Pacific Northwest
NATIONAL LABORATORY

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VOLTTRON™: Integrating Distributed Energy Resources with the Grid

In commercial and other buildings there is growing interest in maximizing efficiency of operations, particularly the internal building systems that control functions such as heating, ventilation and air conditioning (HVAC), lighting and hot water. In power industry terminology, these functions reside "behind the power meter."

VOLTTRON™, a technology developed at the U.S. Department of Energy's Pacific Northwest National Laboratory, is an emerging behind-the-meter control solution for building systems and devices. The innovative tool enables coordination of building energy loads and distributed energy resources (DERs), such as onsite solar generation or batteries, with the power grid. This coordination offers significant new flexibility to the grid and supports large-scale integration of renewable generation.

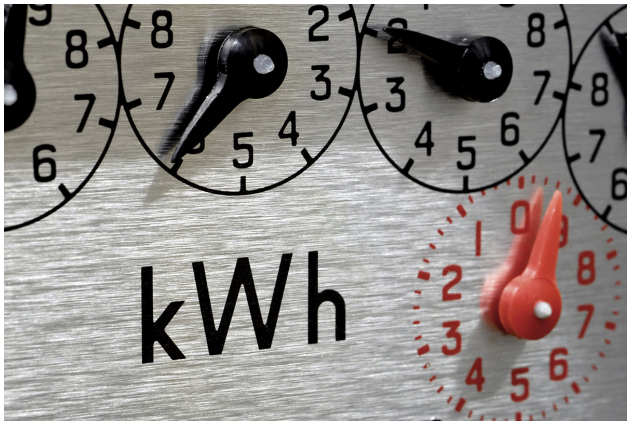
VOLTTRON™ provides four distinct advantages:

- **Cost-effectiveness**—It's an open source software, free to users and can be hosted on inexpensive computing resources
- **Scalability**—Deployable in one building or across a fleet of buildings, such as a school campus or a city
- **Interoperability**—Enables interaction/connection with various systems and subsystems, in and out of the energy sector.
- **Security** – Underpinned with a robust security foundation to combat today's cyber vulnerabilities and attacks.

From its development in 2012, VOLTTRON™ technology has moved rapidly to deployment, with regular updates offering improved capabilities. The Department of Energy has supported development and deployment of the technology, viewing the innovation as a key component of buildings efficiency and emerging buildings-grid strategies.

A CLOSER LOOK

VOLTTRON™ is a distributed control and sensing software platform that provides a new and improved level of supervisory control for the automation systems that manage heating, cooling, lights and other functions in buildings. VOLTTRON™ deploys special applications,



VOLTTRON™'s value behind the meter in buildings also translates to benefits for the power grid.

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known as V-agents, to seek out and analyze an automation system's operational data. In addition to identifying and diagnosing issues, such as erroneous temperature settings, the technology can report and correct those problems. VOLTTRON™ also aids in the efficient development of the V-agent applications, providing a host environment and core platform services that save developers time and effort.

BALANCING POWER USE, INTEGRATING DERs

Researchers at PNNL are optimizing VOLTTRON™ and V-agent capabilities to help manage building loads and DERs in real time, which brings improved flexibility and stability to grid operations.

Renewables Integration—Solar panels, gaining in popularity, now often provide power directly to homes and buildings. But when clouds appear, generation suddenly drops. This loss of power and the urgent need to replace it can cause immediate imbalances on the grid. VOLTTRON™ V-agents will detect this and move into action, helping restore balance by quickly marshalling a range of temporary actions in buildings to reduce power consumption. These actions might include slightly dimming lights and adjusting heating or cooling levels, or modulating variable-frequency drives in HVAC systems.

Grid Flexibility—On the grid, challenges emerge when, for example, winds die down at utility-scale wind farms and replacement power must be brought online. If weather forecasts predict calm winds ahead, VOLTTRON™ can rapidly initiate "virtual storage" options that take advantage of current heavier wind loads and abundant power to withstand anticipated shortfalls. These options, which

VOLTTRON™ capabilities, installed in building systems, can help the grid manage the challenges posed by wind and solar energy.

could include pre-cooling a building or turning on a water heater system, ultimately help stabilize the grid. Improved stability also can be achieved through "ancillary services" approaches. This involves grid operators periodically asking buildings or other entities to quickly reduce or increase loads to address dynamic grid conditions. VOLTTRON™ can provide sub-minute responses to the requests, adjusting building devices, such as air-handler fans, to address the immediate need. Similarly, VOLTTRON™ has demonstrated effectiveness in managing traditional demand response approaches.

Intelligent Load Control—VOLTTRON™ can adjust and manage a building's multiple controllable loads to remain below an agreed-upon power consumption threshold established with a utility.

ABOUT PNNL

Interdisciplinary teams at Pacific Northwest National Laboratory address many of America's most pressing issues in energy, the environment and national security through advances in basic and applied science. Founded in 1965, PNNL employs more than 4,000 staff and has an annual budget of approximately $1 billion. It is managed by Battelle for the U.S. Department of Energy's Office of Science.

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To download VOLTTRON™, visit
https://github.com/VOLTTRON/volttron

Web site: ***Volttron.org***

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PNNL-SA-117076