



## NREL + HAWAIIAN ELECTRIC

NREL and the Hawaiian Electric Companies are collaborating with the solar and inverter industries to implement advanced inverters, allowing greater solar photovoltaic (PV) penetrations that will support the State of Hawaii's goal to achieve 100% renewable energy by 2045. Advanced inverters will help maintain stable grid operations by riding through grid disturbances when the PV output is needed, operating autonomously to smooth voltage fluctuations, and coordinating the start-up and reconnection of PV systems and other distributed energy resources.

### R&D STRATEGY

NREL and Hawaiian Electric worked closely with engineers from Apparent, Inc.; Enphase Energy; SMA America; and SolarEdge Technologies to test the companies' advanced inverter models. Hawaiian Electric selected two feeders with high PV penetrations, and NREL developed more than 250 test cases to simulate the interaction of the advanced inverters with the modeled feeders under normal and abnormal grid conditions, using the ESIF's power hardware-in-the-loop (PHIL) capability. The simulations coupled the actual hardware devices with dynamic feeder models, populated with additional software models of each inverter to examine how the inverters would interact with the feeders in real time.

### IMPACT

All inverters tested were able to perform six of the seven tested grid-support functions, and all are expected to pass the UL 1741 SA certification tests when Hawaii begins requiring this certification for interconnection in September 2017. Based on these results, NREL provided Hawaiian Electric with recommendations for implementing the grid support functions; collaborated with Hawaiian Electric's Smart Inverter Technical Working Group to help develop a [Source Requirements Document](#), a key technical standards document for the UL certification that can be used by any PV inverter manufacturer aiming to sell their product in the Hawaii market; and helped Hawaiian Electric harmonize their Source Requirements Document with the ongoing revision of IEEE Standard 1547, which sets standards for distributed energy resources.



Solar panels adorn a home in Kaupuni Village on the Hawaiian island of Oahu. NREL and Hawaiian Electric are studying the use of advanced inverters to allow more solar power installations in Hawaii. *Photo by Adam Warren, NREL 34717*

### 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:

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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

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