Amazing resource.

Dr. Lawrence Cheung and the team from GE Global Research are maximizing the power production of clean energy wind farms.

As a clean, renewable energy source, wind power is unbeatable. Research studies show that wind, harnessed effectively, could meet all the world's energy demands.

But a gap still exists between potential and reality… a gap that Lawrence Cheung and GE Global Research are working on closing.

Dr. Cheung is a lead mechanical engineer at GE Global Research Center's Aerothermal discipline. There, he studies wind and noise — elements critical to the design of wind turbines and wind farms.

"The research is so interesting," Cheung says. "We're trying to understand what the wind is doing around the turbines, why it might not be getting enough power here or why it's not efficient there. It's a process of capturing better clues and filling in missing gaps."

Cheung calls the science and technology of wind energy a "grand challenge." For one, wind is almost mythically difficult to track and measure. Not only is it invisible to the naked eye, wind motions vary in scale and their movements change hourly, daily and seasonally.

From a product development standpoint there's the ongoing challenge of refining turbine blade design for maximum cost efficiency, productivity and noise mitigation.

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Then there's the placement of turbines in relation to one another. Turbines grouped together in a land-based wind farm affect the flow of wind, and thus, energy capture.

"In a wind farm you want to figure out the optimal layout and spacing for each wind turbine to maximize their output," Cheung says. "To do that we have to get better at predicting the kind of wind that will come in." And traditional methods such as radar and wind measurement devices don't provide a comprehensive enough picture of what's going on around an entire array of turbines.

Answers to all these challenges can be found in one approach — computational fluid dynamics (CFD) simulations. But the size and scale of the data required to simulate wind movements would translate to months of calculations on anything other than a supercomputer.

Using their Cray system, Cheung and GE are running predictive simulations of wind farms in a couple of weeks. "Instead of going out there with radar we'll set up a simulation for that equivalency," Cheung says.

Cheung and the team are encouraged by what they've accomplished so far. "We've been able to measure and repeat what we've seen in the atmosphere," he says. "We can see what's going on in the wind field around the turbine and those learnings will be built into some of the next turbines."

Supercomputing capability has been critical to that insight. "We're getting things that can't ever be reasonably measured in the field. We're getting information that would be impossible to measure by others means," Cheung says. And with that, the gap between potential and reality shrinks.

SYSTEM DETAILS

Cray® XE™ series supercomputer
Cray® XC™ series supercomputer