Offshore wind farms could tame hurricanes before they reach land, study says

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Credit: AI-generated image (disclaimer)

For the past 24 years, Mark Z. Jacobson, a professor of civil and environmental engineering at Stanford, has been developing a complex computer model to study air pollution, energy, weather and climate. A recent application of the model has been to simulate the development of hurricanes. Another has been to determine how much energy wind turbines can extract from global wind currents.

In light of these recent model studies and in the aftermath of hurricanes Sandy and Katrina, he said, it was natural to wonder: What would happen if a hurricane encountered a large array of offshore wind turbines? Would the energy extraction due to the storm spinning the turbines' blades slow the winds and diminish the hurricane, or would the hurricane destroy the turbines?

So he went about developing the model further and simulating what might happen if a hurricane encountered an enormous wind farm stretching many miles offshore and along the coast. Amazingly, he found that the wind turbines could disrupt a hurricane enough to reduce peak wind speeds by up to 92 mph and decrease storm surge by up to 79 percent.

The study, conducted by Jacobson, and Cristina Archer and Willett Kempton of the University of Delaware, was published online in *Nature Climate Change*.

The researchers simulated three hurricanes: Sandy and Isaac, which struck New York and New Orleans, respectively, in 2012; and Katrina, which devastated New Orleans in 2005.

"We found that when wind turbines are present, they slow down the outer rotation winds of a hurricane," Jacobson said. "This feeds back to decrease wave height, which reduces movement of air toward the center of the hurricane, increasing the central pressure, which in turn slows the winds of the entire hurricane and dissipates it faster."

In the case of Katrina, Jacobson's model revealed that an array of 78,000 wind turbines off the coast of New Orleans would have significantly weakened the hurricane well before it made landfall.

In the computer model, by the time Hurricane Katrina reached land, its simulated wind speeds had decreased by 36-44 meters per second (between 80 and 98 mph) and the storm surge had decreased by up to 79 percent.

For Hurricane Sandy, the model projected a wind speed reduction by 35-39 meters per second (between 78 and 87 mph) and as much as 34 percent decrease in storm surge.

Jacobson acknowledges that, in the United States, there has been political resistance to installing a few hundred offshore wind turbines, let alone tens of thousands. But he thinks there are two financial incentives that could motivate such a change.

One is the reduction of hurricane damage cost. Damage from severe hurricanes, caused by high winds and storm surge-related flooding, can run into the billions of dollars. Hurricane Sandy, for instance, caused roughly $82 billion in damage across three states.

Second, Jacobson said, the wind turbines would pay for themselves in the long term by generating normal electricity while at the same time reducing air pollution and global warming, and providing energy stability.

"The turbines will also reduce damage if a hurricane comes through," Jacobson said. "These factors, each on their own, reduce the cost to society of offshore turbines and should be sufficient to motivate their development."

An alternative plan for protecting coastal cities involves building massive seawalls. Jacobson said that while these might stop a storm surge, they wouldn't impact wind speed substantially. The cost for these, too, is significant, with estimates running between $10 billion and $40 billion per installation.

Current turbines can withstand wind speeds of up to 112 mph, which is in the range of a category 2 to 3 hurricane, Jacobson said. His study suggests that the presence of massive turbine arrays will likely prevent hurricane winds from reaching those speeds.

Provided by Stanford University

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