Alternative wind turbine designs

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Global wind power installations have more than quadrupled over the past decade, thanks to improved designs and growing awareness. As research in this area grows, more innovative designs are emerging, promising higher adoption rates and energy generation. Here are eight of the most exciting of these next-gen wind power innovations.

Horizontal axis wind turbines are the most common turbine arrangement today. However, vertical axis wind turbines (VAWTs) -- where the blades rotate perpendicular to the ground rather than parallel to it -- perform better in inconsistent wind conditions. New VAWT designs make them more resilient and efficient, letting organizations take full advantage of their flexibility.

Norwegian startup World Wide Wind has created a VAWT with a maximum output of 40 megawatts, 2.5 times more than the current largest turbine. The key is using two vertical turbines rotating in opposite directions.

This coaxial rotation multiplies the VAWT''s relative speed, producing more power under the same conditions. It also stabilizes the turbine, making it last longer and reducing its impact on the surrounding environment.

Affordability is another crucial aspect of next-generation wind power. Some organizations are addressing turbines'' cost problems by building their blades from recyclable materials. Using recycled resources lowers blade production costs and enables further recycling in the future, keeping those expenses low.

Instead of using virgin fiberglass and steel, manufacturers are turning to balsa wood, recycled glass and novel thermoplastic resins. They also bind them with resins that liquefy at high temperatures, which makes it possible to break components apart to recycle them in the future. In addition to lowering costs, this recyclability will help improve turbines'' overall environmental impact.

Another way to improve turbine blades is to make them larger, as longer blades generate more electricity. In past designs, size increases eventually reach a point of diminishing returns because of the blades'' weight. Some companies are addressing this by breaking blades into segments.

Turbine blades are often 195 feet or longer, making production, shipping and assembly challenging and expensive. Segmented blades allow for faster, cheaper manufacturing with less room for error when extracting them from molds. Similarly, companies can ship and assemble them more quickly, creating larger turbines without excessive costs.

Segmentation also helps blades withstand stress from the wind and gravity, reducing the need for extra support and reducing their weight. Consequently, they last longer and turn more efficiently.

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While some next-generation wind power designs aim to make larger turbines, others maximize the benefits of smaller ones. Small turbines do not generate as much power overall, but they are more efficient, considering their size-to-energy ratio. Smaller turbines can also take advantage of ducts, which constrain airflow to spin the blades faster without higher winds.

Ducted designs do not work on the scale of a large turbine with 200-foot blades, but researchers have found they can use an array of smaller ducted turbines as a solution. Instead of using one large fan, they create a wall of small ducted ones. This design combines the efficiency benefit of ducts and smaller turbines and the scale of larger installations.

One often overlooked issue with wind turbines is they interfere with radar. That interference affects the accuracy of flight traffic control systems, weather services and defense operations, especially as wind farms become more common. One way to address this problem is to build turbine blades out of more radar-friendly materials.