



# NREL + VERIZON WIRELESS

Verizon Wireless and the National Renewable Energy Laboratory (NREL) are working to develop and validate a new design solution for telecommunications facilities. Network equipment is all DC, so rather than relying on conventional AC power, the design will employ photovoltaics (PV) and batteries, and it will require new DC cooling systems. The new design will ease utility interconnection by connecting PV to the DC bus and batteries, increase resiliency by allowing PV to contribute—and cooling to continue—in a power outage, lower costs with day-to-day utility cost savings, and increase efficiency through reduced part count and fewer power conversions from DC to AC.

## R&D STRATEGY

To validate the DC power system configuration, researchers conducted testing in the Energy Systems Integration Facility's environmental chamber at temperatures as low as -40°C and as high as 55°C. The optimal power system configurations' thermal and electrical performance were tested to confirm that the cooling systems can maintain required temperatures, that the controls correctly prioritize PV power and optimize battery dispatch, and to calibrate computer models.

Modeling was conducted using NREL's OpenStudio® and REopt software tools. Modeling extrapolated results to 17 climate zones, four different power levels, and with/without PV as a shade canopy over the equipment. Modeling produced recommendations for types of cooling systems that minimize total costs and the amount of PV and battery storage that should be used.

These results serve as a guide that provides site-specific recommendations for the design of new sites and refurbishment of existing sites.

## IMPACT

The power system topology that NREL suggests will be a new approach to powering telecommunications facilities. An all-DC facility is a sustainable and reliable solution to powering Verizon Wireless's many existing and forthcoming sites. NREL will propose to expand the approach from this project to data centers in collaboration with the U.S. Department (DOE) of Energy Federal Energy Management Program and the DOE Center of Expertise for Energy Efficiency in Data Centers.



NREL is helping Verizon Wireless design an all-DC solution for the telecommunication company's facilities. *Photo from Verizon Wireless*

## Partner with NREL at the ESIF

User facility access to the ESIF is awarded through the review and approval of user proposals, depending on the scientific merit, suitability of the user facilities, and the appropriateness of the work to DOE objectives, and includes a signed user agreement for the facility.

For more information, please visit:

[www.nrel.gov/esif/work-with-us.html](http://www.nrel.gov/esif/work-with-us.html)

or contact:

Dr. Martha Symko-Davies  
martha.symko.davies@nrel.gov  
(303) 898-4834

The Energy Systems Integration Facility (ESIF) at the National Renewable Energy Laboratory (NREL) provides the R&D capabilities needed for private industry, academia, government, and public entities to collaborate on utility-scale solutions for integrating renewable energy and other efficiency technologies into our energy systems.

To learn more about the ESIF, visit: [www.nrel.gov/esif](http://www.nrel.gov/esif).

**National Renewable Energy Laboratory**

15013 Denver West Parkway • Golden, CO 80401 • 303-275-3000 • [www.nrel.gov](http://www.nrel.gov)

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