Concentrated Solar Power with Thermal Energy Storage Can Help Utilities' Bottom Line

NREL News

The storage capacity of concentrating solar power (CSP) can add significant value to a utility company's optimal mix of energy sources, a new report by the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) suggests.

The report found that CSP with a six-hour storage capacity can lower peak net loads when the sun isn't shining, enough to add $35.80 per megawatt hour to the capacity and operational value of the utility, compared to photovoltaic (PV) solar power alone, and even higher extra value when compared to CSP without storage. The net load is the normal load minus variable renewables such as photovoltaic and wind.

The additional value comes because thermal storage allows CSP to displace more expensive gas-fired generation during peak loads, rather than displacing lower-priced coal; and because it can continue to flatten the peak load in the evenings when PV isn't contributing to the mix because the sun has set.

The report, "Simulating the Value of Concentrating Solar Power with Thermal Energy Storage in a Production Cost ModelPDF," by NREL's Paul Denholm and Marissa Hummon, noted that the $35.80 per megawatt extra value would come in a scenario in which there is relatively high penetration of renewables into the utility's mix, about 34 percent. If the penetration was lower, the extra value would be lessened.

The authors simulated grid operations in two balancing areas primarily in Colorado. NREL is also using the same methodology it developed for the Colorado scenario for the more complex California system controlled by the California Independent System Operator. A report on the value that CSP with thermal storage adds to the California system is expected early next year.

The Colorado study marks one of the first times that the operational and capacity value of CSP with thermal storage has been evaluated using a production cost model, a traditional utility planning tool.

The NREL authors employed Energy Exemplar's PLEXOS simulation model that allowed them to isolate the relative value of thermal energy storage (TES) with and without storage.

CSP with TES, with an ability to store thermal energy in, say, molten salt, can use its heat-energy to drive turbines at power plants over much longer stretches of the day.

"We've known for a long time that CSP with storage adds significant value, however, we are now able to quantify this value in the language utilities understand," said Mark Mehos, manager of NREL's Concentrating Solar Power program.

Compared to other renewable options, at high penetration levels CSP with TES can be dispatched to displace natural gas rather than coal. This is important because electricity produced from natural gas fired generators is typically more costly than that produced from coal.

"With CSP with thermal storage, you aren't diving as deep into the generation stack, displacing cheaper and cheaper fuel," Denholm said. "You're always displacing the highest-cost fuel."

Also, CSP with TES can lower peak net loads in the evenings when electricity use can still be high, but PV isn't available. So, it helps utilities offset the need to build new gas-fired generators in order to meet the electricity demand when the sun goes down.

"CSP with thermal storage can continually reduce that peak demand as the peak moves into the evening," Hummon said. "It continually maintains a high operational value and high capacity value."

NREL is the U.S. Department of Energy's primary national laboratory for renewable energy and energy efficiency research and development. NREL is operated for DOE by the Alliance for Sustainable Energy, LLC.

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