Wind Energy Investments: Forecast of Growth Markets and Innovations

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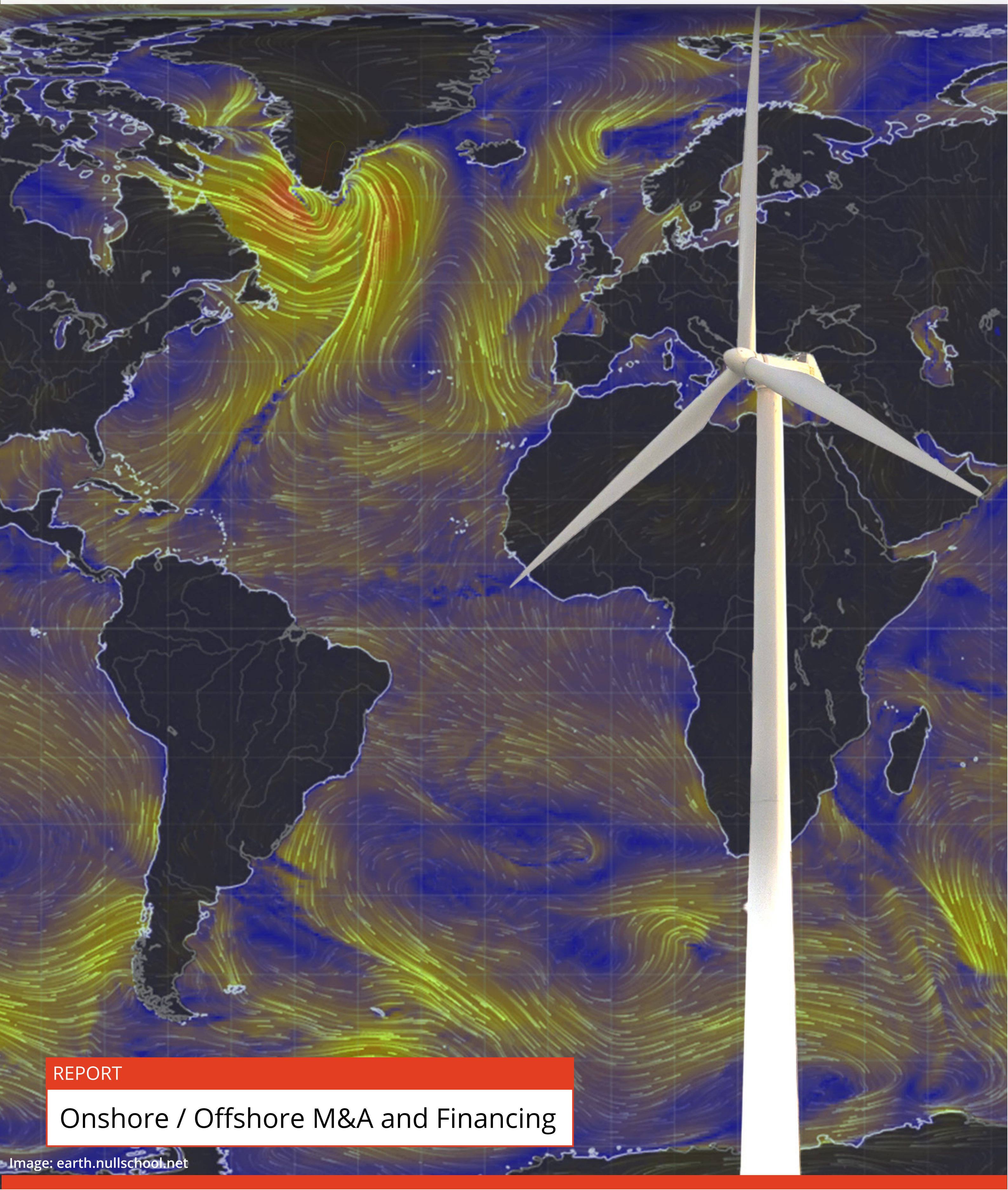

REPORT

Onshore / Offshore M&A and Financing

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Stirling Infrastructure

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Stirling Infrastructure is an M&A and capital raising firm focusing on project finance and operational onshore and offshore wind projects. The firm arranges both debt and equity financing for renewable projects internationally. The firm has established relationships with institutional investors, listed companies and private market investors.

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PURPOSE OF THIS PAPER

The purpose of this paper is to outline innovations within wind as well as the changing global profile for wind energy. This paper begins by approaching wind as a source of energy, then developments in the manufacturing and supply of windfarm components. Finally, the paper concludes with a focus on the history and growth of wind energy going forward.

1. AN INTRODUCTION TO WIND ENERGY TECHNOLOGY AND MARKET GROWTH

WHY WIND ENERGY?

Energy systems around the world are experiencing a rapid transition that will alter how we transport ourselves, heat our houses, and power industries. Beyond the 2015 Paris agreement and sister arrangements, the costs of extreme weather systems and environmental degradation are driving political platforms that will accelerate the shift to renewables. Wind power, therefore, as a non-exhaustible natural resource with a proven and established path to powering grids is highly likely to benefit from this shift and has already displayed increased efficiency and output as a result of growing investment.

DEVELOPMENT OF WIND TECHNOLOGY

The electrification and decarbonization of economies have driven a significant push towards wind energy. Wind capacity has grown dramatically to 650GW in 2019 (see section 5 for a more detailed analysis of wind growth) and this increase in installed output has been coupled with a transformation in the underlying technologies used to construct and operate windfarms. As a result, the output cost of electricity has fallen dramatically and wind turbines have increased in complexity and scale. In recent years the Levelised Cost of Electricity (a common measure of the cost of production of wind energy) has fallen from 0.08USD/kwh in 2010 to 0.06USD/kwh in 2018 with this trend likely to continue. In addition, there have been significant advancements in the technology of wind projects. Although there are many ways to harness energy from the wind, the most commercially mature technology is the 3-blade horizontal axis wind turbine which uses aerofoiled blades to generate rotational motion from the incoming wind stream. This can gain efficiency through integrating Internet of Things (IoT) with Artificial Intelligence (AI) to automatically gather data and remotely control the systems located in the wind turbine, known as predictive maintenance. These advancements, along with many more, support a great future for wind energy globally.

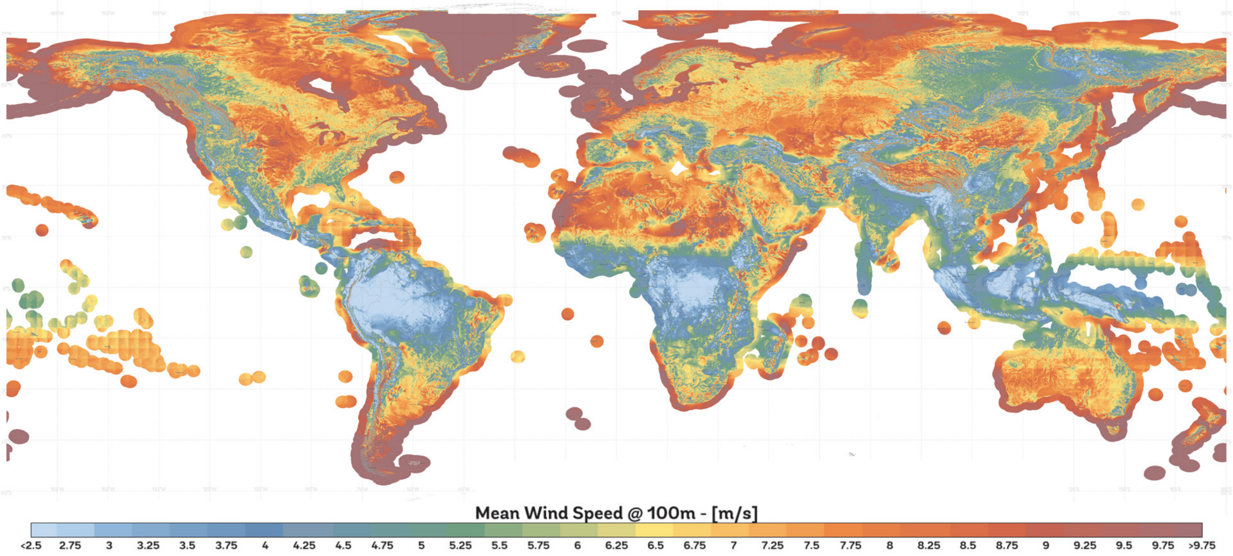
2. EXAMPLES OF RECENT WIND ENERGY DEVELOPMENTS

To determine potential locations for wind farms, the focus lies in producing detailed and accurate assessments, alongside supporting calculations, for adequate wind speeds and currents. These predictions can be made using Exhibit 1 whereby red hues signify higher mean wind speeds. As seen below, there are many locations which have favourable wind potentials, however, it should be noted that it is predicted Europe and China will account for 70% of the global offshore wind capacity by 2040, with the USA shortly thereafter[1]. The specific wind potential for a wind farm site is far from trivial and provides a great deal of information for the future of the farm. Although offshore wind farms propose larger financial and logistical demand, it is often the case that offshore wind can provide higher wind speeds at a more consistent rate.

[1] REN21. (2020). "Chapter 3: Market and Industry Trends: Wind Power." Renewables 2020 Global Status Report. https://www.ren21.net/gsr-2020/chapters/chapter_03/chapter_03/#start-wind

Exhibit 1. Global Mean Wind Speed at 100 m

This wind resource map shows the estimated mean wind power density at 100 m above surface level. Power density indicates wind potential, part of which can be extracted by wind turbines.



Source: (Global Wind Atlas, 2020)

The following section provides some insight into and familiarisation with the types of wind energy projects that are being developed currently.

ONSHORE WIND: EXAMPLE OF ESTABLISHED WIND FARM AND REPOWERING DEVELOPMENTS

An exemplary onshore wind project is the Hadyard Hill Wind in the Carrick District, UK.[2] It comprises of 52 x 2.3MW Siemens wind turbines with a total capacity of 120 MW, developed by Scottish and Southern Energy (SSE) and DP Energy Ireland. It is able to power the equivalent of 80,000 homes in the south of Scotland.

Familiarisation with key players and established projects is crucial to understand the wind landscape. Typically, wind farms are designed with a 20 to 25-year lifespan in mind. As seen by the Hadyard Hill, although the wind project has delivered its requirements, decommissioning will have to take place. However, there is great interest in the repowering of old wind sites to make use of the existing infrastructure (foundations, power electronics, etc.), and to increase the power and efficiency of the site (e.g. through blade and gearbox replacement). There is great political and economic interest in repowering such sites: one such example of this is demonstrated by a study by the Irish Wind Energy Association outlining that 15 GW of electricity capacity can come from repowering wind farms by 2050 (A Guide to Repowering Ireland, IWEA, 2019). Therefore, repowering is seen to be an important aspect of wind energy that will require its own specialised financing.

OFFSHORE WIND: EXAMPLES OF POLITICAL AND ECONOMIC ADVANCEMENTS TOWARDS OFFSHORE DEVELOPMENTS

Although onshore is more established, developments such as deep-water foundation technology and favourable environmental conditions for offshore wind are causing its rapid growth. In the North American market, the state of New Jersey (NJ) is pioneering its development of wind fleet. NJ is aiming to reach 3.5 GW wind capacity, to power 3.2 million homes in its Offshore Wind Strategic Plan (OWSP) of the New Jersey Board of Public Utilities (NJBPU). Recently, a 1,100 MW wind farm has been commissioned via the OWSP to be developed by Ørsted utilising the 12 MW GE Haliade-X. There were to be many more solicitations through the NJBPU, between 1,200 – 2,400 MW in September 2020 and thereafter another solicitation every 2 years for over 1,200.[3]

[2] The Gazetteer for Scotland. 2020. "Hadyard Hill Wind Farm." https://www.scottish-places.info/features/featurefirst11861.html

[3] Durakovic, Adnan. September 11, 2020. "New Jersey Opens 2.4 GW Offshore Wind Solicitation." offshoreWIND.biz. https://www.offshorewind.biz/2020/09/11/new-jersey-opens-2-4-gw-offshore-wind-solicitation/

There are also many offshore wind developments in East Asia, for example in Yunlin, Taiwan. The Yunlin offshore project 8 km from the coast is scheduled to be commissioned in December 2021. This project is to be developed mainly by wpd, and will have a capacity of 640 MW using Siemens 8MW wind turbines[4]. This is one of the eleven projects which the Taiwanese government is including in their feed-in-tariff programme, and showcases the political and economic will behind the environmental policies of advanced economies.

3. SUPPLY CHAIN OF WIND FARM CONSTRUCTION

Whilst the highlighted projects in Section 2 demonstrate the global potential for wind energy, the ability to meet the increased demand will prove pivotal in determining which firms are key market players, as well as where future potential growth in the manufacturing space may occur.

The manufacturers with the greatest market shares are shown in Exhibit 2:

Exhibit 2. Wind Turbine Manufacturing: Key Market Players

Manufacturer	Vestas	Siemens Gamesa	Goldwind	GE Renewables	Enercon
Country of Origin					
Total Asset (1000's Euro)	14,885,000	16,855,079	12,844,483	-	6,-74,766
2019 Market Share	18%	17%	16%	14%	5.5%
Total Installed Capacity (GW)	100	99	60	62	50
2020 Installed Capacity (GW)	9.6	8.79	8.25	7.37	-
New Debt (USD Million)	-1,396.7	158.1	1,875.3	57,210.0	-
Total Debt/EBITDA	2.24x	8.89x	13.69x	9.55x	-
Cash (USD Million)	2,350.5	1,727.3	1,375.4	31,011.0	-

Source: Information gathered from S&P Capital IQ - 2020

To better understand the table, there are two reasons for omitting certain data points. Firstly, despite Enercon remaining a market player, the legal 'distance-between-wind turbines' practice in Germany (Enercon's base of operations), as well as the country's recent wind energy policy disruptions have resulted in Enercon failing to remain a competitive manufacturer over the last few years. Secondly, GE Renewables' Total 'Cash' and 'Net debt' remain disproportionate to the rest of the manufacturers, on account of it being considered under GE as a whole. In summary therefore, Vestas, Siemens Gamesa and Goldwind are the greatest market players in the wind turbine manufacturing environment, and thus should be most closely observed for their future growth and strategy plans. The key takeaway is that China-based manufacturers have rapidly grown their capabilities and stand as a testament to the shift from Europe-only wind to global wind.

These key market players further demonstrate the current regional focus for wind turbine manufacturing (Exhibit 3). Whilst most of plants on wind turbine manufacturing has historically been throughout the EU, an increasing number of manufacturers and thus plant locations are arising in Asia, notably in China and India. As technology and information are increasingly shared, future trends posit a transition of manufacturing plants towards the developing nations, due to reduced manufacturing costs.

[4] Buljan, Adrijana. April 23, 2020. "First Wind Turbines for Yulin OWF En Route to Taiwan." offshoreWIND.biz. https://www.offshorewind.biz/2020/04/23/first-wind-turbines-for-yunlin-owf-en-route-to-taiwan/

Exhibit 3. Wind Turbine Manufacturers: Locations of Manufacturing Plants

Vestas	Siemens Gamesa	Goldwind	GE Renewables	Enercon
Aarhus, Denmark	Zamudio, Spain	Urumqi, China	Paris, France	Aurich, Germany
28 Locations	16 Locations	11 Locations	21 Locations	11 Locations
Europe: 14 Denmark (6); Germany(3); Spain (3); Turkey (1) **Asia: 7** China (5); India (2) **North America: 4** USA (4) **Latin America: 3** Argentina (1); Brazil (1);Mexico (1)	**Europe: 7** Denmark (2); Germany(1); Spain (3); UK (1) **Asia: 5** China (2); India (3) **North America: 2** USA (2) **Latin America: 1** Brazil (1) **Africa: (1)** Morocco (1)	**Asia: 11** China (11)	**Europe: 8** Spain (2); France (2);Denmark (1); Poland(1); Turkey (1); Germany(1) **Asia: 8** China (4); India (3);Vietnam (1) **North America: 3** USA (2); Canada (1) **Latin America: 2** Brazil (2)	**Europe : 6** Germany (3); Sweden(1); Turkey(1); Portugal (1) **Asia: 1** India (1) **North America: 1** Canada (1) **South America: 1** Brazil (1)

Source: Vestas, Siemens Gamesa, Goldwind, GE Renewables and Enercon websites - 2019

Meanwhile, the increased prevalence of nationalistic rhetoric in the political and business landscape suggests a potential barrier in the outsourcing of wind turbine manufacturing. Regardless of this potential influence, however, the construction of new manufacturing plants in the future is more likely to occur in countries such as China and India as developing nations seek to build their presence in the renewables space in accordance with their respective environmental commitments.

In terms of the research and turbine design, the pre-existing infrastructure in place within these western-focused market players does suggest the EU will still dominate the turbine development stage. All of the key market players maintain a physical separation between manufacturing and development plants, and thus a likely trend for the future would entail the research and development epicentres to remain near the company headquarters in western nations, with manufacturing, as aforementioned, moving production towards Asia, notably China.

4. WIND ENERGY ORIGINS AND GROWTH

ORIGINS OF WIND ENERGY

To understand the future growth of wind energy it is useful to begin with the origins of wind power. Wind has been an energy resource for hundreds of years, for transportation and industry, however the first modern commercial use for energy generation can be traced back to the 1941 connection of a 1.25MW turbine to the local distribution grid in Vermont, US. Since then a range of developments have made wind energy grow in scale, for example the creation of specialist firms such as Vestas focusing solely on wind generation in 1987 and the introduction of a subsidy "feed-in-tariff" (a government backed guarantee of a fixed income for each MWh produced) in 1992 in Germany. The policy support led to the first major benchmark for wind, with installed capacity passing the 1.2GW mark in 1993, followed by successive governments across the globe committing to increasing wind support. Initially with the Kyoto protocol in 1997, and more recently with the 2015 Paris climate change agreements, the origins of wind power are closely linked to commitments to de-carbonising the global economy and reducing reliance on fossil fuels.

MODERN WIND ENERGY

The state of wind energy is still closely tied to policy expectations and government support, with many modern projects relying on schemes to be profitable (for example, the CFD scheme currently operating in the UK). However, there has been a paradigm shift in the story of wind energy. Firstly, the underlying technology has utterly transformed the economics of wind production. The turbine connected to the grid in Vermont in 1941 had blades that were 23 meters long, while modern blades can reach lengths beyond 108m (Siemens Gamesa 14-222 DD model) and modern construction methods raise the load capacity and potential of each turbine. This has led to increasing efficiency of MW output and growing competitiveness against other fuel sources. Secondly, the necessity for subsidy support, while still crucial to large-scale adoption, has reduced. In 2017 in Germany, the first 0 subsidy tender for a wind project was successful, demonstrating the transformation within wind energy financing.

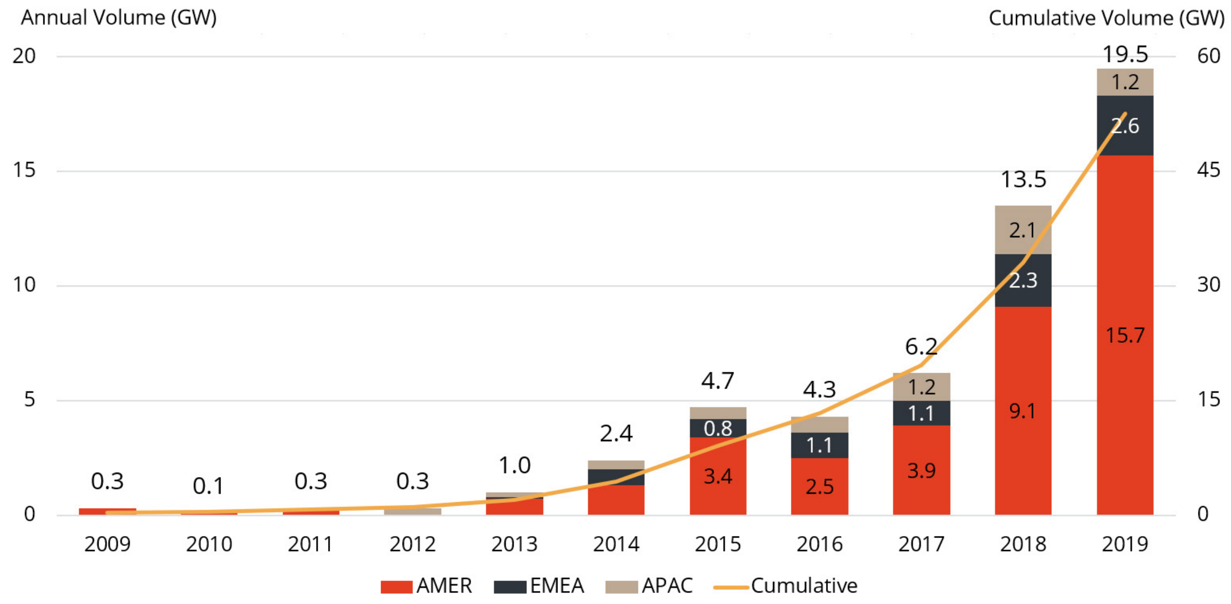
Lastly, it is clear that the scale of wind energy has radically shifted. Global wind capacity has grown from 1.2 GW in 1993, to 100 GW in 2008 to 651 GW[5] by the end of 2019, after the second highest annual increase of 62 GW. This growth has been global in scale. China and the US were the main contributors in recent years, installing over half of new capacity between them, but significant contributions also came from Spain, Sweden, Mexico and Argentina. The implications of these developments are complex and are explored further below, with one significant aspect being the deepening of the market for purchasing wind energy.

GROWTH AND DEEPENING THE MARKET FOR PPAS

Power Purchasing Agreements, or PPAs, are one of the most common contracts used to purchase energy from suppliers. Conventionally, these contracts would be between one generator and one consumer, for example, with an on-site PPA covering one windfarm and one corporate consumer. The growth in the demand for PPAs is illustrated in Exhibit 4 below, and is immense with a tripling of corporate PPAs in the last three years.

Exhibit 4. Global Volume in Corporate PPAs

Estimates are from Bloomberg New Energy Finance; volume is the maximum (DC) capacity of the renewable assets.



Source: Bloomberg New Energy Finance

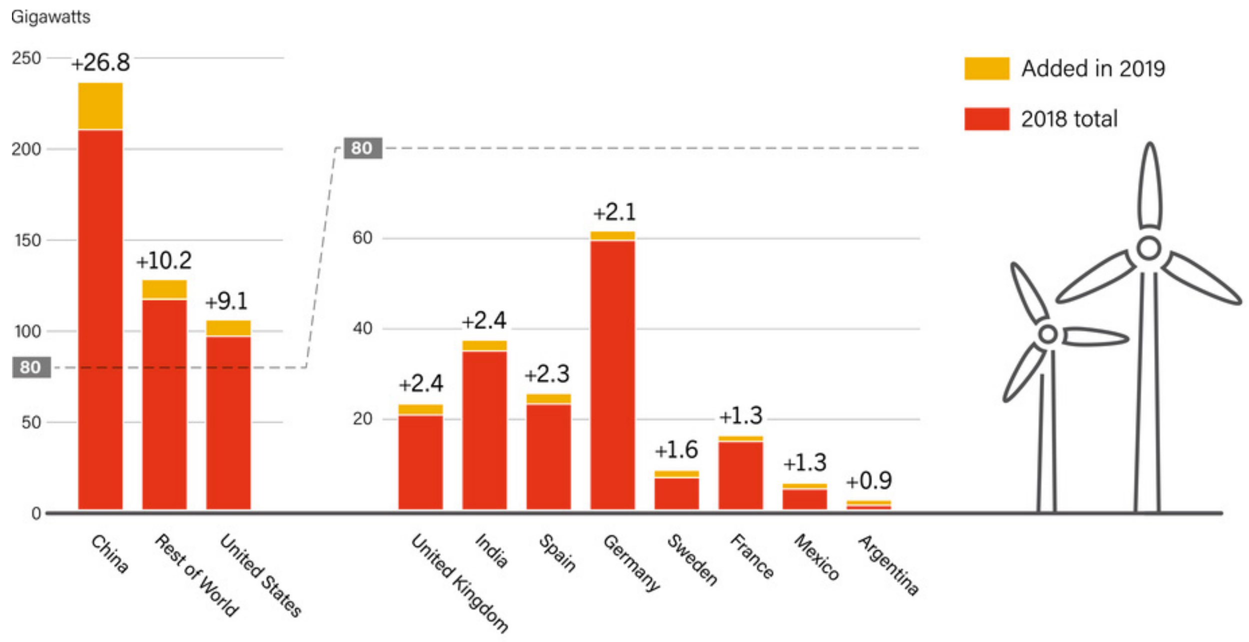
The sheer scale of the potential market for wind power has led to an evolution of the PPA market. Large corporates, such as Microsoft in 2017 have held private auctions to provide generation to their datacentres, and for public bidding processes the market has led to the development of "collaborative PPAs". These can take a range of forms, such as with a consortium (similarly sized businesses with similar risk tolerances aggregate energy demand to allow for access to the PPA market), with an anchor (one single entity contracts the majority of the PPA, smaller PPAs are made by other entities), or a reseller (a large buyer acquires a PPA then divides the offtake into smaller parcels which are resold). Similarly, on the supply side of the PPA, multiple renewable energy producers can aggregate their output to create a more reliable and competitive PPA offering.

In this way the development of collaborative PPAs accommodates an entirely new customer base which previously could not access renewable energy at competitive rates, while the developers face less risk with aggregation enabling a standardisation of PPA contracts. The growth of this approach enables renewables to embed themselves more deeply into communities and increase investor demand for opportunities in wind projects going forward. For further information on PPAs and how they play a key role in financing opportunities within wind energy, please refer to the Stirling Infrastructure Wind Financing paper.

[5] REN21. (2020). "Chapter 3: Market and Industry Trends: Wind Power." Renewables 2020 Global Status Report. https://www.ren21.net/gsr-2020/chapters/chapter_03/chapter_03/#start-wind

5. THE GLOBAL FUTURE OF WIND ENERGY

Exhibit 5. Wind Power Capacity and Addition, Top 10 Countries, 2019



Note: Additions are net of decommissioning.

Source: Renewables 2020 Global Status Report

Recent figures show wind power represented an estimated 5.9% of electricity generation in 2019. Going forward, onshore and offshore wind together is expected to generate anywhere between 20% and 35% of total electricity needs by 2050 according to policy ambitions, depending on the source. This translates into a median case of 6,000 GW of wind capacity globally.[6] Rapidly falling costs per kilowatt-hour have made wind energy ever more competitive and will play a key role in the accelerated deployment pathway for wind power. 2020 marked a pivotal moment for wind energy, being the first year that onshore wind consistently offered a less expensive source of new electricity than the lowest cost fossil fuel alternatives in most regions. This is a sign that the onshore industry is now mature enough to proceed without direct government support, although the offshore industry could still benefit from favourable policies and well-designed auction and tender structures. Offshore wind currently represents only 5% of the total wind output and only 10% of new annual installation capacity, although 2019 was a record year for new offshore installations. This is expected to increase now that technology has advanced to 10 MW capacity turbines being commercially available and the World Bank announced a new programme to accelerate the deployment of offshore wind power in emerging markets, many of which have strong offshore wind resources.

COVID-19 IMPACT

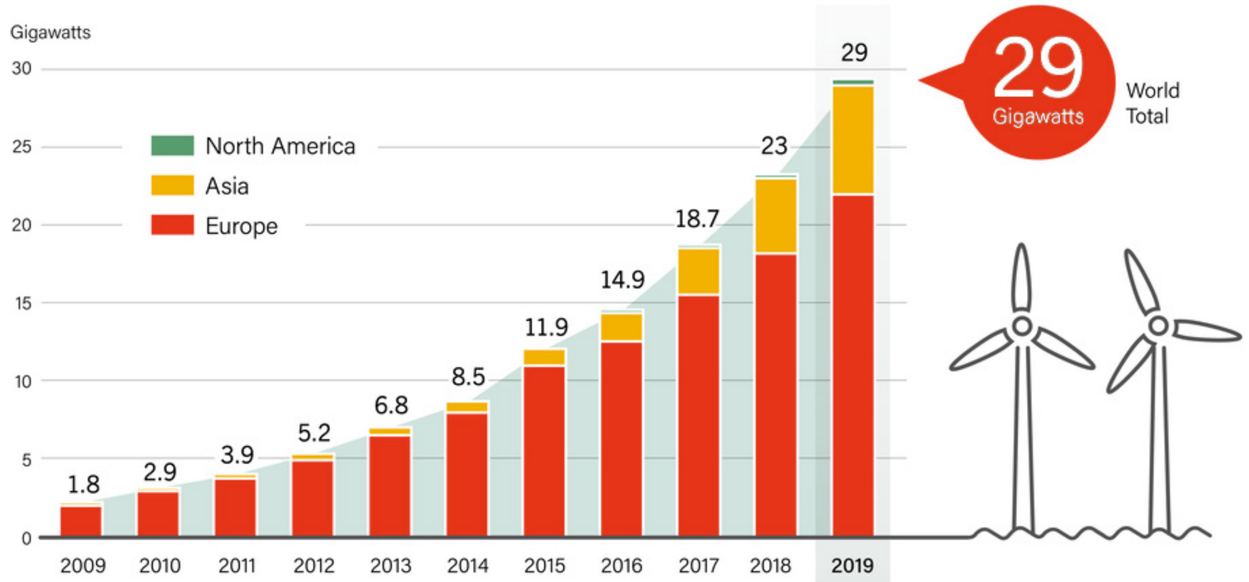
It is important to note that in the short term it remains to be seen how COVID-19 will impact the 150 GW installation expected over the 2020-21 build cycle. There are indicators that there could be delays or withdrawal of planned investment due to restrictions on labour availability and construction delays, particularly within the onshore segments. However, this shorter-term delay could lead to ever higher adoption of wind as a solution to the problems of the COVID recession. The wind industry is expected to create over seven million new jobs that didn't exist before, which already are part of a post-COVID "Green New Deal" rhetoric that is global, with advocates across Europe and the US. It is important to note that the overall impact of COVID-19 on wind growth will depend highly on economic growth, which rests on policy responses to the virus. Therefore, care must be taken to understand the specific nation or region of interest and their respective policy outlook.

[6] International Renewable Energy Agency. (2019). Future of Wind: Deployment, investment, technology, grid integration and socio-economic aspects. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Oct/IRENA_Future_of_wind_2019.pdf

REGIONAL GROWTH

Europe currently still is the leader in offshore wind capacity (Exhibit 6), being home to 75% of global offshore wind capacity, with the UK accounting for about half of their offshore installation for 2019.[7] Germany became the first country to add more offshore capacity than onshore in a year.

Exhibit 6. Wind Power Offshore Global Capacity by Region, 2009-2019



Source: Renewables 2020 Global Status Report

Global auctioned capacity in 2019 was more than double the 2018 total, with 25 GW auctioned onshore and 15.8 GW offshore.[8] While declining costs and fierce competition have driven down average bid prices in many countries, bids have been rising in others, such as Germany where five of the six onshore auctions were undersubscribed. Some of the lowest bids (excluding China) were seen in Brazil (USD 20.8 per MWh) and Denmark (USD 22.8 per MWh) paving the way for increased activity in these regions.

6. CONCLUSION

We believe that there are many areas of interest for wind investment, but top ranked opportunities lie primarily within the US, China, France, Germany and the UK. These are attributable to strong economic growth drivers, favourable environmental policies and reliable track records in meeting previously stated targets. Forecasts from The World Bank reinforce these expectations, where renewable energy developments are expected to be supported by sustainable growth rates in these regions from 2021 onwards. Beyond these more conventional regions for wind energy there is also significant potential in emerging economies that are set to experience rapid growth into the renewable energy market. Examples include India and Argentina. However, currently, aspects such as the absence of competitive finance solutions, qualified workforces and associated technology such as developed grid infrastructure increase the risks of investing into these markets. These markets can also offer good return potential for investors who have the appetite and competitive advantage to enter these markets. The source of capital and risk of currency depreciation must be managed carefully when investing into these jurisdictions.

Stirling Infrastructure advises on capital allocation and the acquisition and disposal of renewable assets globally. Our team is well-positioned to conduct thorough due diligence into onshore and offshore wind opportunities. We work with and have access to a diversified range of global debt and equity providers. Our function is to secure the most flexible and competitively-priced capital available on the international private debt and equity markets. Both debt and equity providers will have variable expectations from market to market in relation to the risk they are willing to assume and the returns that they require to allocate capital. For any requests for further information or for project-specific advice please contact us at: enquiries@stirlinginfrastructure.com.

[7] Global Wind Energy Council. (2020). Global Offshore Wind Report 2020. https://gwec.net/wp-content/uploads/dlm_uploads/2020/08/GWEC-offshore-wind-2020-5.pdf

[8] REN21. (2020). "Chapter 3: Market and Industry Trends: Wind Power." Renewables 2020 Global Status Report. https://www.ren21.net/gsr-2020/chapters/chapter_03/chapter_03/#start-wind

OUR OTHER PUBLICATIONS ON THIS SUBJECT

Wind Financing: Financial Instruments and Key Considerations

Energy Storage Financing for Sustainable Infrastructure

FOR FURTHER INFORMATION

This report is a primer that presents our renewables M&A transaction team and debt & equity capital raising team's expertise in advising project sponsors, institutional investors and private market investors. The firm provides M&A transaction services and debt / equity capital raises for renewable projects globally.

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