New solar energy solutions

Top 9 Emerging Trends in the Solar Energy Industry [2025 & Beyond]

"This is a great time to be involved with solar technology," said Chris Deline, head of the National Renewable Energy Laboratory"s photovoltaic field performance group.

As solar energy booms in the U.S. with record investments and installations, a wave of technological advancements is set to transform the amount of energy solar can produce, where it can be deployed, and how long it can last.

"It seems like when there"s a good idea, it can very rapidly get rolled out through the whole industry," said Chris Deline, a research engineer who leads the National Renewable Energy Laboratory"s photovoltaic field performance group.

Over the last five years, Deline said, the industry "entirely switched over" from aluminum back surface field solar, or Al-BSF, cells to passivated emitter rear contact, or PERC, cells. "And it seems like there are new emerging entrants within n-type silicon that are poised to do the same thing," taking over from PERC, he said.

For example, the solar industry is now beginning to make a switch from p-type PERC to n-type tunnel oxide passivated contact, or TOPCon, cells. N-type cells have their wafers doped negatively using chemicals like phosphorus, while p-type cells are doped positively. Doping is the process of adding an impurity to the semiconductor to increase its ability to conduct electricity.

In the early days of solar technology, installations were limited to space applications like satellites, and p-type cells proved more resistant to radiation and degradation in space than n-type cells. This allowed p-type technology to stake out a larger market share early on, and this domination continued after terrestrial solar installations began -- though n-type cells are more efficient and resilient for utility and other applications outside of space.

Now, n-type cells are gaining ground.

"That"s going to be a big transition," Deline said. "It"s like Moore"s Law of faster and faster computer processors that allows them to keep going to higher and higher efficiencies."

PERC continued to dominate the solar panel market in 2022, but experts predict the technology will go the way of its predecessor, Al-BSF. The German industrial association VDMA said in an April report that it projects TOPCon"s market share will increase from around 10% in 2022 to as much as 60% globally within the next decade, and become the dominating cell type after 2025.

"It is a generally accepted view that TOPCon will ramp up relatively quickly in market share and likely dominate crystalline silicon solar technology in the not-so-distant future," said First Solar"s Chief Technology Officer Markus Gloeckler.

Across all panel types, the average dollars-per-kilowatt cost of solar construction has fallen by a few thousand dollars since 2013, and fell 6% to $1,561 per kW in 2021, the Energy Information Administration said in an October analysis.

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