PLATFORM FOR ACTION ON RENEWABLE ENERGY (PoA)

BRIEFING PAPER

WIND POWER

Introduction

Wind power is one of the fastest-growing renewable energy technologies worldwide. As indicated in Figure 1, wind power is the second largest source of renewable electricity globally, after hydro power, and along with solar power is currently humankind's greatest hope for the transition to a 100% renewable energy future. Usage of wind power is on the rise worldwide, partly because costs are falling and partly because technology innovations in the sector have helped maximise electricity produced per installation, while also improving on electricity produced per megawatt installed, thereby helping unlock more sites with lower wind speeds.

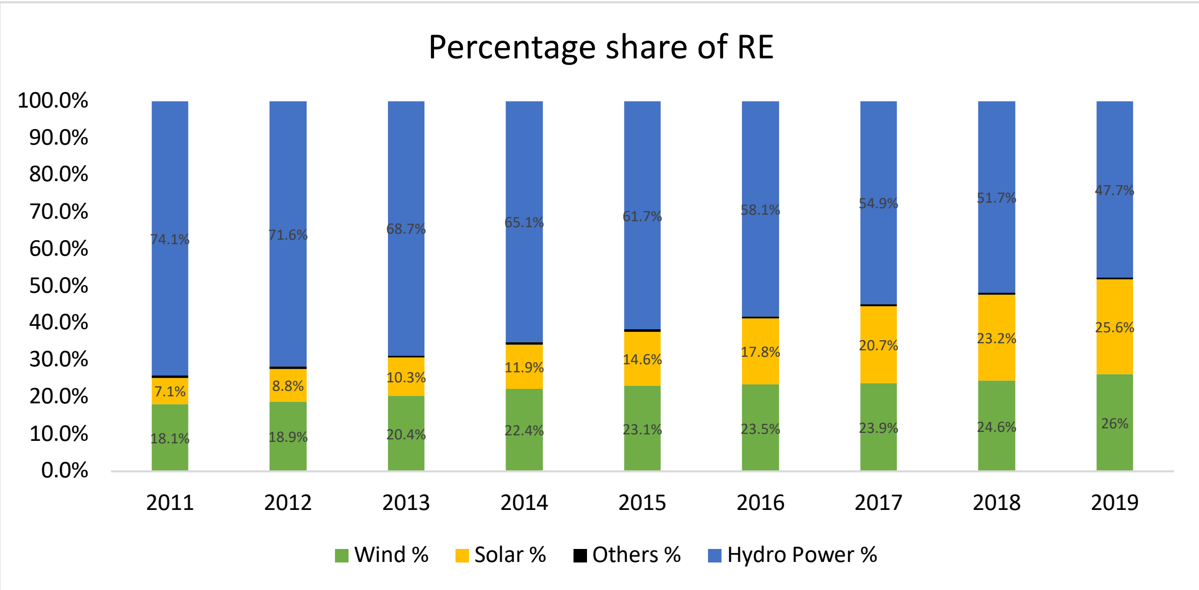

Figure 1:Cumulative global percentage share of RE capacity

Graph based on raw data from IRENA website[1].

As of 2021, wind power is mainly harvested in onshore sites where wind turbines are installed on land, in areas with high wind speeds. However, offshore wind power is expected to grow rapidly since offshore wind is able to take advantage of the better wind resources in the sea thereby achieving more full-load hours, while also benefitting from not having to compete with

[1] International Renewable Energy Agency (IRENA) (2021), "Renewable Capacity Statistics 2021", https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Apr/IRENA_RE_Capacity_Statistics_2021.pdf

alternate uses of the space that the wind turbines occupy. Offshore wind, in combination with storage solutions like green hydrogen, is considered the best bet for meeting the energy demand in the hard-to-abate sectors, such as steel production, chemicals, aviation, maritime shipping and other forms of long-haul transport that have higher barriers for electrification.

Current Status

Global wind capacity reached 743 GW in 2020, with the global wind industry showing year-over-year (YoY) growth of 53%[2]. Despite 2020 being a challenging year with disruption to both the global supply chain and project construction, the market grew by a record 93 GW of new installations, of which 86.9 GW was on-shore and 6.1 GW was offshore. China and the US remained the world's largest markets for new onshore additions, and the world's two major economies together increased their market share by 15% to 76%. In the offshore wind sector, the Netherlands took the lead for new additions in 2020 followed by Belgium, the United Kingdom, Germany, Portugal, the United States of America and South Korea. Total off-shore wind capacity passed 35 GW, representing 4.8% of total global cumulative wind capacity. In terms of cumulative installations, the top five markets at the end of 2020 were China, the US, Germany, India and Spain, which together accounted for 73% of the world's total wind power installations.[3]

Wind Power generated around 1,591.6 TWh of electricity in 2020, of which 111.6 TWh came from offshore wind and 1,480.4 TWh came from onshore wind.[4] This amounted to 50.6% of the electricity generated from global renewable electricity (3147 TWh) and 5.9% of the of total global electricity generated (26823.2 TWh) in 2020.[5]

Future Outlook

As per estimates of the Global Wind Energy Council (GWEC), indicated in Figure 2, the Compounded Annual Growth Rate (CAGR) for onshore wind in the next five years is 0.3% and GWEC expects annual installation of 79.8 GW. In total, 399 GW is likely to be built in 2021-2025. The CAGR for offshore wind in the next five years is 31.5%. The level of annual installations is likely to quadruple by 2025 from 6.1 GW in 2020, bringing the global market share of offshore wind new installations from today's 6.5% to 21% by 2025. In total, more than 70 GW offshore is expected to be added worldwide in 2021-2025.[6] According to the Bloomberg NEF analysis, onshore wind became one of the cheapest new sources of electricity

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[2] IRENA (2021) ibid Pg. 13

[3] GWEC Global Wind Report 2020; Pg. 46

[4] IEA (2021) "Wind Power 2021", https://www.iea.org/reports/wind-power

[5] BP(2021) "BP Statistical Review of World Energy 2021", https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html

[6] GWEC Global Wind Report 2020; Pg. 68-72

in 2020, while offshore wind has delivered incredible global LCOE (Levelised Cost of Electricity, the measurement of full life cycle cost per kWh during operation) reduction of more than 67% over the last 8 years, and costs will decline by another third by 2030. GW-scale wind projects at falling costs, paired with hydrogen, highlight the opportunity to achieve commercial viability by the end of this decade.[7]

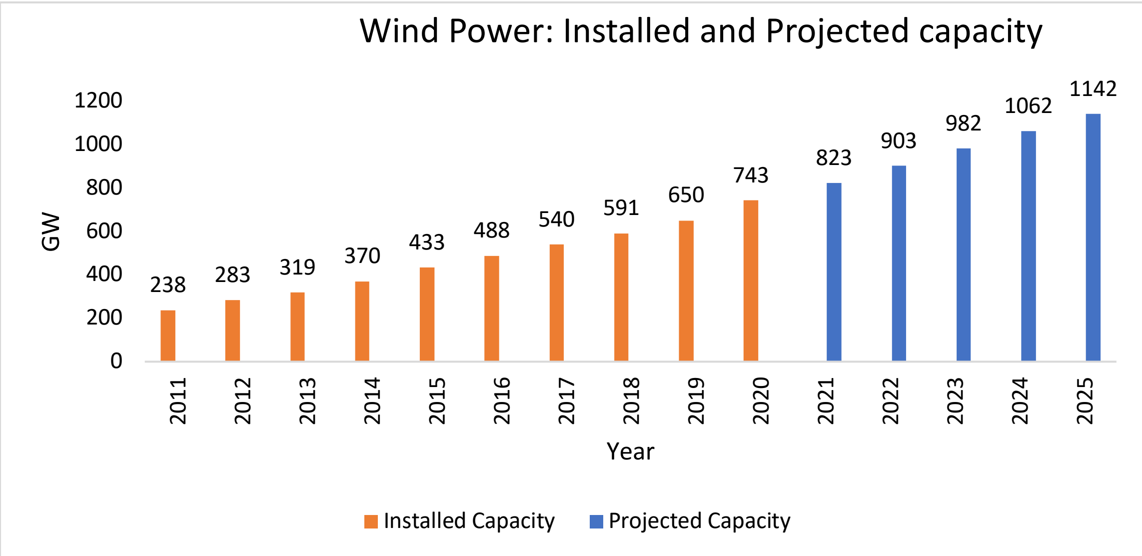

Figure 2: Wind Power: Installed and Projected Capacities
Graph based on data from GWEC Global Wind Report 2020; Pg. 68-72

Challenges and Bottlenecks

Wind power deployment around the world faces certain challenges, which can be classified into technical, environmental, financial and political and legal challenges, as indicated in Figure 3.

[7] GWEC Global Wind Report 2020; Pg. 20

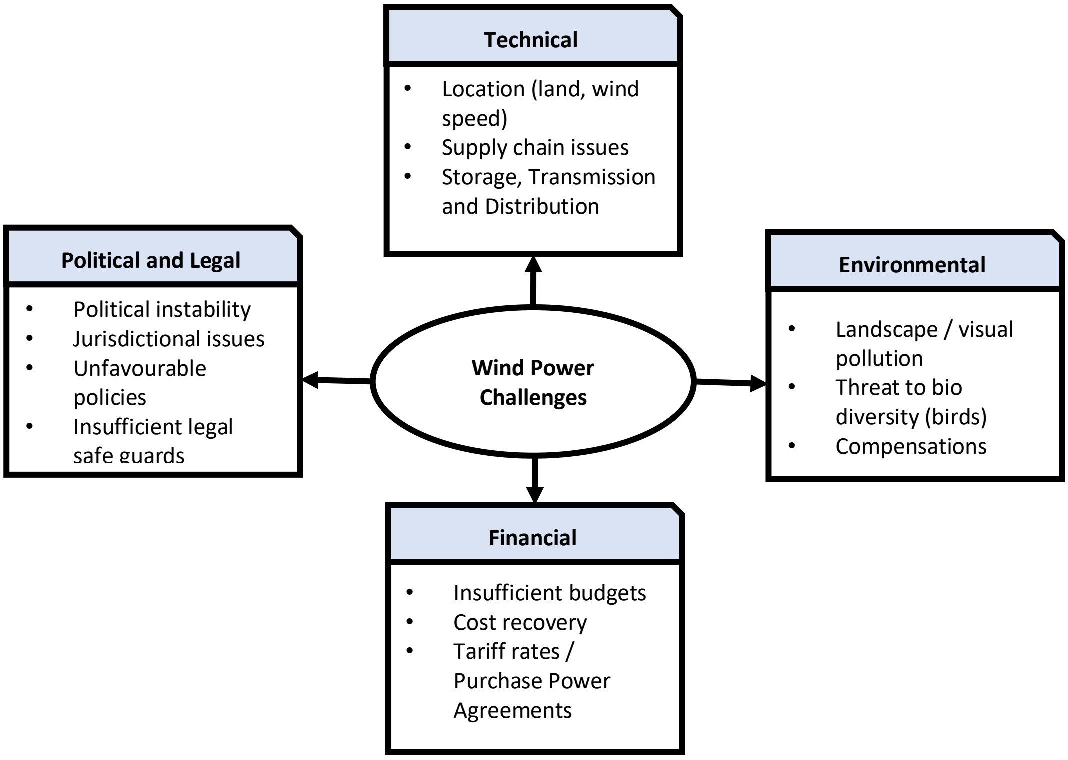

Figure 3: Challenges faced by Wind Power sector

Technical challenges: The biggest challenge that wind power faces is that of seasonality and weather-dependence. While particularly wind power offshore installations display high load factors over the year and in several cases reach "baseload" quality, onshore wind energy cannot be made available 'on-demand' like energy generated from fossil fuels and therefore make it imperative to combine wind energy with efficient storage adding to the cost of delivered energy and linkages to an effective high voltage transmission system. In many countries with potentially high power demands, the load might fluctuate significantly from day to day or month to month, from below 20% to over 80%. That makes a well-managed grid system indispensable to keep the lights on with reliable and affordable electricity. Site specificity with the sites with the best wind potential often located in remote areas, far from the usage points or markets underline the requirement for a reliable transmission infrastructure to be developed.

Environmental challenges: Often windparks, both onshore and offshore installations face the challenge of having to compete with alternate uses of land in some countries or with biodiversity concerns in others. While sensitive, participatory and planned siting and management of windparks with appropriate Environmental Impact Assessments will diffuse most concerns like noise, bats and birds impacts etc., there are still certain groups opposed as a matter of principle to wind power in some countries.

Political and Legal challenges: Wind power plants are often spread across a large geographical area to take advantage of economies of scale, often spread across regions or states. This poses jurisdictional challenges for market participants, as they need to navigate cross-border government policies. In addition to this, political instability affects wind power deployment as renewable energy policies might change with change in government. In many countries governments define the policies, the "whether" and the "how" related to tariff rates and industrial power purchase agreements. These may not always provide sufficient legal protections to the suppliers, which hampers installation plans.

Financial challenges: Developing countries may have insufficient budgets or investment capabilities to deploy wind power installations. Cost recovery becomes an issue for market participants if the tariff rates defined in the country are too low.

Technological development and challenges: Wind power offshore and onshore are expected to operate in the future with new large scale (10-15 MW) turbines in a utility scale mode or with much smaller ones in a more local, distributed, mini-grid or off-grid system in community owned systems and to overcome energy poverty in the Global South. All sizes of new wind power turbines are expected to increase their load factor/efficiency, their recyclability once retired and their reduction of demand for conflict minerals in a much more Circular Economy. Floating wind power in marine environments are likely to add in the coming decade to the great clean energy wind potential, so are mini-wind and roof-based wind turbines. Generally good planning by governments and in liaison with nature conservation agencies should succeed to earmark and allocate to the landscape efficient use of windparks and transmission grids.

Conclusion

Wind energy is one of the most important sources of clean and renewable energy in humankind's efforts to a 100% transition from fossil fuels in global energy systems. Falling costs and improved technology has helped bring wind energy to the forefront in the basket of renewable energy technologies that will help to cutting global emissions by 50% by 2030 as required by science, and reaching the 'net-zero' goal by 2050, thereby limiting global warming to 1.5°C. Onshore wind is already a mature and mainstream energy source which is cost-competitive with new fossil fuel plants. In more and more regions, including parts of China, the EU, India, and the United States, it is now cheaper to build new wind farms than to build new fossil fuel power plants or to even operate existing coal-fired power stations**.** Offshore wind, due to its inherent advantages is expected to grow significantly and already has achieved commercial viability in several marine regions in the North West Atlantic of Europe and will be soon in China and the USA followed by other countries with a suitable coast line. Further, a combination of wind with hydrogen is considered the best bet for meeting the energy demand in the hard-to-abate sectors. Of all renewable energies, offshore wind and wind-solar hybrid projects have the highest potential to improve the economics of green hydrogen projects due to cost competitiveness and scalability. However, if wind power has to achieve large-scale market penetration and acceptance it will require balancing and storage technologies to go hand in hand, so as a achieve an effective and secure energy transition.