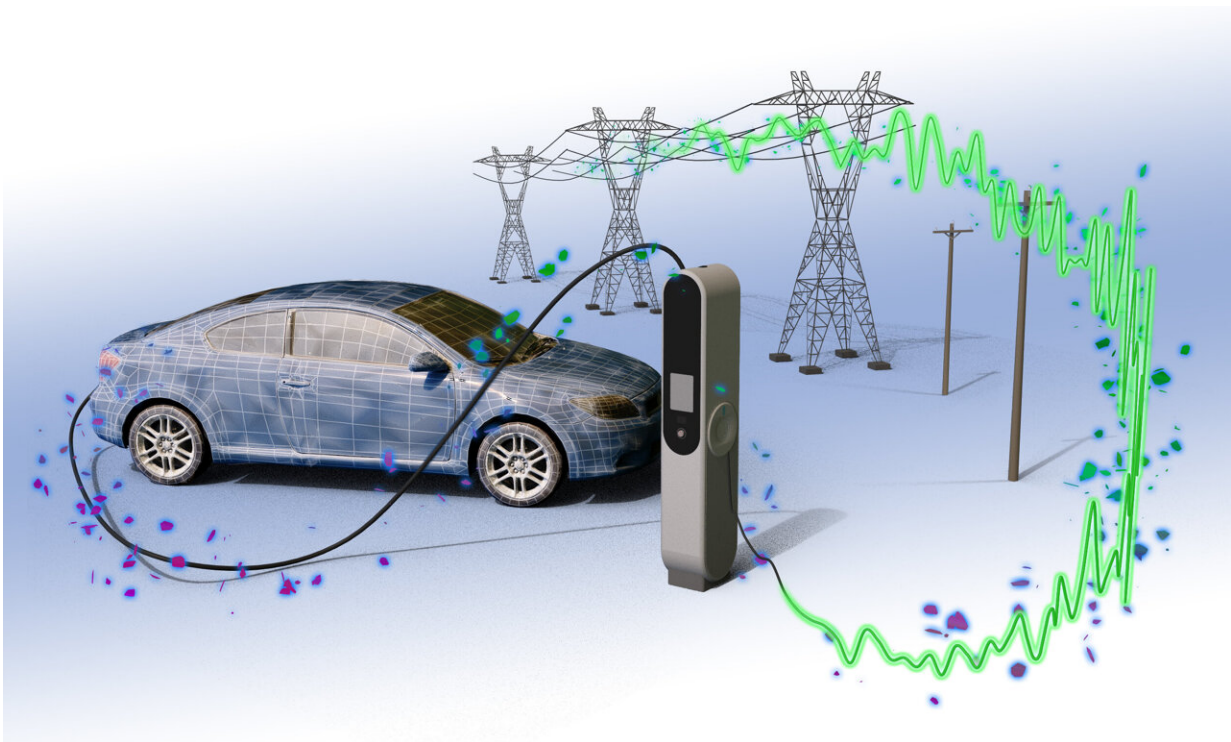


Riding through: Researchers enhance reliability of electric vehicle charging

April 4 2024, by S Heather Duncan



ORNL researchers are developing algorithms and multilayered communication and control systems that make electric vehicle chargers operate more reliably, even if there is a voltage drop or disturbance in the electric grid. Credit: Andy Sproles/ORNL, U.S. Dept. of Energy

American drivers have long been accustomed to quickly filling up at a gas station with plenty of fuel available, and electric vehicle drivers want

their pit stops to mimic this experience. Driver uncertainty about access to charging during long trips remains a barrier to broader EV adoption, even as the U.S. strives to combat climate change by converting more drivers.

Researchers at the Department of Energy's Oak Ridge National Laboratory are working to make EV charging more resilient. "The main focus is to make [chargers](#) available for EVs even if there is an electrical disturbance or hardware failure inside or outside the charger," said ORNL's Namwon Kim, a lead researcher on the project. "We want drivers to be able to use EV chargers as soon as they arrive at the charging station."

After identifying the major challenges, ORNL researchers found solutions to address two key causes of charger failure — the first triggered by voltage shifts in the electric grid and the other originating within the charger itself.

Kim and his team developed [new algorithms](#) to manage the operating parameters of the power electronic converters that are the keystone of EV charging hardware. These converters are designed to shut off when power flow strays outside a standard range. If a small fault in the electric grid causes a fleeting drop in voltage, EV charging stops. Similarly, the failure of one internal component can also shut everything down. Re-activating these chargers often requires maintenance, causing significant downtime at unmanned stations.

To cope with brief voltage sags, ORNL researchers implemented a ["ride-through" control algorithm](#) that rapidly reduces charging power, then restores it when voltage returns to normal seconds later. [The team created a real-time, automated test setup](#) to emulate how the converter hardware responds to a variety of voltage blips. The ride-through controls enabled quick recovery of charging power.

There are broader benefits, too. If a grid fault causes many EV chargers to disconnect during high-power fast charging, the [voltage](#) level in the power grid can suddenly increase. This condition may damage other unprotected electrical equipment. For this reason, ride-through capability protects not only the charger but also the broader [electric grid](#).

Sometimes, a disturbance occurs within the charger itself. A single EV charger contains three power modules working together to convert and control charging power. The ORNL team [created another algorithm](#) allowing the converter to detect and adjust to an internal failure instead of turning it off.

"Now, when one module goes out, the converter can try to continue providing as much power as it can by dividing the load among the remaining two," Kim said. "We are trying to keep the charger running at lower power while it awaits repair."

Researchers also developed a new, multilayered approach for control and communication across the kind of larger EV charging system that resembles a [gas station](#) with many pumps: A systemwide controller is automatically notified of problems at individual chargers. It can then alter equipment settings for the best customer charging experience.

This research fits into [a larger project](#) with partners Pacific Northwest and Idaho national laboratories that include automatic management of charging vehicle fleets, such as delivery or long-haul trucks, as well as monitoring for potential cyberattacks. The station controller could control vehicle charging order and charging rates, balancing energy costs with cargo priorities.

Kim said the next step will be modeling how integrated battery storage and solar power could further ensure a station's EV charging performance.

Provided by Oak Ridge National Laboratory

Citation: Riding through: Researchers enhance reliability of electric vehicle charging (2024, April 4) retrieved 2 May 2024 from <https://techxplore.com/news/2024-04-reliability-electric-vehicle.html>

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