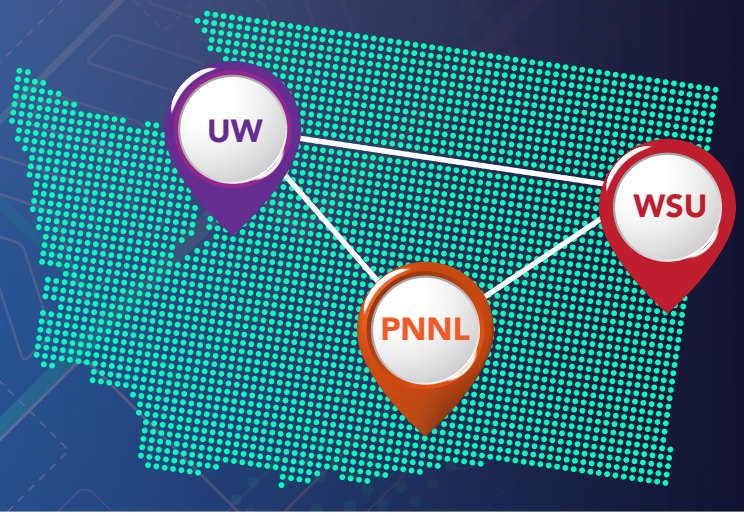
A Blueprint for the Nation's Transactive Energy

Effort in Washington state develops and tests technologies to realize new synergies between buildings, the power grid and renewable energy



A national laboratory and two universities lead a trailblazing regional grid modernization project focused on advancing transactive energy, particularly in buildings.

Launched in late 2015, the Clean Energy and Transactive Campus (CETC) project involves three campuses: Pacific Northwest National Laboratory in Richland, Wash.; the University of Washington in Seattle, Wash.; and Washington State University in Pullman, Wash. The Washington Department of Commerce, via the Clean Energy Fund, is providing $2.25 million to the project, matched by the U.S. Department of Energy.

The two-year effort focuses on researching, developing and demonstrating technologies that will enable single buildings and sets of buildings—and eventually entire cities—to respond to and act on transactive control signals. By extending transactive control strategies to multiple devices, buildings and locations, the project will demonstrate improved building performance, better management of building power loads, optimized use of renewable energy, improved grid operations, and cost savings and increased efficiency.

PROJECT OBJECTIVES

The CETC project is the first implementation of transactive energy at this scale, involving multiple buildings and devices, to:

- Advance understanding of transactive control implementation in building loads and distributed energy resources (renewable energy, battery storage, etc.)
- Define implementation of transactive control and transactive energy concepts at scale, which will foster broader adoption.

Transactive Energy is achieved through implementation of transactive control strategies. Transactive control enables devices to continuously exchange energy use and price information and negotiate and respond to that information to optimize energy use in real time.

Pacific Northwest NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

WASHINGTON STATE UNIVERSITY

UNIVERSITY of WASHINGTON

Solar energy integration is one focus of the CETC project.

Another key objective is the establishment of a transactive energy system test bed. The partners will examine how the test bed can be operated as both a flexibility resource to help manage electricity loads and bring intermittent renewable energy onto the power grid, and as a platform for future research and development in the emerging buildings-grid discipline.

The project also expects to take demand response to an entirely new level. Demand response programs typically involve a utility controlling (with consumer permission) home appliance operation to reduce electrical load during peak power use periods. In the campus project, loads will be coordinated within and across multiple buildings. Rather than yielding device control to a utility, building managers, using tools created by the project, will determine how best to manage energy use and reduce consumption to meet grid and building needs. This is a key step toward increased involvement of buildings in transactive energy.

Ultimately, the project's outcomes will establish a blueprint, spanning from theory to implementation, for broad deployment of transactive energy across the nation.

The Building Operations Control Center at PNNL will monitor and control information on energy usage at the three campuses, supporting research and testing of transaction-based energy use in and between buildings.

RESEARCH IN ACTION

The three campuses are pursuing unique but interconnected experiments and activities.

» **PNNL** is developing network infrastructure to connect the three campuses and enable testing of transactive methods. PNNL also is deploying its VOLTTRON™ distributed control and sensing platform, and associated V-agents (applications), in five buildings to monitor operating conditions, run diagnostics, and improve building performance. This capability will help enable active power load control, allowing loads to be optimized and adjusted to balance fluctuations from solar energy and other sources. VOLTTRON™ also serves as a central technology in UW and WSU projects.

» **UW** is installing multiple smart inverters to control power production from campus solar panels, and eventually will feed campus-produced photovoltaic power into the power grid. UW also is installing a lithium-ion battery energy storage system to increase flexibility of the power consumption across campus, and using its data analytics expertise to develop strategies to make buildings responsive to transactive control signals.

» **WSU** is installing photovoltaic modules on campus for the first time and integrating them with Pullman's "Smart City" test bed and WSU's microgrid system. Experiments will show that campus energy generation can power critical city infrastructure in the event of an outage. WSU also is developing strategies for sharing energy between WSU's smart buildings and the solar modules.

Communication is a key aspect of the project. Technologies must talk to other technologies and buildings must talk to other buildings, all acting upon signals from the power grid. The idea is that smart technologies will make decisions and automatically adjust energy loads based on pre-determined criteria related to cost, essential services, comfort levels, time of day, etc. The project is developing the mechanisms to make that happen with minimal human direction.

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http://bgintegration.pnnl.gov/connectedcampus.asp