FLEXGRID®

THE PREMIER TESTBED FOR BUILDING-TO-GRID INTEGRATION AT FLEXLAB

FLEXGRID ENABLES FLEXIBLE TESTING OF GRID SUPPLY, RENEWABLE ENERGY, STORAGE, ELECTRIC VEHICLE, AND BUILDING LOAD ENERGY OPTIONS

THE RESEARCH CHALLENGE

As the contribution of renewable energy on the electrical grid increases, grid management becomes more variable and complex. Electric grid operators desire greater flexibility to manage grid conditions under variable renewable power production—such as through customer options that provide building load flexibility, local renewable energy, or storage. Until recently, no venue has been available to test flexible building loads and new distributed energy resources (DER) management strategies in various combinations and under diverse demand and grid conditions. A lack of demonstrated performance data has slowed their implementation and undermined their effectiveness.

BRIDGING THE RESEARCH GAP

The U.S Department of Energy's FLEXLAB® facility at Lawrence Berkeley National Laboratory is helping to help bridge this knowledge gap with FLEXGRID—an environment where DER equipment and controls can be tested along with building demand-side strategies. FLEXGRID can be used to conduct real-time comparisons among demand, renewables, inverters, and storage, to research and develop effective technologies and controls that span both sides of the grid.

FLEXGRID BUILDS ON FLEXLAB'S SUCCESS

In the short time that FLEXLAB has been in operation, researchers have used it to develop many innovative energy-saving technologies and quantify their effectiveness. FLEXGRID applies this model to management of local power consumption, production, and storage at the building scale, to promote efficient grid integration. The addition of DER testing capabilities within FLEXLAB enables researchers to test the implications of various demand- and supply-side decisions under real-world conditions. For the first time, it is possible to contrast and compare building demand-side strategies with local renewable and storage strategies with feedback on energy performance, energy cost savings, and occupant comfort.

REAL-TIME, REAL-WORLD RESEARCH

FLEXGRID enables real-time comparisons between demand, renewable energy, electric vehicle charging and storage, to improve grid management and provide benefits for both utilities and electricity customers.

FLEXGRID enables users to test and evaluate:

- Multivariate controls strategies that integrate demand, storage, electric vehicles (EV), and generation.
- The optimized use of onsite renewable energy, coordinating between building loads and electric vehicles.
- Comparisons of DER and building demand control strategies for energy, thermal comfort, and other occupant experience metrics.
- Real-time simulation and emulation of electric grid conditions along with “hardware-in-the-loop” building load and DER controls for event management and energy use optimization.
- Power quality sensing and controls to mitigate grid issues.
- Direct current (DC) power distribution, systems, and equipment, to evaluate energy savings.
- Fault detection, diagnostics and analytics adaptation for grid edge and reliability.
- Electric vehicles as a power supply for buildings under defined events.
- Building/EV-to-grid design and operation tools development and validation.
- Cybersecurity options for DER and building systems.

A PALETTE OF COMPONENTS FROM WHICH TO CHOOSE

Users can configure FLEXGRID’s equipment to suit their specific needs. Multiple units of photovoltaics (PV), batteries, and inverters are available to facilitate simultaneous real-time testing and comparisons of different strategies. Inverters, batteries, and building loads are separately metered and controllable to enable users to manage energy use effectively.

Three photovoltaic arrays, 14.6 kilowatt total, provide a renewable power source that can be used alone or in combination with other power sources.

Three sets of Tesla batteries, form a 19 kilowatt-hour battery bank.

Three 7.6 kVA Solar Edge inverters, enable battery, PV, DC and alternating current (AC) power integration.

An Opal-RT grid simulator, enables users to model the electric grid, this computer provides a supply signal to represent varying conditions, to research power availability (such as the “duck curve”) and power quality issues such as harmonics.

Multiple micro synchro-phasor sensor units, monitor power quality through the DER and building power infrastructure, to study grid events and develop control strategies.

Hardware-in-the-loop controls, embed real-time simulation and decision making under real-world conditions at the device level to help users identify the optimal circumstances for using DERs and controlling building loads.

An Ametek MX-30 regenerative power supply, physically replicates the power and power quality conditions that the Opal-RT is simulating.

Over 100 programmable loads and configurable building technologies, integrate into the power supply from FLEXGRID, providing users with a unique opportunity to evaluate the contribution of renewables with real building loads under real operating conditions.

Bidirectional CHAdeMO EV charger, integrates EV charging and discharging into the mix to test vehicle-to-building and vehicle-to-grid scenarios.

Visit https://flexlab.lbl.gov/flexgrid for more information.

BERKELEY LAB

ENERGY TECHNOLOGIES AREA