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Floating Wind Turbines - a Promising Alternative

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Climate change is negatively impacting the global economies. The primary cause of climate change is environmental pollution caused by greenhouse gases emitted from human activities. One of major contributor to greenhouse gases is energy production. Currently, most of the energy is produced from fossil fuel, which is a large source of greenhouse gas emission. Consequently, clean energy sources, such as wind, solar, geothermal, and nuclear, have received considerable attention as alternatives to mitigate emissions.

Wind energy is one of the most readily available sources of energy globally, and there has been a push by countries to harness wind energy. Energy generated from wind depends on wind speed, which is generally very high near coastal areas and deep seas. Wind turbines are used to harness wind energy, and their capacity usually varies based on the size of the blades and the height of the turbines. Wind turbines can be installed onshore or offshore, wherever wind speed is high. Onshore wind turbines have higher adoption compared to offshore, due to their low complexity and ease of installation. However, offshore installations have recorded steep growth in the last 5 to 6 years due to higher wind speed at sea.

Offshore wind turbines are categorized into fixed-bottom and floating wind turbines. Fixed-bottom wind turbines are installed near the shore where the depth is low, while the floating ones are installed in deep water. Countries across the globe, especially developed ones, have shown interest in floating wind turbines in recent years.

Floating Wind Turbine Development

Floating wind turbine technology is relatively new compared with other wind technologies. The demonstration of the first grid-connected MW-scale floating offshore wind turbine took place in Norway in 2009. The overall development and commercialization of floating offshore wind turbines are segregated into three phases: 1. conceptualization (2009–16), which includes inception, prototype development, and successful demonstration; 2. pre-commercialization (2017–23), which includes testing and early phase of commercialization; and 3. commercialization (post-2024), which includes commercial operations of wind turbines. Floating wind turbines are likely to witness greater adoption worldwide once technology get fully commercialized.

Technology Trends

In floating wind turbines, the turbines are installed on floating platforms and technology used for these platforms is key to success for floating wind turbines. Companies have developed and designed many technologies for these platforms such as barges, spar-buoy, semi-spar, semi-submersibles, tension leg platform (TLP), and multi-turbine/hybrid. Of these, spar-buoy, semi-submersible, and TLP are most commonly used at present.

In tandem with technological development in platforms, wind turbine technology is expected to advance at a fast pace, thereby enabling floating

offshore wind energy to scale up in the near future. Improvements in the size of the turbine and rotor diameter may drive the offshore wind energy industry. Enhancements and improvements in other components of the floating offshore wind turbines (e.g., wind turbine nacelle, rotor, balance of plant) could further bring down the cost of floating wind energy.

Advantages and Challenges

One of the main advantages of floating offshore wind turbines is the availability of high-speed wind throughout the year in deep water, which can be used to generate electricity continuously. Since wind speed is higher, high-capacity wind turbines can be employed for electricity generation. Floating wind turbines do not affect the human habitat as it does not use land, which is becoming a scarce resource globally. These turbines can cope with extreme conditions such as tsunami, earthquake, and seabed spreading. Decreased piling, reduced soil disturbance in installation and decommissioning, and less cable burial minimizes the impact on marine life.

The commercial-scale floating wind industry has the potential to introduce new industries to ports, creating new investments in ports. Moreover, abandoned floating platforms of dried oil & gas fields can be used for offshore wind installation.

The major challenge with floating offshore wind turbines is the high upfront installation and maintenance cost. The average cost of a floating offshore wind turbine is twice that of a fixed-bottom offshore wind turbine. Floating offshore wind platforms constitute more than 30–40% of the total CAPEX. However, given the rapid technological innovation and increase in offshore wind energy investments, costs are likely to reduce. As the number of commissioned floating offshore wind farms increases in the coming years as planned, platform and turbine cost would eventually drop.

Another obstacle to floating offshore wind installation is opposition from the fishing community. Fishermen believe that floating wind turbines would disrupt the movement of fish and pose a threat to their livelihood.

Market Scenario

Floating offshore wind is still in an early phase of growth in most countries worldwide. In 2021, around 57.1 MW capacity of floating offshore wind turbines was installed globally. Majority of the new installations in 2021 were in Europe (48 MW in the UK and 3.6 MW in Norway). The overall installed capacity of floating wind turbines was around 121.4 MW globally in 2021. This includes around 78 MW installed capacity in the UK, 25 MW in Portugal, 5.9 MW in Norway, 5.5 MW in China, 5 MW in Japan, and 2 MW in France. Other regions, including North America, have yet to install commercial floating offshore wind capacity on a large scale. In addition, two floating wind turbines were decommissioned in 2021, including a 5 MW capacity turbine in Japan and a 2 MW capacity turbine in the UK.

Future Outlook

According to an estimate around 80% of the world's offshore wind energy potential lies in deep water (water with depth below 60 m), and most of it, is still unexplored. Hence, there is significant potential for floating offshore wind globally. As per the Global Wind Energy Council forecasts, around 28.7 GW capacity of the new floating wind turbines will be added between 2022 and 2031. Roughly 10% of the new capacity would be added during 2022–26, and the remaining 90% is planned to come online during 2027–31. Europe is likely to record the highest capacity of new installations with a total contribution of 59.2%, followed by Asia (29.4%) and North America (11.4%).

The future outlook for floating offshore wind turbines looks optimistic, supported by technological advances and reduction in overall installation cost. Major countries, such as the UK, US, South Korea, Spain, and Ireland, are anticipated to register higher growth in floating offshore wind turbines over the next 8–10 years.