

Investing in energy storage for solar, wind power could greatly reduce greenhouse gas emissions

30 July 2019, by Jim Erickson



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Drive through nearly any corner of America long enough and giant solar farms or rows of wind turbines come into view, all with the goal of increasing the country's renewable energy use and reducing greenhouse gas emissions.

But what some may not realize is at times these [renewable energy sources](#) can produce more power than what is needed, leaving some solar or [wind energy](#) to, in a sense, go to waste. This oversupply condition is a lost opportunity for these clean [energy](#) resources to displace pollution from fossil fuel-powered plants.

But by creating complex models analyzing [power systems](#) in California and Texas, University of Michigan scientists show in a study scheduled for online publication July 30 in *Nature Communications*, that investing in batteries and other energy [storage](#) technologies can be economically viable with proper policy support.

That, in turn, could radically reduce the emissions of greenhouse gases—by up to 90% in one scenario examined by the researchers—and increase the use of solar and wind energy at a time when [climate change](#) takes on greater urgency.

"The cost of energy storage is very important," said study co-author Maryam Arbabzadeh, a postdoctoral fellow at U-M's School for Environment and Sustainability. "But there are some incentives we could use to make it attractive economically, one being an emissions tax."

Arbabzadeh led the research in collaboration with colleagues at Ohio State University and North Carolina State University. Gregory Keoleian, director of U-M's Center for Sustainable Systems, served as her adviser and one of the co-authors of the study.

"Electricity generation accounts for 28% of the [greenhouse gas emissions](#) in the United States, and given the urgency of climate change it is critical to accelerate the deployment of renewable sources such as wind and solar," said Keoleian, a professor of environment and sustainability and civil and environmental engineering.

"This research clearly demonstrates how energy storage technologies can play an important role in reducing renewable curtailment and greenhouse gas emissions from fossil fuel power plants."

Arbabzadeh and her fellow researchers created complex models analyzing nine different energy storage technologies. They looked at the environmental effects of renewable curtailment, which is the amount of renewable energy generated but unable to be delivered to meet demand for a variety of reasons.

They also modeled what would happen if each state would add up to 20 gigawatts of wind and 40 gigawatts of solar capacity, and how all of this would be impacted economically by a carbon dioxide tax of up to \$200 per ton.

What they found was striking.

Adding 60 gigawatts of renewable energy to California could achieve a 72% carbon dioxide reduction. Then, by adding some energy storage technologies on top of that in California could allow a 90% carbon dioxide reduction. In Texas, energy storage could allow a 57% emissions reduction.

But for all of this to happen, utility companies would need a reason to invest in energy storage systems, which require large amounts of capital investment. That is where the use of a carbon tax could be helpful, Arbabzadeh said.

All nine of the energy storage technologies studied, including high-tech batteries, require a significant capital investment and all had different pros and cons. Also adding to the complexity of the research is the different type of generation mix in Texas and California.

Texas uses some coal and natural gas-fired units. California uses more inflexible resources, like nuclear, geothermal, biomass and hydroelectric energy units, which make its renewable curtailment rates much higher than Texas.

The study is titled "The Role of Energy Storage in Deep Decarbonization of Electricity Production."

More information: Maryam Arbabzadeh et al. The role of energy storage in deep decarbonization of electricity production, *Nature Communications* (2019). [DOI: 10.1038/s41467-019-11161-5](https://doi.org/10.1038/s41467-019-11161-5)

Provided by University of Michigan

APA citation: Investing in energy storage for solar, wind power could greatly reduce greenhouse gas emissions (2019, July 30) retrieved 25 January 2022 from <https://techxplore.com/news/2019-07-investing-energy-storage-solar-power.html>

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