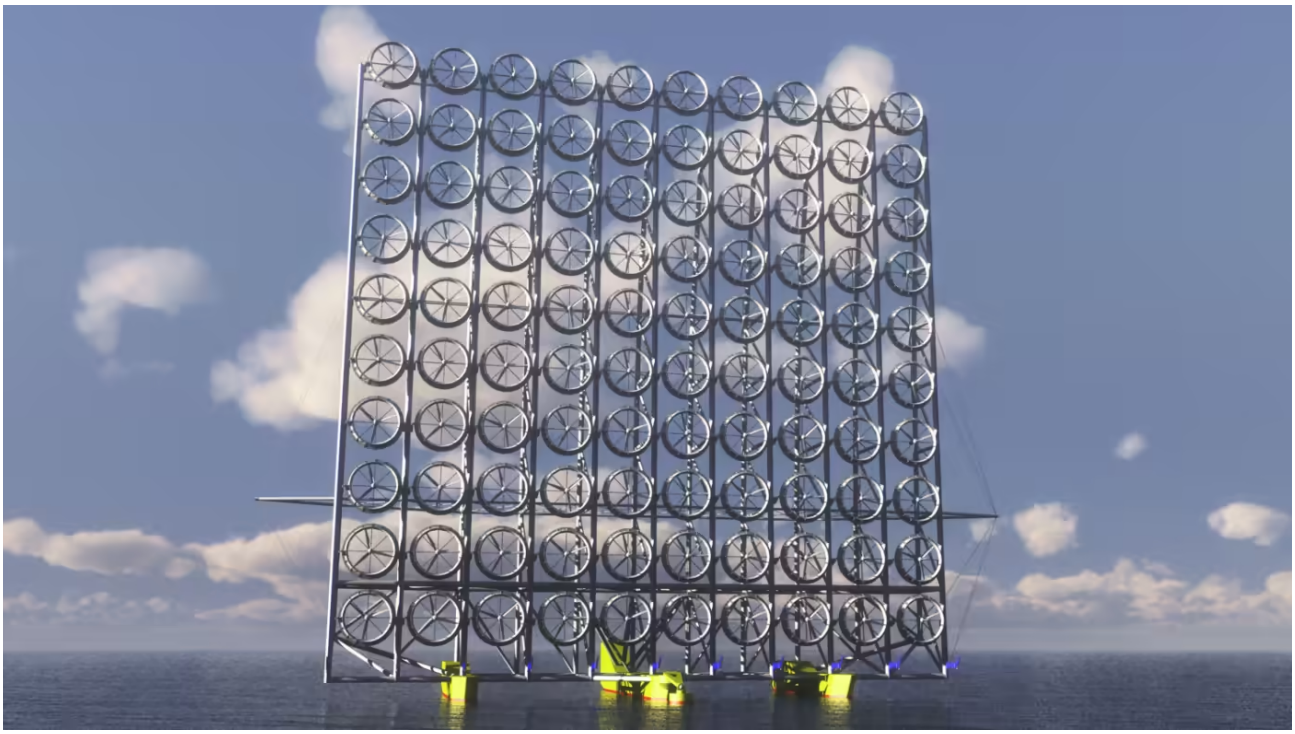
TECHNOLOGY

Cluster-type wind turbines emerge as new energy source

Kyushu University plans to start trials of offshore units by 2028



A multi-turbine system can theoretically generate more power than a single-turbine unit of similar size, according to researchers. (Image courtesy of Kyushu University)

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TOKYO -- As offshore wind power is increasingly touted as a future clean energy source amid growing concerns about climate change and energy security, researchers are racing to develop technologies for cluster-type offshore wind power units consisting of many turbines.

Kyushu University's Research and Education Center for Offshore Wind, for example, has developed a new turbine design featuring a shroud -- a kind of wind-collecting "lens" -- and plans to build a demonstration unit comprised of 100 small wind turbines.

The output of a wind turbine grows in proportion to the swept parts of each turbine blade. This is why blades have grown increasingly larger over the years.

The largest turbines currently in service are nearly 300 meters high, but enlarging their blades requires strengthening the tower on which they stand -- a costly endeavor. Some experts say the cost-effectiveness of simply enlarging the blades for greater output is now approaching its limit.

Large blades spin over 100 meters per second. When blades are spinning at such a high speed, even raindrops can damage them. And the noise emitted by huge, fast-spinning blades is also a problem.

Cluster-type wind power units mounted on a grid provide a possible solution to this, as their blades are designed to generate power efficiently without rotating as fast. And placing turbines close to each has multiplier effects.

Theoretically, a multi-turbine system can generate more power than a traditional single-turbine unit of similar size, according to researchers.

Kyushu University and Riamwind, a Fukuoka-based startup spun off from the university, have joined in a project to build a demonstration system comprised of two turbine units, each with a diameter of 25 meters in 2024.

Data from this demo system will be used to build another consisting of a matrix of beams that support 100 turbines arranged in a 10-unit by 10-unit format. Measuring some 230 meters high and 280 meters wide, the system should produce 20 megawatts of power.

The turbines in the system are smaller than traditional wind turbines and can be repaired separately, which means the system can continue generating power even if some turbines are damaged or stopped for maintenance.

This approach is attracting the attention of investors around the world. Norwegian startup Wind Catching Systems, for example, plans to build a 300-meter-tall unit comprising a matrix that supports about 130 turbines, each with a diameter of about 30 meters.

The company claims that its floating technology can generate five times the annual energy of the world's largest single turbines, or 75 MW. The company was founded in 2017. General Motors Ventures is one of its current investors.

Riamwind innovative turbine technology features a diffuser shroud at the circumference of its rotor for concentrating wind energy. This relatively small, new type of turbine, called a wind lens turbine, can generate power more efficiently.

When wind hits the lens, it creates a vortex. The vortex generated by the wind lens forms a lower pressure area behind the turbine, further increasing the wind flow drawn into the turbine and boosting wind velocity.

Even a small difference in wind velocity translates into a significant increase in power generation. In experiments, the wind lens turbine produced two to three times more power than a conventional wind turbine with the same rotor diameter, according to the company.

Small wind lens turbines with a diameter of several meters have already been put to practical use. Yuji Oya, a professor emeritus of Kyushu University and head of Riamwind, says the new turbine's energy-capture efficiency per unit of the swept area is higher than any other wind turbine in the world.

Vortexes created by the blades within the area inside the lens cancel each other, reducing noise. Results confirm that this system generates less noise than a turbine with the same output capacity.

Since the lens does not move and is easy for birds to detect, the system is also less susceptible to bird strikes.

One of the problems with this design, however, is that the lens catches wind along with the blades, which means the wind lens turbine is subjected to more wind pressure than traditional systems. This raises the risk of damage when subjected to extremely strong winds. The company is considering installing the turbine or the blade horizontally to reduce wind pressure.

One challenge common to cluster-type wind power systems is the high costs of the supporting grid. Reducing the total weight is crucial for making this approach popular.

In a meeting in Sapporo in April, the climate, energy and environment minister of the Group of Seven leading democracies pledged a collective increase in offshore wind capacity of 150 gigawatts by 2030. Achieving the ambitious goal requires promoting new wind power technologies including cluster-type turbines.