Winter could pose solar farm 'ramping' snag for power grid

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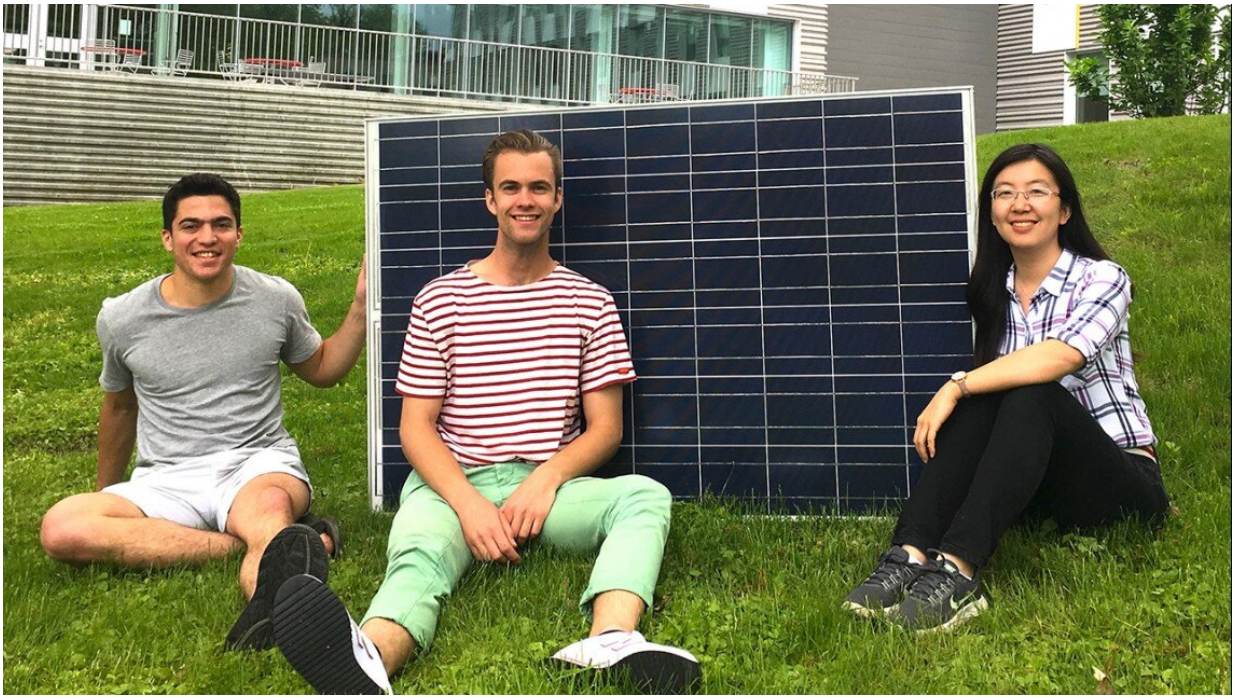

From left, Jackson Siff ’19, Jeff Sward and Jiajun Gu, both doctoral candidates, examined ramping on the electric grid and land parcels for solar farms. Credit: Cornell University

By adding utility-scale solar farms throughout New York state, summer electricity demand from conventional sources could be reduced by up to 9.6% in some places.

But Cornell engineers caution that upstate winters tell a different tale. With low energy demand around midday in the winter, combined with solar-electricity production, New York's power system could face volatile swings of "ramping—which is how power system operators describe quick increases or decreases in demand.

"It's a very surprising finding," said senior author Max Zhang, Cornell associate professor at Cornell's Sibley School of Mechanical and Aerospace Engineering. "When are you going to have maximum ramping take place in New York? It's not going to be in the summer when the solar power is the highest and the needs are more balanced. It turns out to be in the winter."

Said Zhang, a fellow at Cornell's Atkinson Center for a Sustainable Future: "When you have several days of sunshine in a row during winter, that causes the largest ramping on the power system in New York state."

The new paper, "Strategic Planning for Utility-Scale Solar Photovoltaic Development—Historical Peak Events Revisited," was published May 15 in *Applied Energy*. In addition to Zhang, co-authors are Cornell doctoral candidates Jeff Sward and Jiajun Gu, and Jackson Siff '19.

The energy industry's ramping dilemma—due to spikes in net load, which is the total electric demand minus renewable electricity generation—creates a so-called "duck curve." When people wake up and prepare for the day, it takes energy to run the house—and that becomes the morning peak. Since solar reaches peak production in the middle of the day, the net load lags.

When people get home from work in the evening, energy demands create a second peak. Thus, with a peak, a large lag and a second peak that slowly diminishes in the evening, the graphic curve of net load resembles a duck.

Ramping makes the grid less efficient, because system operators then must employ natural gas or other carbon methods to keep up with demand, Sward said. "This paper can inform regional development trends and could lead to the improvement of electricity transmission from upstate to downstate," he said.

"The increasing ramping requirement will be a challenge in pursuing our renewable energy target," said Zhang, "but it can be met with flexible resources, both in the supply and demand sides, as well as energy storage."

As part of the paper, Siff worked with David Kay, senior extension associate in development sociology, with Cornell's Community and Regional Development Institute to conduct spatial analysis of New York state land parcels in order to identify places where utility-scale solar farms could work best.

More information: Jeffrey A. Sward et al, Strategic planning for utility-scale solar photovoltaic development – Historical peak events revisited, *Applied Energy* (2019). DOI: 10.1016/j.apenergy.2019.04.178

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