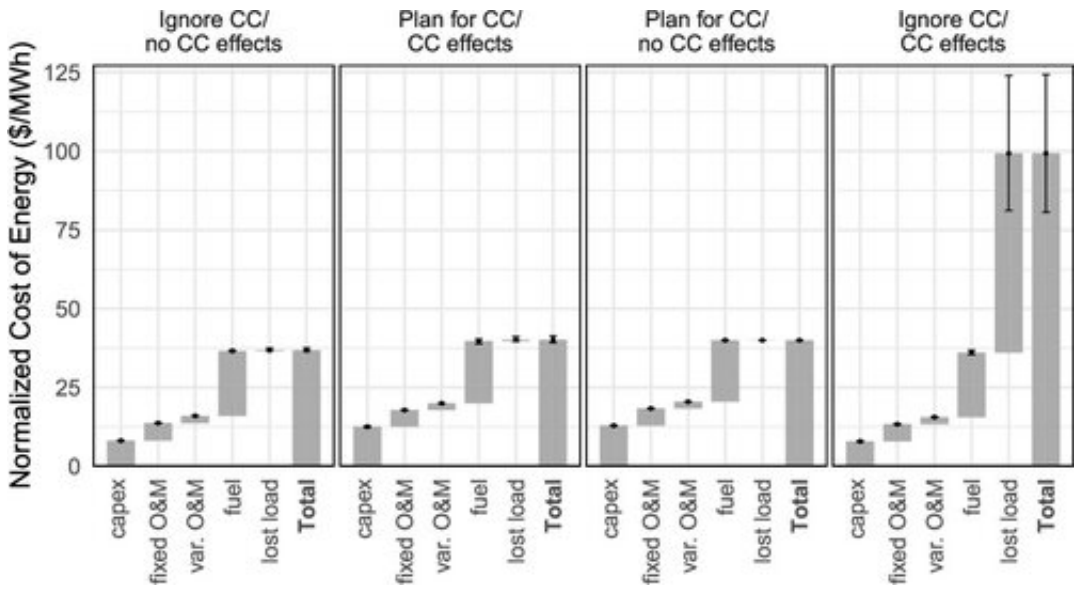
New tool to help electrical grid planners design sustainable systems

September 30 2021, by Dan Carroll



DOI: 10.1021/acs.est.1c01334Credit:

A team of Carnegie Mellon University researchers led by Paulina Jaramillo, a professor of engineering and public policy, has created a new tool to help electrical grid planners design sustainable systems to provide consumers reliable and affordable energy.

The team's recent study focused on climate change and electricity system operations in the southeastern United States. However, similar issues affect regions across the U.S.

"We are excited to have finally published the results of this project, which involved a large team working together for five years," Jaramillo said. "When we started the project, there wasn't too much work about climate impacts on the power systems."

Extreme climatic events like those affecting Texas and the Pacific Northwest have provided an early warning for events to come and have shown that money and lives are at risk when people cannot receive electricity from energy-decision makers whom they rely on to ensure its delivery. As Jaramillo and her team show, energy planning that doesn't account for the effects of climate change will result in tremendous societal costs.

"Our study demonstrates that adapting to climate change isn't a significant driver of future costs," said Michael Craig, who graduated with a doctorate in engineering and public policy from CMU in 2017 and is now a professor at the University of Michigan. "Instead, it's failing to adapt to climate change that can significantly increase costs and have large social consequences"

Their study found that across the U.S. overall electricity demand will rise, and demand peaks during the summer will disproportionately intensify. Increased demand and increases in the size of demand peaks, in particular, will necessitate an increase in generation capacity.

However, increased demand has not been the only factor at play in recent events. Environmental extremes related to climate change also can damage energy infrastructure or push equipment past its parameters for safe operation, forcing system operators to shut it down.

Over the past year, outages occurred because of extreme cold in Texas and wildfire risk in California and Oregon. Even when operational, the strain placed on generating equipment by increased extremes in climate

could reduce the available capacity at individual power plants, a process known as "derating."

Unlike prior work on the power sector, the team's model simultaneously accounts for demand- and supply-side climate impacts and evaluates the effects on planning decisions and operating issues. That is why Jaramillo is eager to get this and similar tools into the hands of the decision-makers charged with building, managing and regulating energy systems.

Jaramillo's team, with the support of the nonprofit Clean Air Task Force, has held one webinar for academics and researchers to discuss the results of this study and identify additional research needs. The team will present their work to industry and regulators at another webinar in November.

"Obviously, there is now more awareness of the risks of climate impacts on power systems," Jaramillo said. "It is also interesting to note that changes in investment decisions to mitigate climate-induced risks can also support carbon emissions reductions, which highlights that mitigation and adaptation strategies can align."

As Jaramillo works to put this new information into the right hands, her research will continue to help chart the way ahead for energy planners. She said she plans to incorporate further historical data into the team's model and expand the tool to model the effects of increased electrification and climate induced extremes on energy systems.

The team also includes Carnegie Mellon's Mario Berges, professor of civil and environmental engineering, and Edson Severnini, an associate professor of economics and public policy, as well as colleagues at the University of Washington and the Pacific Northwest National Laboratory. They also are exploring the impacts of climate change on renewable energy sources, transmission efficiency across the power grid

and through acute climate events like forest fires or flooding.

More information: Francisco Ralston Fonseca et al, Climate-Induced Tradeoffs in Planning and Operating Costs of a Regional Electricity System, *Environmental Science & Technology* (2021). DOI: 10.1021/acs.est.1c01334

Provided by Carnegie Mellon University