Microgrid solar energy

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Simply put, we need a reliable and secure energy grid. Two ways to ensure continuous electricity regardless of the weather or an unforeseen event are by using distributed energy resources (DER) and microgrids. DER produce and supply electricity on a small scale and are spread out over a wide area. Rooftop solar panels, backup batteries, and emergency diesel generators are examples of DER. While traditional generators are connected to the high-voltage transmission grid, DER are connected to the lower-voltage distribution grid, like residences and businesses are.

Microgrids are localized electric grids that can disconnect from the main grid to operate autonomously. Because they can operate while the main grid is down, microgrids can strengthen grid resilience, help mitigate grid disturbances, and function as a grid resource for faster system response and recovery.

Solar DER can be built at different scales--even one small solar panel can provide energy. In fact, about one-third of solar energy in the United States is produced by small-scale solar, such as rooftop installations. Household solar installations are called behind-the-meter solar; the meter measures how much electricity a consumer buys from a utility. Since distributed solar is "behind" the meter, customers do not pay the utility for the solar power generated.

Distribution grids are vulnerable to outages that can affect large regions and millions of people and businesses, particularly as a consequence of extreme, destructive weather events. When parts of the grid are equipped with DER, they can continue serving other loads on the same distribution network, meeting local needs with local generation. This is called islanding. Electrical systems that can disconnect from the larger grid, engaging in intentional islanding, are often called microgrids.

Technology is advancing to manage the risks caused by islanding with better control software and to provide grid services. Without the larger grid to help stabilize the power supply, an islanded grid could damage connected equipment or injure workers who think it is disconnected from power. For this reason, many solar energy systems are programmed to detect islanding and disconnect from the grid if it occurs. Beyond microgrids, some researchers are studying nanogrids--smart electricity systems on the scale of a single building.

When power outages happen, this energy management system allows for fast reconfiguration of distributed renewable energy resources to turn power back on faster than before.

Microgrids are localized electric grids that can disconnect from the main grid to operate autonomously, even with the larger grid is down. While microgrids are still rare--as of 2022, about 10 gigawatts of microgrid capacity was installed in the U.S.--interest in renewable energy microgrids is growing rapidly. Now, thanks to a research project with Siemens Corporation, new technologies enable microgrids to work together, further

increasing their potential to support resilient energy systems.

As natural disasters become more common due to climate change, and as more Americans power their lives with solar energy and other distributed energy sources, advanced microgrid technology like this will become an increasingly important tool to ensure reliable electricity.

The second layer allows distributed energy resources to cooperatively maintain electric service without central control. Even if an event such as a cyberattack knocks out the control room, microgrids can effectively talk to each other to determine the health of surrounding microgrids and chip in with the energy they"re producing if needed. This layer is also able to maintain a basic level of power supply to critical loads, like power for hospitals and fire stations.

The third layer enables autonomous restoration of the power system without human intervention through the use of grid-forming inverters. In the project"s testbed, researchers were able to use 24 grid-forming inverters to restart the simulated grid after it had been knocked completely offline--a process known as blackstart. The team successfully resynchronized four microgrids, despite short circuits and large loads, and were then able to restart the entire grid.

The built-in intelligence of this three-layer control architecture is unique because it enables the grid to function without human intervention, greatly reducing the amount of time it takes to reestablish electric service after a blackout from hours and days to just minutes.

This DOE-funded technology is now being rolled into the larger commercially-available Siemens" Spectrum Power Microgrid Management System and Microgrid Control platforms.