Research finds silicon-based, tandem photovoltaic modules can compete in solar market

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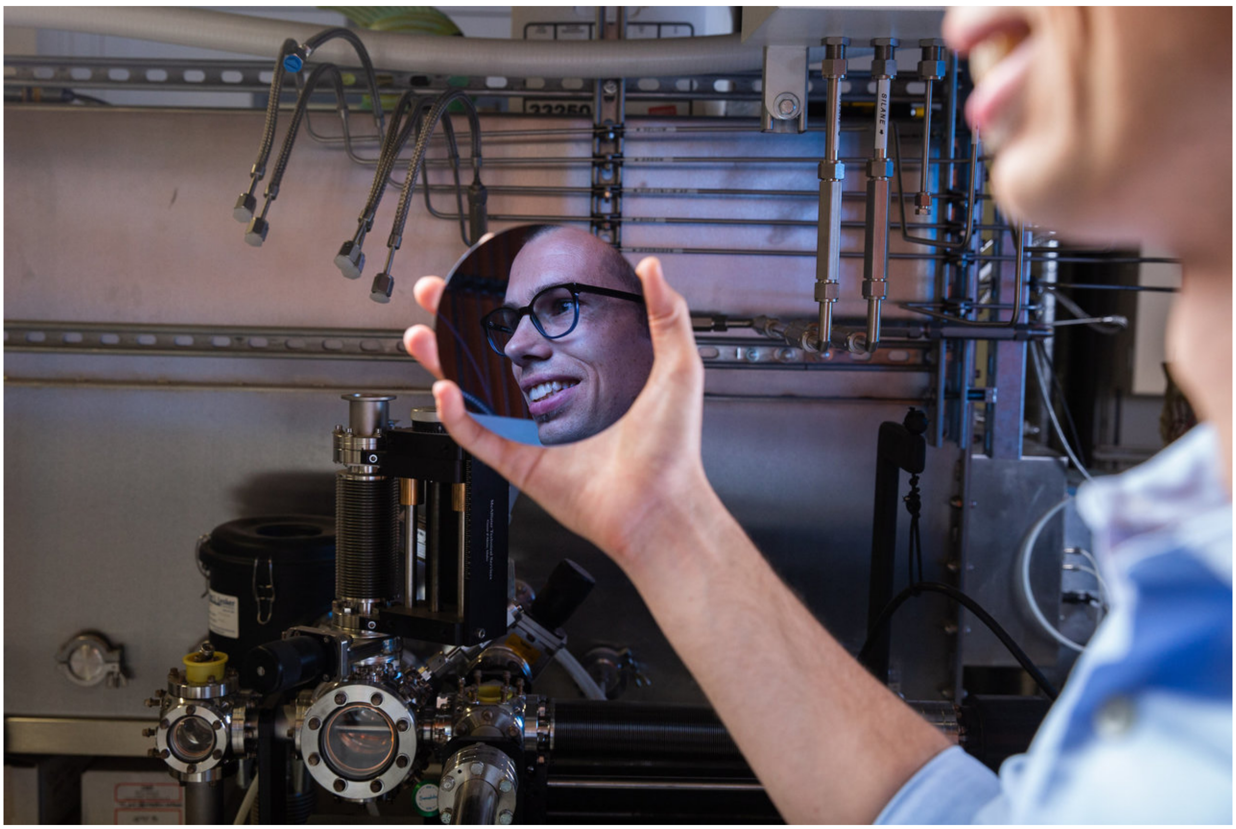


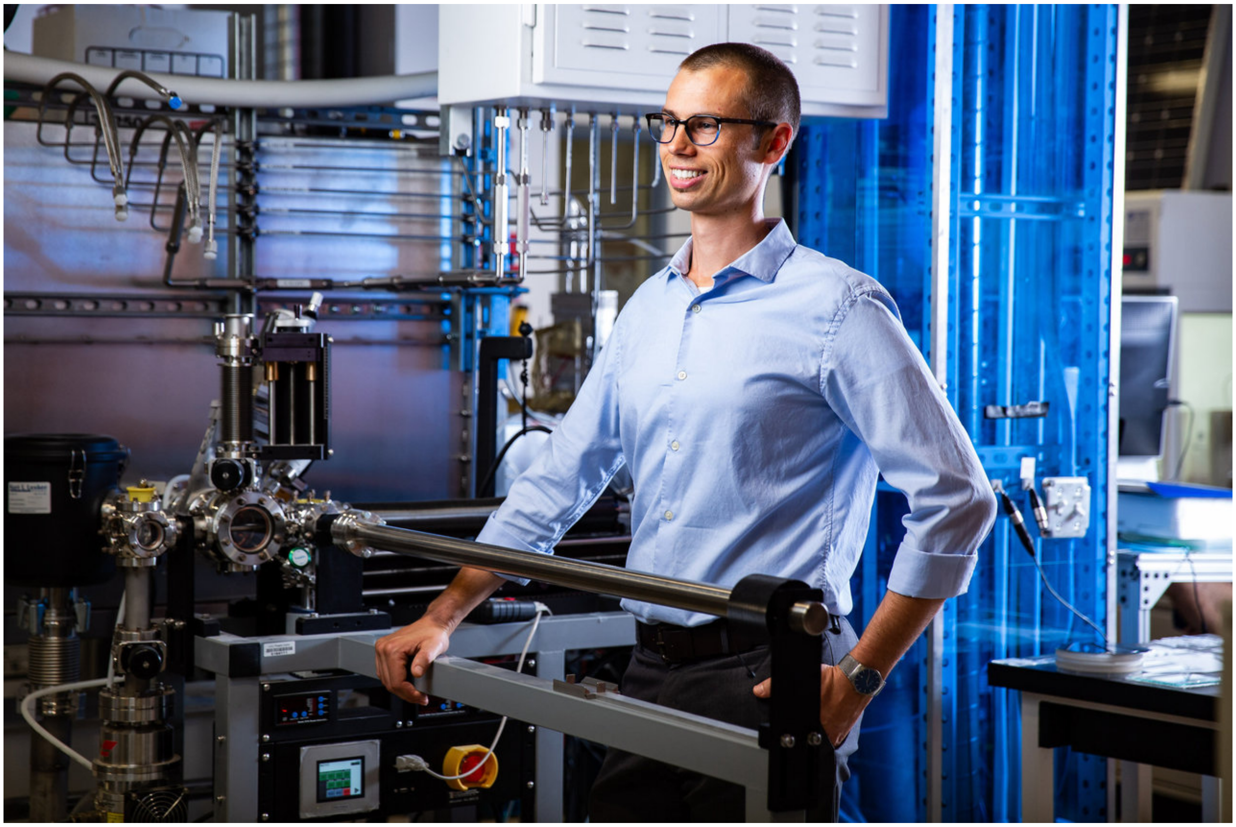
Assistant Professor Zachary Holman's holds his reflection in a solar cell in the Holman Research Group Lab. Holman's research focuses on solar cells, transparent conductive oxides and semiconductor nanoparticles. Photo by Deanna Dent/ASU Now Credit: Deanna Dent/ASU Now

New solar energy research from Arizona State University demonstrates that silicon-based, tandem photovoltaic modules, which convert sunlight to electricity with higher efficiency than present modules, will become increasingly attractive in the U.S.

A paper that explores the costs vs. enhanced efficiency of a new solar technology, titled "Techno-economic viability of silicon-based, tandem photovoltaic modules in the United States," appears in *Nature Energy* this week. The paper is authored by ASU Fulton Schools of Engineering, Assistant Research Professor Zhengshan J. Yu , Graduate Student Joe V. Carpenter and Assistant Professor Zachary Holman.

The Department of Energy's SunShot Initiative was launched in 2011 with a goal of making solar cost-competitive with conventional energy sources by 2020. The program attained its goal of $0.06 per kilowatt-hour three years early and a new target of $0.03 per kilowatt-hour by 2030 has been set. Increasing the efficiency of photovoltaic modules is one route to reducing the cost of the solar electricity to this new target. If reached, the goal is expected to triple the amount of solar installed in the U.S. in 2030 compared to the business-as-usual scenario.

But according to Holman, "the dominant existing technology—silicon—is more than 90 percent of the way to its theoretical efficiency limit," precipitating a need to explore new technologies. More efficient technologies will undoubtedly be more expensive, however, which prompted Holman and co-authors to ask, "does a doubling of module efficiency warrant a doubling of cost?"



Assistant Professor Zachary Holman research group focuses on solar cells, transparent conductive oxides and semiconductor nanoparticles. Credit: Deanna Dent/ASU Now

Tandem modules stack two, complementary photovoltaic materials—for instance, a perovskite solar cell atop a silicon solar cell—to best use the full spectrum of colors emitted by the sun and exceed the efficiency of either constituent solar cell on its own. The study was designed to determine how much more expensive high-efficiency tandem photovoltaic modules can be and still compete in the evolving solar marketplace.

Results indicate that in the expected 2020 U.S. residential solar market, 32-percent-efficient anticipated tandem modules can cost more than three times that of projected 22-percent-efficient silicon modules and still produce electricity at the same cost. This premium, however, is a best-case scenario that assumes the energy yield, degradation rate, service life and financing terms of tandem modules are similar to those of silicon modules alone. The study also acknowledges that cost premium values will vary according to region.

"Our previous study defines the technological landscape of tandems; this study paints the economic landscape for these future solar technologies that are only now being created in labs. It tells researchers how much money they're allowed to spend in realizing the efficiency enhancements expected from tandems," says Yu.

More information: Zhengshan J. Yu et al, Techno-economic viability of silicon-based tandem photovoltaic modules in the United States, *Nature Energy* (2018). DOI: 10.1038/s41560-018-0201-5

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