Newer solar power equipment ages better than older units

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Utility-scale photovoltaics, ground-mounted projects larger than 5 megawatts of alternating current, are the largest sector of the overall solar market within the U.S. and the fastest-growing form of renewable power generation.

This fleet of utility-scale photovoltaic projects is relatively young and hasn't been operating long enough to establish a lengthy history of operational field service. The first utility-scale photovoltaic projects in the U.S. came online in 2007, and most projects have been operating for only a few years.

In the *Journal of Renewable and Sustainable Energy*, Mark Bolinger and colleagues from the U.S. Department of Energy's Lawrence Berkeley National Laboratory and the National Renewable Energy Laboratory assess the performance of a fleet of 411 utility-scale photovoltaic projects built within the U.S. from 2007 through 2016.

This fleet produced more than half of all of the solar electricity generated within the U.S. in 2017.

After correcting for variations in weather and curtailment, the group found, on average, the first-year performance of these systems was largely as expected, and that newer projects have degraded at a slower rate than older ones. This suggests photovoltaics technology has improved over time. Interestingly, they also confirmed that projects in hotter climates tend to degrade faster than those in cooler climates.

"A large and rapidly growing market that lacks a lengthy operating history means that investors are fronting a lot of money—$6.5 billion for projects built within the U.S. in 2018 alone—based on as-yet untested assumptions about the long-term performance of these projects," said Bolinger.

Photovoltaic cells degrade in efficiency and performance over time due to a variety of factors.

"Most photovoltaic module manufacturers warrant that their modules' performance won't degrade by more than a certain percentage, for example, losing 0.5% per year, during a 25-year period," he said. "But module degradation is only part of the story, because the other components of a utility-scale photovoltaic system—the inverter, tracking system, fuses, wiring—can also negatively affect output."

Many existing studies so far have explored module-level degradation, but the total system-level performance and degradation is what truly affects the bottom line.

"To our knowledge, our study is the first use of fixed effects regression techniques to analyze photovoltaic performance degradation," Bolinger said. "Unlike other approaches commonly used, fixed effects regression is compatible with low-frequency generation data."

Because low-frequency generation data tends to be publicly available, in contrast to high-frequency data, which is often proprietary, this new approach is more accessible to researchers and enables large-sample or even fleetwide analyses.

"But the flip side is that lower-frequency data often results in greater uncertainty around degradation estimates," Bolinger said. "By focusing on system-level rather than module-level performance, our approach provides a more holistic and realistic estimate of long-term investment risk."

More information: "System-level performance and degradation of 21 GWDC of utility-scale PV plants in the United States," *Journal of Renewable and Sustainable Energy* (2020). DOI: 10.1063/5.0004710

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