cumulative onshore wind capacity, which accounts for almost 63% of its overall renewable energy installed capacity.

GDP (2019E) (Current Prices)	US$566 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	2.88%
Currency	Polish złoty (zł)
Country Credit Rating (S&P)	A-
Renewable Energy capacity (2019)	55.3GW
Onshore Wind Share in Renewables (2019)	63%
Electric Power Consumption (2018)	4.3 MWh/capita
Renewable Energy Target	23% of final gross energy from renewable energy sources by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Poland

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

GDP (2019E) (Current Prices)	US$566 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	2.88%
Currency	Polish złoty (zł)
Country Credit Rating (S&P)	A-
Renewable Energy capacity (2019)	55.3GW
Onshore Wind Share in Renewables (2019)	63%
Electric Power Consumption	4.3 MWh/capita
Renewable Energy Target	23% of final gross energy from renewable energy sources by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

The energy sector in Poland is traditionally based on fossil fuel - hard and brown coal. In terms of the renewable energy mix in Poland, onshore wind energy is the leader accounting for 64% of the 9.3GW installed capacity in the country in 2019.

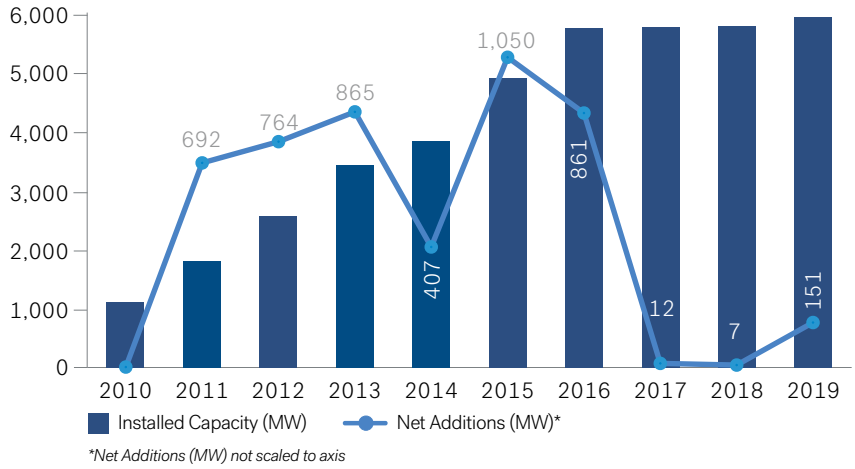
The development of the onshore wind industry in Poland has been lumpy, owing in part to inconsistent policy formulation. In January 2019, the Ministry of Energy presented the draft Energy Policy of Poland, which stated that all existing wind turbines would be scrapped by 2035, with the ones just contracted by the government a few years later. At that time, Poland was the only country in Europe that announced complete elimination of the technology and scrapping of the entire infrastructure left after the decommissioned turbines.

This was followed by a revision to the country's renewables legislation in July 2019, which paved the way for a 2.5GW onshore wind auction towards the end of the year. The 2.2GW of onshore wind capacity tendered in the auctions held in December 2019 marked the largest European dedicated onshore wind auction ever. This highlighted the strong growth potential of the Polish onshore wind energy market.

The Polish government has set ambitious targets aiming to double the share of renewables in the country's power mix to 39% by 2030. Estimates indicate that Poland has an onshore wind potential of roughly 21-23GW by 2030 and 36GW by 2040. Achieving the 2030 target would entail adding ~1.7GW of capacity every year, requiring a massive boost over current levels.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Onshore wind capacity addition in Poland has been irregular, peaking at ~1GW in 2015, followed by a steep decline in subsequent years. Only 12 and 7MW capacity was added in 2017 and 2018 respectively, as the regulatory environment ceased to be supportive. Capacity addition progressively declined from 2016 because of the enacted legislation which deterred shovel-ready projects from reaching construction and blocked new wind farm development.

As per the law, minimum distance between a wind power plant and any building or naturally protected site must amount to 10 times the turbine height from the ground level to the highest point of the structure including technical elements. Very few sites in Poland meet such criteria restricting development of new projects. However, the regulatory environment is seemingly improving and that was evident from the 151MW of onshore wind capacity added in 2019 and the success of the 2.5GW onshore wind auction, the largest ever in Europe.

5.9GW Onshore Wind Capacity

- ✓ **Impending removal of legislative bottlenecks such as the 10H rule**
- ✓ **Steep decline in wind power prices that have helped spur increased take-up**
- ✓ **Strong investor interest as evident from the record-setting wind auction in December 2019**
- ✗ Government's ambivalence in committing to EU-mandated decarbonisation goals
- ✗ Modernising a coal-based power grid to be flexible enough to absorb variable renewable power
- ✗ Emergence of offshore wind as a competing technology

Demand Driver

Demand for onshore wind energy market in Poland was initially driven by the regulatory reforms such as the green energy certificate, which was the backbone for renewable energy market in Poland from 2000 to 2015. Recently, The Ministry of Energy issued the draft RES Act Amendment according to which, the auction support system shall be prolonged from 31 December 2035 until 30 June 2039. Therefore, the last possible date for entry into the support system to achieve 15-year support is 30 June 2024. Consequently, the renewable energy auctions including onshore wind should be continued at least till 2021. The Polish Wind Energy Association (PWEA) has requested the government to extend the auction support scheme for renewables by five years at least to 2026.

The Polish government had budgeted $4.43 billion to support the 2.2GW of wind capacity auctioned in December 2019. Besides this, the Polish government is contemplating removing the controversial 10H rule from January 2021, which has been instrumental in blocking further development of new onshore wind projects in the country.

Price for onshore wind fell substantially in recent years. The average bid price for onshore wind in the December 2019 auctions was below 200 PLN/MWh (US$51.1/MWh), lower than the wholesale electricity price of 220 PLN/MWh (US$57.3/MWh), thus emerging as the cheapest electricity source in the country. This has been a major enabling factor in the government's decarbonisation goals. Onshore wind investors are increasingly willing to explore market mechanisms for development of the market, shifting away from the prevailing auction support scheme.

Market Opportunity

Poland is looking to decommission almost 20GW of fossil fuel-based generation assets by 2035. Renewables are expected to bridge a major part of the ensuing capacity gap, with wind, which accounted for ~65% of renewable installed capacity in Poland in 2019, expected to play a key role. It is estimated that Poland has an onshore wind potential of 21-23GW by 2030 and 36GW by 2040.

Polish wind developers currently hold a total of around 3.4GW of ready-to-build onshore wind projects and have already spent around €500 million - €700 million (US$639.5 million - US$814.0 million) to develop that potential. Once these projects get the approval, they are going to bring attractive opportunities for investors and O&M operators.

Subsidy-free projects are beginning to appear in the horizon. In November 2019, Polish utility Polenergia launched the construction of the 38MW Szymankowo wind farm, the country's first subsidy-free renewable energy project. Poland is planning to develop wind energy without future subsidies through long-term green PPAs between a customer and a vendor. The PPAs would be instrumental in securing investments in renewable energy sources for financial institutions, which would make the onshore wind sector less risky for the investors. Several PPAs have been signed in recent times, Orange Polska S.A., Asahi Breweries Europe and Mercedes Benz being key examples.

Challenges

The absence of a consistent policy framework for renewables has been a key challenge to renewable investors in the country. There have been mixed signals from Warsaw, with the country being the only EU state to commit to climate neutrality by 2050. In contrast, several initiatives are being taken to remove the legislative bottlenecks that have been holding up development of the industry, besides investing heavily to promote the offshore wind sector.

The last few years have seen onshore wind development being stalled completely by the 10H rule, that stipulated the construction of wind turbines at a distance less than tenfold their tip height, which means that only the 1990s-sized turbines may be built in Poland. Modern, tall wind turbines could be built only on farmland with no residential houses within 2 km, which is almost impossible in the country.

The Polish electricity grid also needs to be expanded and modernised to accommodate higher generation from variable renewable sources. The existing electricity grid is primarily based on coal-based generation, which untill recently accounted for 80% of the power generated in the country. Corresponding investments in energy storage infrastructure needs to be made to support higher penetration of renewable generation assets.

The decreasing profitability and increasing risk have made funding difficult. The level of own contribution required by the banks has risen to above 50% in many cases. Also, investors have become increasingly cautious about their participation in wind power projects, and many of them have completely given up funding of the projects.

Outlook

After a few years of stagnation, there is well-grounded optimism for the dynamic development of onshore and offshore renewable energy sources. Policy makers are taking steps to remove critical bottlenecks such as the 10H rule that should restore momentum to onshore wind capacity expansion.

Following the auctions held in 2018 and 2019, nearly 3.2GW of new onshore wind capacity was contracted which will take the cumulative installed capacity beyond 9GW. Added to this, the offshore wind potential in Baltic Sea is tentatively estimated to be 12-14GW, making wind one of the primary sources of energy in Poland.

Portugal

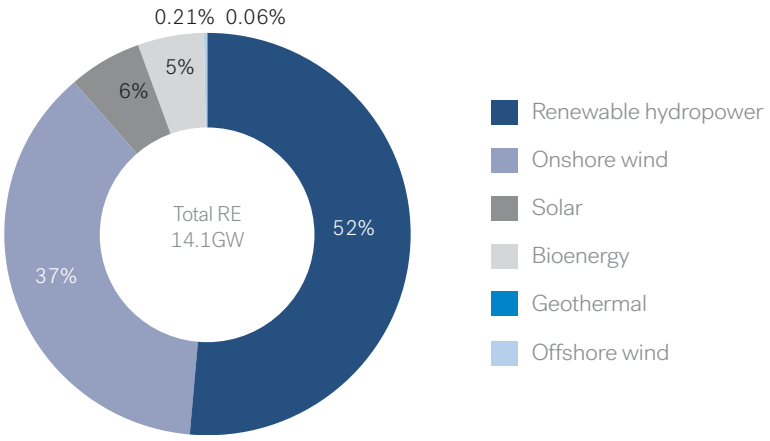
In Portugal, renewables account for two-thirds of all the generation capacity installed in the country. As per the Portugal government's Renewable Energy Action Plan, by 2030 the country aims to achieve 80% of its gross electricity consumption from renewable sources, with an anticipated increase by 2x in installed capacity up to 28.8GW, compared to 14.1GW in 2019. Currently, onshore wind is responsible for 27% of Portugal's electricity consumption, the third-highest in Europe after Denmark and Ireland.

GDP (2019E) (Current Prices)	US$236 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	1.59%
Currency	EUR (€)
Country Credit Rating (S&P)	BBB-
Renewable Energy capacity (2019)	14.1GW
Onshore Wind Share in Renewables (2019)	37%
Electric Power Consumption (2018)	5.1 MWh/capita
Renewable Energy Target	47% renewable energy share by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Portugal

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

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GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Wind energy is a significant source of power in Portugal. Since Portugal has no proven oil and natural gas resources, dependence on renewable energy is important for the country.

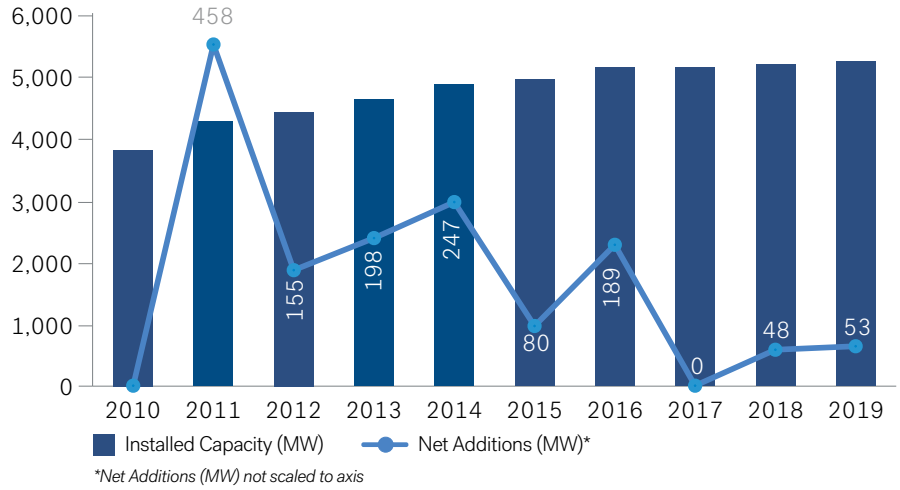
In May 2020, renewable energy sources accounted for 71.6% of the electricity generation mix in Portugal, in line with the national target of reaching carbon neutrality by 2050. The total installed onshore wind power capacity at the end of 2019 was 5,225MW. With strong potential for attracting investment in the country, Portugal has already invested €650 million (US$727.7 million) in the wind and solar industry.

Though the potential of onshore wind energy in Portugal is quite high, more than half of it is already in use. The sites which are still untapped, are constrained by environmental or land planning constraints and lack of grid infrastructure. Moreover, Portugal has almost reached its 2020 target of having 5.3GW of onshore wind installed capacity with the existing wind power facilities setting new records in terms of both, the peak wind contribution and the maximum daily penetration. It validates the Portuguese aim to achieve 100% of its total power demand from renewable energies by 2050.

The principal instrument for promoting renewable electricity was the special production regime, whereby renewable energy benefitted from a feed-in tariff (FiT). In 2013, the FiT for large-scale power projects was removed. Currently, the last renewable energy projects with guaranteed remuneration via FiTs are now nearing completion, and no new incentive schemes have been approved thus far for new wind farms.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Portugal added around 516MW of onshore wind installed capacity between 2014 and 2016, a 36% decrease compared to cumulative additions in 2011-2013. Trend-wise, average capacity addition equalled around 220MW in the six years between 2011-2016. Since then, the average declined to ~34MW during 2017-2019. The country's withdrawal of tariff support for onshore wind projects has been a major factor driving the decline in net capacity addition. In 2019, 53MW onshore wind capacity was added, highlighting the industry's continued stagnation.

5.2GW Onshore Wind Capacity

- ✓ **Ambitious commitments to achieve carbon neutrality by 2050**
- ✓ **Establishment of a new value for the maximum tax depreciation of wind through implementation of Green Tax**
- ✓ **Planned auction-based capacity allocation**
- ✗ Drop in electricity consumption owing to stagnant economy
- ✗ Removal of FiT for utility-scale power
- ✗ High grid-connection expenses

Demand Driver

Ambitious decarbonisation goals and supportive policy framework bode well for the onshore wind industry. The Portuguese government aims at sourcing 80% of total electricity generation from renewable energy resources by 2030. Achieving this entails an estimated 30.5GW-32.0GW of additional capacity will need to be installed during this period, of which 9.3GW is expected to be based on wind power.

Green Tax implemented in 2015, establishes a new value for the maximum tax depreciation of wind and solar technologies. The new value has been set at 8%, which represents twelve and a half years (minimum is twice this value). The proposal of reducing 50% of the Municipal Real Estate tax (IMI) for renewable energy power-producing buildings was accepted in 2015 and will be carried out within five years. This was a significant step in reducing the cost of power projects and will drive investors to the wind power sector.

Under the new government legislation, the project operators would be able to add turbines up to 20% of the grid connection capacity at existing wind farms without regulatory permission. The new plan aims to boost the wind capacity while protecting consumers by setting a fixed 15-year tariff of €45/MWh (US$50.4/MWh) for the additional electricity generated.

Market Opportunity

Portugal aims to hold two auctions per year, which is expected to attract interest from global players, especially for merchant-based projects. A capacity-based auction market will be launched for renewable energy resources, as per decree-law 215-B/2012 which will bring further opportunities. The decree imposes an obligation to purchase all the electricity generated by renewable sources during the period it benefits from FiTs.

The new energy and climate plan will establish a minimum mandatory renewables capacity total, which will have a significant impact in terms of providing an impetus for energy reform. Investor confidence will also improve from the fact that the proposed energy reform seeks to achieve a satisfactory balance between producer and consumer interests regarding the length of the contracts.

The Iberian Peninsula's wind power potential is untapped due to transmission bottlenecks. A new strategy on renewable energy and energy efficiency has focused efforts on meeting national and European energy policy objectives. The strategy includes proposals to reinforce interconnections with transnational European electricity network, to reach a 10% share of electricity interconnection capacity in total installed generating capacity by the end of 2020 as planned by the European Council. It brings new opportunities for producers to sell energy during low consumption periods in Portugal.

In the absence of government subsidy schemes, an increasing focus on renewable installation in the country has progressed the PPA market. Without the dependence on government subsidies, developers are tempted to explore options to enter into fixed-price arrangements to ensure price certainty and bankability of projects.

Challenges

In 2013, the FiT for large-scale power was withdrawn. Renewable energy resources currently have no incentive in place. They were integrated with the regular electricity market. As per a decree published by the power ministry in 2017, renewable energy producers have to repay any financial support received in addition to the FiT in the National Electricity System, amounting to US$166 million.

The government has also shifted its focus from conventional renewable sources to emerging renewable technologies like offshore wind. In the absence of any support mechanism, the onshore wind might take a backseat with increased competition from offshore wind and other non-conventional renewable sources.

The increasing share of renewable electricity decreased the daily marginal spot price significantly. The current spot price is so low that it does not cover the real costs of generation of any kind of technology, whether renewable or conventional. The Iberian marginal price-setting mechanism is creating volatile market conditions which does not produce a predictable and stable climate conducive to investment.

In Portugal, foundation and grid connection expenses are higher than other countries. It is approximately 32% of the total turbine expense compared to Germany (24%), Italy (21%) and Denmark (16%). It is a considerable hindrance in the development and expansion of wind resources in the country for the industry developers.

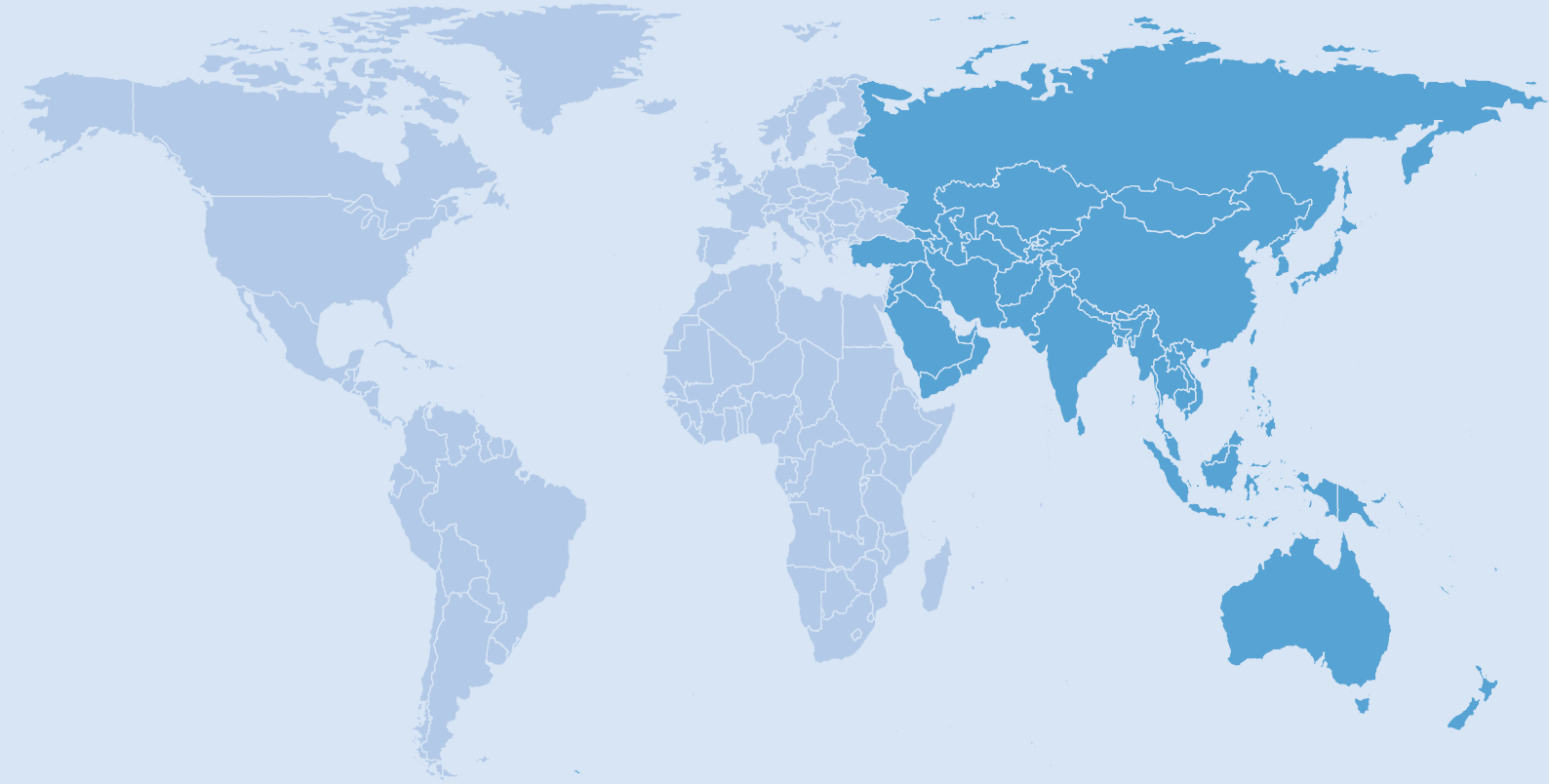
Outlook

According to the Portuguese National Plan for Energy and Climate, the country aims to achieve a 52% reduction in CO2 emissions by 2030. The national target for wind power capacity is about 9.3GW, to be reached by 2030. This target includes repowering, overcapacity and new wind parks.

Portugal anticipates a drop in energy prices in real terms between 2023 and 2025. The main reason for the decline is the assumption for the growth of 15GW of installed capacity in wind and solar capacity by 2025 over other energy sources.

Portugal needs to invest around €20 billion (US$23.3 billion) to reach its target of becoming carbon neutral by 2050. Grid integration will be a critical element for developing wind power. The sector will benefit from the fact that smart grids are promoted and deployed throughout Portugal as part of the National Energy.

ASIA-PACIFIC



China

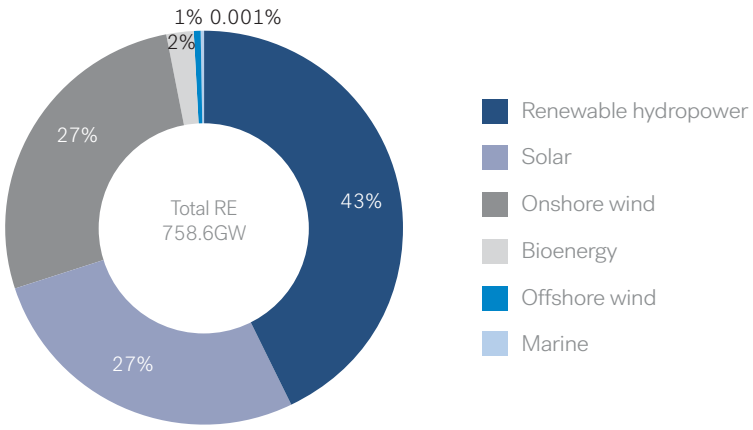
Sustained government support has propelled China to the pole position in the global wind energy industry, helped in part by a robust manufacturing ecosystem that has been delivering indigenously developed turbines to large scale wind projects since 2006. The country had an installed capacity of 204GW of onshore wind, accounting for 34% of global onshore wind capacity in 2019.

GDP (2019E) (Current Prices)	US$14,140 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	5.78%
Currency	CNY (¥)
Country Credit Rating (S&P)	A+
Renewable Energy capacity (2019)	758.6GW
Onshore Wind Share in Renewables (2019)	27%
Electric Power Consumption (2018)	4.9 MWh/capita
Renewable Energy Target	35% share of renewables in electricity consumption by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

China

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

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Renewable Energy capacity (2019)	758.6GW
Onshore Wind Share in Renewables (2019)	27%
Electric Power Consumption (2018)	4.9 MWh/capita
Renewable Energy Target	35% share of renewables in electricity consumption by 2030

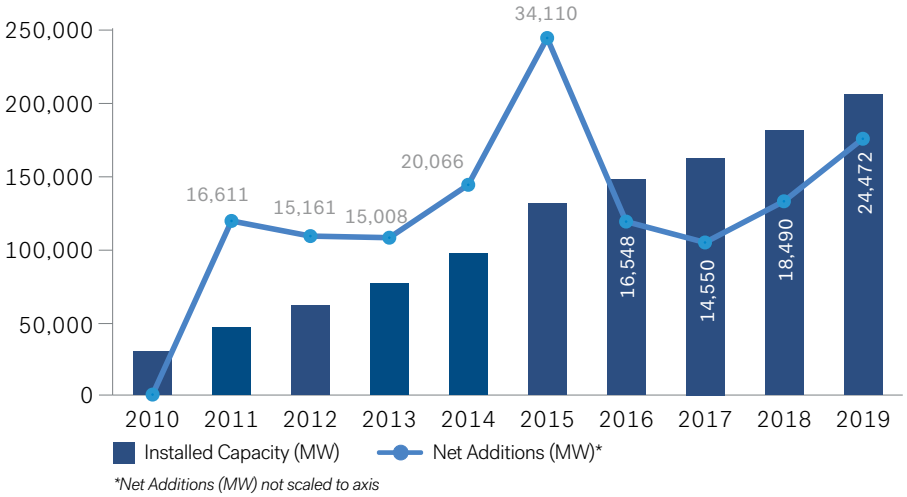
GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

The initial push for wind market development came in 2007 when the National Development and Reform Committee 's Medium and Long-Term Development Plan allocated about US$250 billion for development of new energy including wind power. In 2009, China introduced FiT for wind power which was a major driver for growth in the period of 2010 to 2012. Additionally, industry players were entitled to favorable tax deductions and, in some cases, exemptions. However, subsidy-free renewable energy development is gaining momentum in the country. In May 2019, China's National Development and Reform Commission (NDRC) gave the go-ahead to c.21GW of renewable energy projects which was to be developed without government subsidies. Of the total, 56 projects are for wind farms with a combined capacity of 4.5GW.

The Renewable Energy Development Fund (REDF) subsidizes the FiTs for wind power projects. However, in order to reduce subsidy pressure on the central government and reach grid parity (zero-subsidy) by 2020, the National Energy Administration (NEA) replaced the FiT scheme for future wind projects with the launch of the auction mechanism in July 2018. Also, The Chinese National Development and Reform Commission (NDRC) showed a clear roadmap in May 2019, in which projects already approved until 2018 will continue to receive FiT if they are grid-connected before the end of 2020, whereas projects approved in 2019 and 2020 will enjoy the 2019 FiT and 2020 FiT respectively if they are connected to grid by the end of 2021. Starting from 1 January 2021, all newly approved onshore wind projects shall reach the grid parity (zero-subsidy).

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Since 2011, China has been adding on an average 19GW of onshore wind capacity. Following a record installation of 34GW in 2015, the installed capacity of wind power projects dropped in the next 2 years driven by impending feed-in tariff reductions. However, the installations regained momentum in 2018 with the nation's clean and low-carbon energy strategy settling into place. Onshore wind capacity expansion further picked momentum from 18.5GW in 2018 to 24.4GW in 2019 as the government lifted development bans in certain regions in response to relaxing curtailment levels since 2016. Notably, China ordered 50GW of wind turbines for both onshore and offshore projects in 2019, which is 39GW more than the 2018 figure.

204.5GW Onshore Wind Capacity

- ✓ Rapidly expanding domestic manufacturing ecosystem
- ✓ O&M market opportunity which is expected to surpass $5 billion by 2029
- ✓ Opportunity in repowering
- ✓ Issuance of green certificates
- ✗ Insufficient grid interconnection capacity resulting in grid curtailment
- ✗ Supply chain disruption due to COVID-19 pandemic will lead to project delays

Demand Driver

Economies of scale have led to cost rationalization. Despite FiT cuts since 2014, the onshore wind growth has been stable due to the continued reductions in installation costs. In the past 20 years China's wind turbines price fell by 70%, to 3,550 yuan/kW (US$522.3/kW) and the cost of wind farm construction dropped by 50%, to 7,160 yuan/kW (US$1,053.5/kW).

The NEA is promoting the concept of tradeable green energy certificates, aimed at reducing the reliance on FiTs. Under the programme, qualified onshore wind power producers can sell the certificates to buyers and each certificate represents 1MWh of electricity output.

Future wind power additions in the country will be driven by the auction mechanism. Annual wind power additions are expected to rise significantly from 2020 onwards, once the auction mechanism is fully in place.

China's onshore wind industry is an export-oriented one. It holds the largest share in the global onshore wind turbine market. Eleven Chinese manufacturers accounted for 63% of the global wind capacity additions in 2017.

Market Opportunity

With its large landmass, China's potential wind power resources are estimated to be about 2,380GW. The new green energy certificates programme will support further development of the sector in the longer term by easing curtailment. Despite dwindling subsidy support, onshore wind is set to achieve grid parity, opening new opportunities for wind industry investors in China.

Due to the rapid increase in new capacity over the past years, China offers a great market opportunity for repowering. According to a new report by Wood Mackenzie, China's wind repowering market is expected to grow significantly between 2023 and 2028 with more than 21GW of the country's wind turbine fleet slated to be repowered.

Developers are also expected to get new opportunities from the distributed wind power projects. Although, distributed wind power projects participating in market trading pilots cannot receive the national subsidy, they can apply to transfer to subsidy-free projects and enjoy incentive policies such as T&D fees and exemption from cross-subsidization. Also, such projects can earn extra revenue by selling voluntary green certificates. Other distributed wind power projects are eligible to receive utility-scale onshore wind power FiTs without tendering.

China, because of its predominant share in onshore wind capacity, is now also among the largest markets globally for wind O&M. A significant share of its onshore wind capacity is nearing expiry of warranty and performance guarantee levels which offers a major opportunity for O&M service providers, and for the OEMs.

Challenges

Grid curtailment remains a critical challenge facing the wind industry in China. Large volumes of wind power supplies have been wasted because inland wind power installations in many cases have lacked access to grid connectivity. However, the situation is improving, with the national average curtailment rate decreasing from 12% in 2017 to 7% in 2018 (27.7TWh). The National Development and Reform Commission (NDRC) has rolled out a new renewable power quota system in its efforts to make better use of its renewable energy resources and cut renewable power wastage rates to 5% by 2020 down from 12% in 2018. Notably, in Q1 2019, curtailment for wind power was down 4.5 percentage points from a year earlier.

Other than curtailment, delayed connection to the grid, constraints in grid management, less than optimal turbine models, and siting of wind farms have all lowered actual use of energy generated by wind turbines. However, in order to improve the grid infrastructure, China is currently building the largest transmission line in the world, a 1.1million-volt line capable of transmitting 2,000MW of electricity.

Like all other sectors, the wind industry supply chain was badly hit by the COVID-19 pandemic. Most of the manufacturers had shut down their facilities in January and February 2020, resuming production in late February. Construction of onshore wind projects are expected to get delayed by 6 months. The National Energy Administration, via a notice has scaled down subsidized wind power projects in 2020, but those approved before the end of 2018 are encouraged to transit to grid price if they fail to connect to the grid before the end of 2020.

Outlook

The Chinese Wind Energy Association ("CWEA") downgraded its onshore wind forecast for 2020 from up to 35GW to 20-25GW. Following the expected grid-connection deadline extension by NEA, 2021 is likely to be a big year with about 30GW of onshore wind capacity forecasted to be installed. 2023 and 2024 are expected to be difficult years in China after the previously approved project pipelines run their course.

Beyond 2020, grid-connected wind energy capacity is expected to increase as developers would look for investment opportunities in distributed wind power. The auctions would be highly competitive, helping wind power prices to reach grid parity. Lower turbine pricing would be a priority and further pricing reductions are expected during the early stages of the auction mechanism.

Over the past decade, the wind energy sector has seen significant growth, both in terms of capacity and production. China boasted the highest expansion rate in the world, even during a global slowdown. It has already achieved its wind target of 210GW of installed wind capacity by 2020 of which 98% (204GW) is dominated by onshore wind. The 14th Five-Year Plan (2021–25) will be a crucial element in shaping the next phase of growth.

India

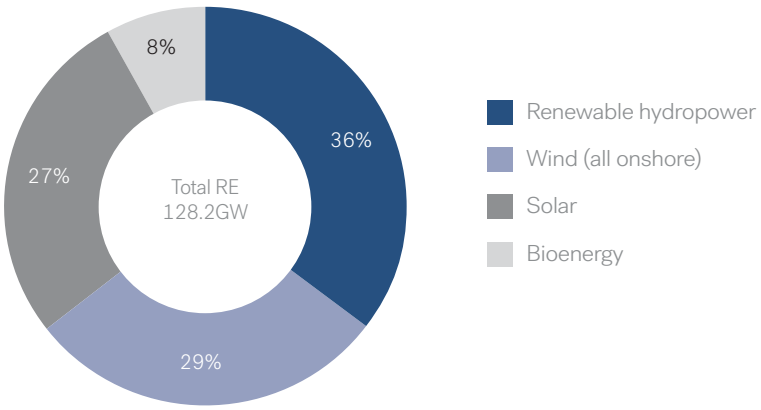
Presently, India is among the leading emerging markets for onshore wind power and ranks fourth in the world in terms of total onshore wind installed capacity. Although the country looks set to miss its ambitious goal of 60GW cumulative installed capacity in onshore wind by 2022, it still has enough potential to remain a key wind market globally for several years to come.

GDP (2019E) (Current Prices)	US$2,936 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	7.13%
Currency	INR (₹)
Country Credit Rating (S&P)	BBB-
Renewable Energy capacity (2019)	128.2GW
Onshore Wind Share in Renewables (2019)	29%
Electric Power Consumption (2017)	1.0 MWh/capita
Renewable Energy Target	450GW of renewable energy capacity by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

India

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

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GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

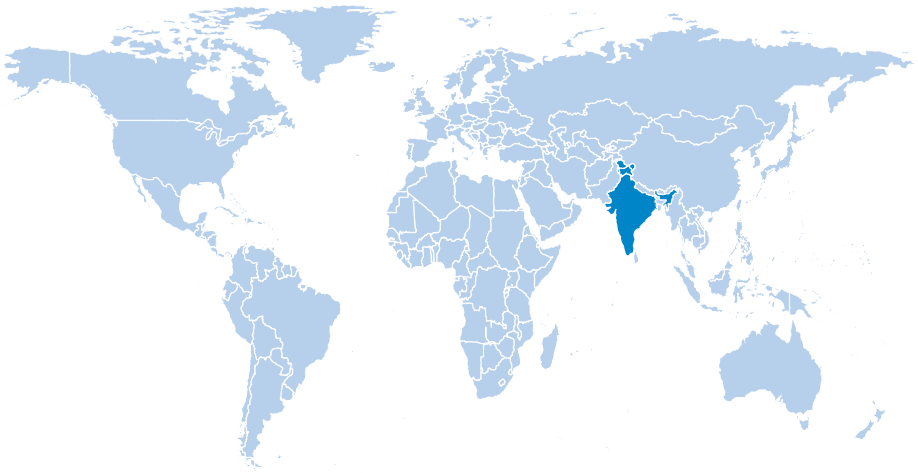
As per IRENA, onshore wind accounts for 29% of the country's renewable energy mix with the installed capacity reaching 37.5GW at the end of 2019. Wind power has become one of the key renewable energy sources for power generation in India, contributing at least 6-7% to the country's electricity generation mix at present.

Growth of the Indian wind sector has been primarily led by private sector investment, strongly backed by policy and fiscal support from the government. With energy demand set to rise significantly in the coming years, the Indian government has set a target of 175GW of renewable energy by 2022, out of which 60GW is earmarked for onshore wind. But due to challenges around pricing, payment risk mitigation, limited transmission capacity and land use, India may fall short of its 2022 targets. Wind installations in India totalled 2.22GW in 2019, which was nearly half of the 4.1GW capacity installed in 2017. As per Global Wind Energy Council (GWEC), the cumulative installed base of onshore wind would reach only 54.2GW by 2022 assuming that all the bottlenecks are resolved.

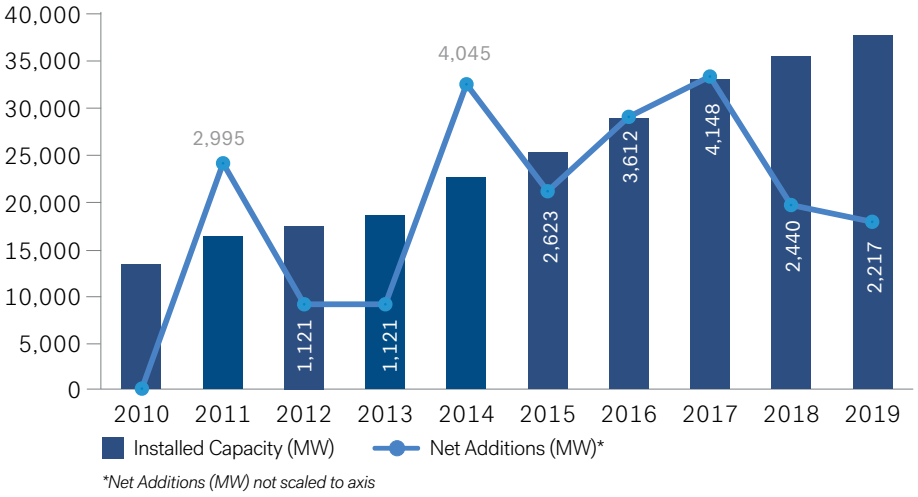
Auction-based capacity allocation is key to the build-out in onshore wind capacity. In India, 1.2GW of renewable hybrid capacity was auctioned for projects that include both an energy storage system and renewable energy capacity. A tender for another 2GW of wind energy capacity was announced on March 7, 2020, with tariff caps removed from the auction to boost investment.

The wind turbine manufacturing sector in India has great potential as localization is a main theme in the country. Currently India has a capacity of 8GW-10GW of wind turbine manufacturing per year and as per the Ministry of New and Renewable Energy (MNRE) data, Indian onshore wind sector has achieved 70%-80% indigenization level.

Onshore Wind Capacity



Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

India has added around 15GW of onshore wind capacity over the last five years. After a record installation of 4.1GW in 2017, capacity addition has slipped in the two following years, touching 2.4GW in 2018 and 2.2GW in 2019. A probable cause for this slowdown is the removal of incentives and switching procurement method to reverse auctions from feed-in tariffs. However, the market is gradually getting adjusted to the new mechanism and is expected to regain momentum in the coming years.

35.3GW Onshore Wind Capacity

- ✓ Regulatory initiatives such as renewable energy certificates and renewable purchase obligations
- ✓ Introduction of green bonds and removing tariff caps
- ✓ Strong supply chain in wind turbine manufacturing
- ✗ Policy uncertainty in India
- ✗ Project development challenges involving land acquisition or timely grid connectivity
- ✗ Lack of payment security for developers

Demand Driver

Growing demand for power is the main driver behind development of renewable energy power sources in India. The country plans to have an installed capacity of 450GW of renewable energy by 2030, implying a more than five-fold expansion in capacity over the 86GW capacity installed till the end of 2019.

Commercial wind power projects have been promoted through many fiscal and promotional incentives. The main driving force for development of the wind energy sector has been the attractive feed-in tariffs set by the different states. Other policy mechanisms include Accelerated Depreciation tax benefit (reduced to 40% from 80% earlier), Feed in tariff (FiT), Renewable Purchase Obligation (RPO), Renewable Energy Certificate (REC), Green Corridor programme, Repowering Policy and solar-wind hybrid policy.

The demand for wind originates from non-solar Renewable Purchase Obligations (RPO) compliance by state power distribution companies. Nearly ~20GW of demand exists in the market in terms of unfulfilled non-solar RPOs towards 2022. Economically, as well, wind auction bid prices are 30-40% lower than the average pooled power procurement cost (APPC) for most of the states in India. Hence, demand and price are the fundamental drivers of wind support in India.

Market Opportunity

Global independent power producers (IPPs) are rapidly tapping into India's wind energy market. In the FiT regime, 70-75% share of the wind market has belonged to Indian domestic IPPs, roughly 20% to captive players and foreign participation was limited to CLP, a Chinese player. After 2017, with redesigned auction rules, the share of global IPPs rose to 25-30%, with domestic IPPs at 60-65% and the remaining 10% by captives. Under the new auction system, the project development risk is shared between the original equipment manufacturers (OEMs) and IPPs.

Despite the low offtake in the latest auction, around 8.6GW worth of active orders can be seen in the country. Of this, 3GW is scheduled for commissioning in 2020, 5.2GW in 2021 and 0.4GW in 2022. MNRE wind data also indicates a gross onshore wind potential of about 302GW at 100 meters and 695GW at 120 meters hub height.

The government is taking a mixture of reactive and proactive steps to address the issues of land, grid connections and payment delays. Realizing the impact of infrastructure bottlenecks in the market, the government removed pricing caps in the latest wind tender. Payments for short, medium, and long-term defaults are being guaranteed to boost investor confidence. The government is also planning a 25GW plug-and-play wind park to resolve land and grid issues and provide longer duration visibility.

Challenges

Shift from feed in-tariff to auction system aligned the power purchase agreements (PPAs) to market prices, while obviating fixed prices for producers. But aggressively low tariffs, driven by competition, also threatened the long-term project viability.

By 2019, authorities have decided to use the extremely low prices (₹2.4-2.8/kWh or US$0.03 - US$0.04) captured in the first six auctions as a benchmark for an upper price cap in the last two auctions. Developers have not been able to meet such price expectations. Moreover, problems around infrastructure availability prevented them from participating in the recent auctions. Furthermore, the winning bidders faced significant challenges in securing connectivity.

While the regulations recently notified on connectivity for renewable energy projects are positive for developers, the adequacy of the existing inter-state transmission infrastructure in the states with high wind potential remains a challenge. Also, progressive withdrawal of tax incentives over from FY 2016-17 is likely to impact investors.

Land availability hurdles and concerns over the viability of low tender bids have resulted in delays to the implementation of tendered projects and progressively lowered interest in new auctions.

Most of the utilities are strapped with heavy losses on their books. This makes them delay subsequent payments to power producers. As per government's data, the utilities owed renewable energy generators ₹62.19 billion (~US$856.2 million) in outstanding payments as of January 2020. As a result, investors have been wary of investment commitments in the absence of payment security.

Outlook

The impact of COVID-19 will put a brake on growth in 2020, due to the disruptions in the supply chain. This worsens the challenges from unavailability of transmission network and the land that were already affecting the installations. Beyond 2020, the uncertainty around new tendering and the overall business environment may further deepen the impact.

Reaching the target of 60GW wind capacity by 2022 is becoming increasingly unlikely for the country in the current market scenario. India is expected to install 11-17GW between 2020 and 2022, taking the cumulative installed base of wind power in India to only 54GW by 2022, in the best-case scenario.

Prevailing market conditions might trigger large-scale consolidation in the domestic wind energy market. Smaller OEMs in India have not been able to sustain their businesses under increasing cost pressures, which is seen in the contraction of supplier numbers in 2019 compared to 2015. While small OEMs exited the market, larger domestic and global OEMs are struggling to keep their Indian operations profitable.

Australia

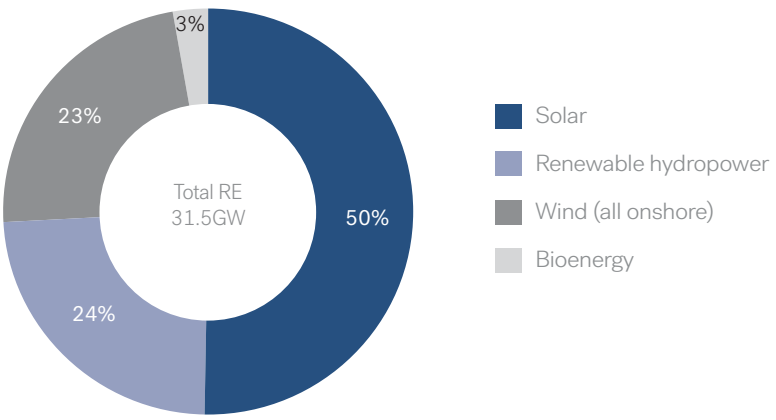
In 2019, wind overtook hydro as Australia's leading source of clean energy. Currently, onshore wind energy is the cheapest form of renewable energy available in Australia. It is well supported by the country's clean energy regulator – RET and will continue to have a major share in the country's renewable energy mix.

GDP (2019E) (Current Prices)	US$1,376 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	2.43%
Currency	AUD (AU$)
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2019)	31.5GW
Onshore Wind Share in Renewables (2019)	23%
Electric Power Consumption (2018)	9.9 MWh/capita
Renewable Energy Target	50% share of renewables by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Australia

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

GDP (2019E) (Current Prices)	US$1,376 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	2.43%
Currency	AUD (AU$)
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2019)	31.5GW
Onshore Wind Share in Renewables (2019)	23%
Electric Power Consumption (2018)	9.9 MWh/capita
Renewable Energy Target	50% share of renewables by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

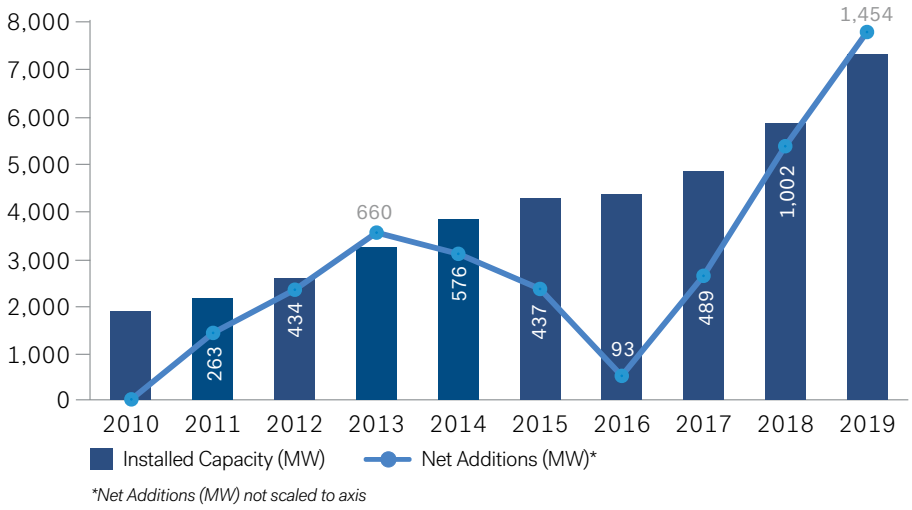
At the end of 2019, Australia's cumulative onshore wind installed capacity stood at 7,272MW. In 2019, the onshore wind farms produced 35.4% of the country's clean energy and supplied 9.5% of overall electricity. More than a third of the country's total installed wind capacity comes from South Australia, which is increasingly emerging as a test case of renewable energy replacing conventional options.

In October 2019, an enhanced Victorian Renewable Energy Target (VRET) was passed into law. This entails achieving a renewable share of 50% (out of total power generation) by 2030, on top of the existing targets of 25% by 2020 and 40% by 2025. The progress towards VRET for 2020 is on track.

The Australian Capital Territory (ACT) government has achieved the goal of sourcing 100% of generation from renewable energy. South Australia's 109MW Hornsdale Stage 3 wind farm put the ACT over the 100% target. It cut the territory's emissions by 40% below 1990 levels and led ACT to legislate the target to be carbon neutral by 2045.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Between 2010 and 2019, the installed onshore wind capacity quadrupled. Annual capacity addition, which averaged at about 400MW since 2010, jumped to over 1GW in 2018 and 2019. The country installed around 1,454MW of new onshore wind capacity in 2019, breaking all previous records.

7.3GW Onshore Wind Capacity

- ✓ **Growing stature of wind as the most important source of renewable energy in the country**
- ✓ **Wind being the cheapest renewable energy source, has received considerable support from RET (Renewable Energy Target)**
- ✗ Lack of an over-arching federal policy for investments
- ✗ Grid connectivity constraints which has increased project risk for developers and investors

Demand Driver

The combination of a stable federal RET, and state government renewable energy schemes provide a strong incentive for new project development. A couple of other factors which acted as key catalysts behind the record investment in Australian renewable energy sector in the last two years are the cost reductions in renewable energy and additional support from the Australian Renewable Energy Agency and the Clean Energy Finance Corporation (CEFC). Under the RET, renewable power plants can create large-scale generation certificates (LGCs) for the energy generated, which then could be traded.

Notable policy developments could impact the onshore wind energy market. These include revisions to the RET legislating a target of 33,000GWh to come from renewable energy annually from 2020 onwards equivalent to 23.5% of Australia's electricity generation. The RET succeeded in beating the target of achieving 33,000GWh renewable energy generation annually last year when it generated 55,093GWh (24% of total generation) from renewable sources. The Large-scale Renewable Energy Target (LRET) has also created a financial incentive for the establishment or expansion of renewable energy power stations through LGCs.

The Levelized Cost of Energy (LCOE) for onshore wind projects decreased by 60% since the second half of 2009 when projects averaged at US$111/MWh. By the first half of 2020, LCOE is estimated at an average US$44/MWh. The decrease in the cost is driven by technological innovation and economies of scale in project development.

Market Opportunity

Prices in power purchase agreements continue to fall, opening up further market opportunities, as well as placing downwards pressure on wholesale power market prices. This is particularly important in the context of aggressive energy transition plans underway at various provinces.

Select major projects under development reflect the trend towards large-scale wind projects to capitalise on scale. The 1,026MW MacIntyre project at Queensland, involving investment worth AU$1.96 billion (US$1.4 billion), is one key example. It is regarded as one of the largest onshore wind farms in the world.

Investment in electricity storage is likely to increase over the coming years to help balance supply and demand within the National Electricity Market (NEM). The country is expected to add 1.2GWh of energy storage capacity in 2020, more than double the 499MWh installed in 2019 and this will set the cumulative storage capacity to 2.7GWh. According to Wood Mackenzie, by 2025 Australia's cumulative energy storage investment will reach AU$5.34 billion (US$3.8 billion) translating to 12.9GWh of cumulative storage deployments. This is likely to support further grid integration of wind power.

Challenges

The key barriers to the wind industry in Australia are the policy uncertainty currently being created by the imminent end of the RET and lack of clarity around the National Energy Guarantee (NEG). The surge in renewable investment will not be sustained unless the current government becomes more ambitious with its emission reduction targets under the proposed NEG, which is currently set at 26% below 2005 levels by 2030.

The wind energy projects face community complaints related to noise, health and planning process. The National Wind Farm Commissioner and Independent Scientific Panel are expected to investigate these complaints and table a report to a Senate Select Committee on Wind Farms. Any proposal to implement more stringent planning requirements can have an adverse impact on development schedules, creating bottlenecks to the development pipeline, as has been seen in several leading European markets.

Grid congestion could shrink the 67GW renewable energy pipeline (6GW under construction and 61GW on suspended projects) in Australia. In the current plan, developers have been warned that renewable construction projects that are still under construction might not be connected to the grid in time, with projects in West Victoria facing a delay of over nine months.

Outlook

Australia's current electricity mix is largely dominated by the large and emissions-intensive coal-fired plants. However, according to Australian Energy Market Operator, 63% of Australia's current coal-fired plants are likely to be closed by 2040. To offset this, over 30GW of new wind and solar capacities are required.

At the end of 2019, 30 wind farms with a combined capacity of 5.5GW were under construction or financially committed nationally. The onshore wind pipeline continues to be strong despite the various challenges and competition it faces. Based on the pipeline, there are expectations that the country could reach 18GW of installed capacity by 2030.

Japan

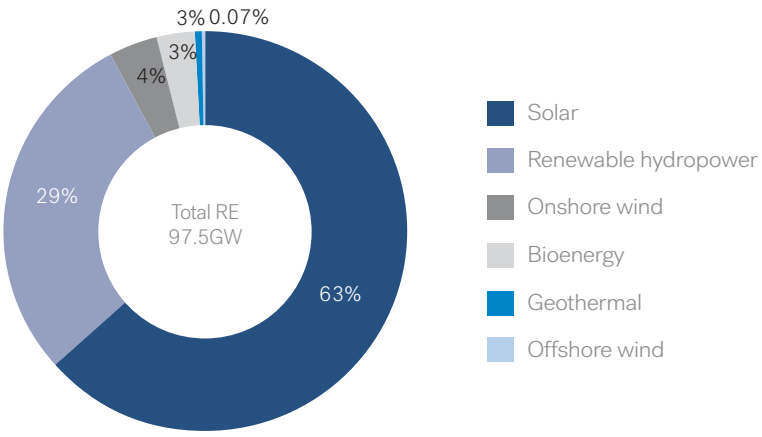
Annual capacity addition of onshore wind in Japan has been progressively declining and touched 119MW in 2019, marking the fourth consecutive year of decline. Despite having an onshore wind potential of 144GW, development of the industry has been impacted by a lack of clarity on policy support.

GDP (2019E) (Current Prices)	US$5,154 bn
GDP Growth Forecast (2019-2024) (Constant Prices)	0.56%
Currency	JPY (¥)
Country Credit Rating (S&P)	A+
Renewable Energy capacity (2019)	97.5GW
Onshore Wind Share in Renewables (2019)	4%
Electric Power Consumption (2018)	7.8 MWh/capita
Renewable Energy Target	24% share of renewables by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

Japan

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics 2019

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Onshore Wind Share in Renewables (2019)	4%
Electric Power Consumption (2018)	7.8 MWh/capita
Renewable Energy Target	24% share of renewables by 2030

GDP Source: IMF, World Economic Outlook Database October 2019, October 11, 2019

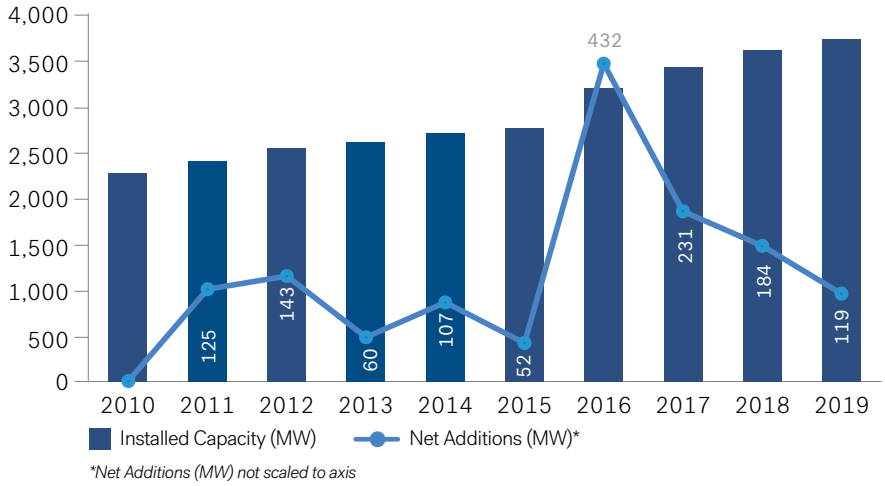
The Fukushima nuclear disaster of 2011 triggered a realignment in Japan's policy on energy mix. Since then, nuclear power's share in electricity generation plummeted to 3-5% from 30% earlier. Policymakers pushed the case for renewables capacity development during this period to offset the nuclear generation capacity being phased out. But the progress so far has been far from desired levels.

Japan added only 1.3GW of onshore wind capacity between 2011 and 2019, quite small compared to the capacity buildout seen in other developed markets. Decline in wind power prices has been relatively slow, adversely impacting the adoption, particularly in the commercial and industrial (C&I) segment. It is estimated that the LCOE of onshore wind would not undercut coal-based power prices before 2025, following solar PV (2023) and offshore wind (2022).

The Japanese government's commitment to decarbonisation has also been brought into question, with 21 new coal-based power plants having a cumulative capacity of 11GW being planned, developed or built throughout the country. The government's renewable energy target too was widely criticized for not being ambitious enough, especially considering the global trends. Sustained policy push will be required to realize the untapped potential in onshore wind power generation.

Onshore Wind Capacity

Onshore Wind Installed Capacity



Source: IRENA Renewable Capacity Statistics 2019

Japan installed around 161MW of onshore wind capacity annually between 2011-2019. Annual capacity addition has declined for the fourth year in a row reaching 119MW in 2019. Trend-wise, wind power growth has been less than expected especially considering the country's potential of 144GW of onshore capacity. Several factors have stymied market development – concerns around noise pollution, conflicts over land-use rights and high power prices have contributed to marginal expansion in onshore wind capacity in the last decade.

3.7GW Onshore Wind Capacity

- ✓ **Policy objectives at expanding penetration of renewable energy**
- ✓ **A huge untapped onshore wind power generation potential that is suitable for baseload capacity**
- ✓ **Reforms in power sector to allow greater private investments, especially in grid expansion**
- ✗ High relative cost of system installation weakening the competitive edge
- ✗ Lack of assured returns or incentives for prospective onshore wind power developers
- ✗ Policy preference towards offshore wind energy as a renewable resource

Demand Driver

Wind speed in Japan tends to change relatively slowly and the wind force is strong at average 5-7 m/s, providing wind the potential to contribute to the baseload generation. This brings in a lot of certainty to the investors getting into the market.

FiT approval timelines have been rationalized. FiT will now be approved 2-3 years prior to the start of the project i.e. in the middle of the Environmental Impact Assessment (EIA) process. This amendment will help bring some visibility into the commercials of wind power projects. The government is also planning to replace the FiT regime into a price-based mechanism that would make the wind market more competitive and attract investor's interests.

Japan's Electric Power System reform is progressing steadily which will help unbundling of power generation, transmission and distribution in the country by 2020. This reform will consequently help the inter-regional grid extension which will allow using of rich wind resources in the northern parts of the country.

New Energy and Industrial Technology Development Organization (NEDO), which is Japan's biggest public R&D management organization supported by Ministry of Economy, Trade and Industry (METI) is fostering innovation for the next generation in the wind technologies. Future technological advancement would reduce cost and make the wind energy prospect of the country brighter.

Market Opportunity

As per a recent research by the University of Tokyo, Carbon Tracker and the Carbon Disclosure Project, Japan's cheaper renewable energy projects could displace the country's coal-based power generation. In particular, the study points out that onshore wind could be cheaper than coal-based power by 2025. This is important, considering the inherent challenges onshore wind faces in the country.

Efforts by the government to reduce the complexities and lead-time in the approval process are some of the steps to attract European wind energy developers and manufacturers. In July 2020, Vena Energy, an independent power producer, announced the construction of 47MW Nakasato project involving the tallest turbines in the country as on date.

Sustained investment in energy storage is likely to present new opportunities to onshore wind energy players. Japan is a global leader in this area and is expected to be the single largest market when global energy storage capacity reaches 81GWh in 2024.

Challenges

The Japanese government's ambivalence towards coal-based and nuclear power has sent mixed signals to the investor community within the renewable energy industry. In addition, the move to reduce fixed prices for onshore projects in the feed-in-tariff system has undercut profitability. Given that the onshore wind sector has a high entry barrier due to its development complexity and capital intensity, recent developments have raised the prospect of depressed returns, leading to lukewarm investor sentiment.

The northern part of Japan, namely Hokkaido and Tohuku regions, have the best wind resources in Japan but remain unused due to the limited grid connectivity. These areas have a high upgrading cost of grid network facilities. Also, priority access to grid for renewable energy is yet to be developed. There are other geographical challenges that hamper installation of wind turbines.

Cost competitiveness of wind power in Japan as compared to global standard brings another significant challenge. Cost of wind power system in Japan is almost two times that of India and Germany for the same capacity. The system cost in Japan reached US$156 per MWh for 20MW project, whereas in India and Germany the equivalent cost was US$77 per MWh and US$79 per MWh for the same capacity.

Offshore wind is usurping onshore wind's position as a major source of clean energy in the government's power strategy. In April 2019, a new law took effect allowing offshore turbines to operate for up to 30 years. Previously, most prefectures could only give permits lasting up to five years, making it difficult for developers to invest in major projects. The law also designated 11 sites for offshore wind power and the government is expected to hold public tenders for four areas off the coast of Akita, Chiba and Nagasaki prefectures. This signals long term commitment to the development of offshore wind and is likely to shift investor attention away from onshore wind.

Outlook

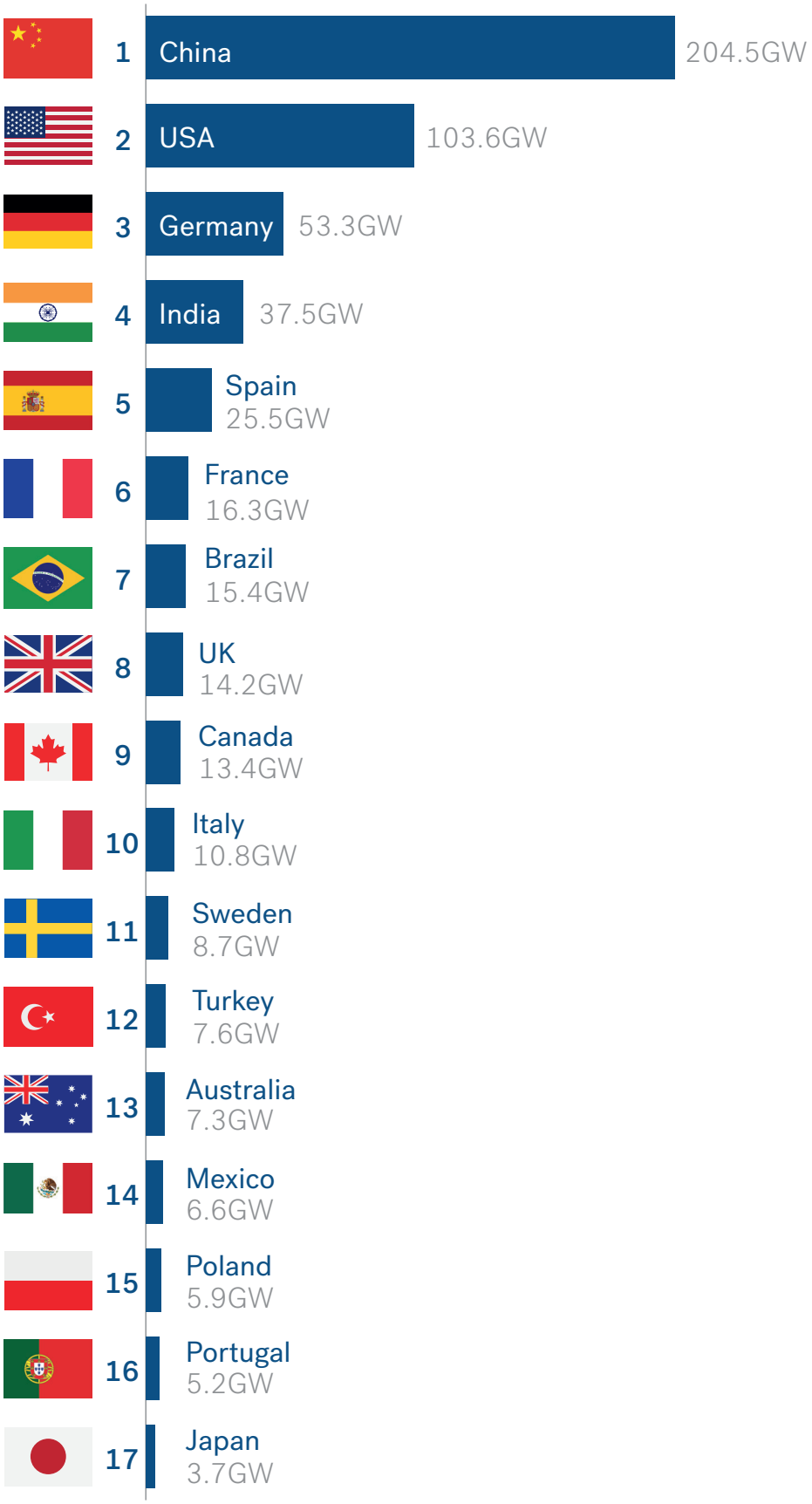
The Japan Wind Power Association has set a target to install 27GW of onshore wind by 2030. In addition, the Japanese government is committed to meeting 22-24% of its energy requirements from renewable sources by 2030, a target deemed not ambitious enough, especially in comparison to other developed economies. To achieve this target, Japan will have to improve its grid infrastructure and overhaul its EIA approval process.

Looking at the medium-term scenario, there are 3.3GW of wind energy projects that have finished the extensive EIA process and have acquired FiT approvals. These projects expected to be rolled out in the coming years. Accordingly, onshore wind development would also ramp up beyond 2020.

Among other major factors that would favorably impact the future of onshore wind energy market in Japan is the construction of the new local grid line in northern Hokkaido. The project has been initiated by Eurus Energy Holdings and new grid line will come into operation in 2022 with 50% cost of grid construction being paid by the government.

Selected Countries Ranking

Selected Countries Ranking by Onshore Wind Capacity 2019



Summary

COUNTRY	INSTALLED CAPACITY (2019)	CAPACITY ADDITION (2019)	MARKET DRIVERS		FISCAL INCENTIVES
			Supply Side	Demand Side	
AMERICAS					
USA	103.6GW	9.2GW	Production Tax Credit (PTC) Corporate and Utility PPAs	Renewable Portfolio Standards (RPS)	Federal production tax credits and grants RPS-driven renewables incentives
Brazil	15.4GW	531MW	Competitive bidding	10-year energy development plan	Long term rate (TLP) Tax exemption Alternative Energy Source Incentive Program, "PROINFA"
Canada	13.4GW	597MW	Competitive bidding Renewable Electricity Program (REP)	National greenhouse gas emssion reduction target	Federal and provincial government incentives
Mexico	6.6GW	1.7GW	Liberalised access to private investment Merchant offtake market		
EUROPE					
Germany	53.3GW	868MW	Corporate PPAs	Decarbonisation goals Repowering	
Spain	25.5GW	2.1GW	Competitive bidding	National renewable target	
France	16.3GW	1.4GW	Feed-in-premium Corporate PPA	PPE target Vehicle bonus-malus	
UK	14.2GW	629MW		Contract for Difference (CfD) Eased restrictions on the remote island to compete in auctions	
Italy	10.8GW	528MW	Feed-in-tariff Green Certificates		FER1 decree incentive scheme
Sweden	8.7GW	1.6GW	Withdrawal of the certificate-based subsidy scheme Merchant PPA	Government target of 100% renewables-based electricity system by 2040	
Turkey	7.6GW	586MW	Incentive related to local manufacturing of equipments Feed-in-tariff	Renewable Energy Support Scheme (YEKDEM)	Tax incentives Resource Support Utilization Fund payments in imports Financing provided by European Bank for Reconstruction and Development (EBRD)

Summary

COUNTRY	INSTALLED CAPACITY (2019)	CAPACITY ADDITION (2019)	MARKET DRIVERS		FISCAL INCENTIVES
			Supply Side	Demand Side	
Poland	5.9GW	151MW	Competitive bidding	Decarbonisation goals RES Act	
Portugal	5.2GW	53MW		Decarbonisation goals	Reduction in Municipal Real Estate Tax Tax benefit through Green Tax
ASIA-PACIFIC					
China	204.5GW	24.5GW	Competitive bidding National Development and Reform Commission	Green certificates	Tax reduction and exemption
India	37.5GW	2.2GW	Competitive bidding Feed in tariff (FiT)	Renewable Purchase Obligation (RPO) Renewable Energy Certificate (REC) Green Corridor programme Repowering Policy and solar-wind hybrid policy	Accelerated Depreciation tax benefit
Australia	7.3GW	1.5GW		Clean Energy Finance Corporation (CEFC) Large-scale generation certificates (LGCs) Australian Renewable Energy Agency Large-scale Renewable Energy Target (LRET) Federal RET State government renewable energy schemes	
Japan	3.7GW	119MW	Feed-in-tariff	Electric Power System reform	

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