



Pacific Northwest
NATIONAL LABORATORY

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Virtual Batteries Overview

Virtual Batteries: The Challenge

- ▶ Growing need for more flexible grid assets due to increasing wind/solar deployments.
- ▶ Current grid-scale energy storage requires high capital investment.
- ▶ Commercial and residential buildings can provide distributed “virtual” storage capacity complementing physical storage, but it needs to be identified, quantified, and controlled.
- ▶ A cost-benefit analysis must be performed to determine potential return on investment and support investment decisions.

Decision support tools allow building owners and utilities/grid operators to quantify the amount of virtual storage potential



Virtual storage assets provide grid flexibility

<p>Refrigeration Warehouses and Supermarkets</p> 	<p>Commercial HVAC with Roof Top Units</p> 	<p>Commercial HVAC with Air Handling Units</p> 	<p>Residential Water Heaters and Refrigerators</p> 	<p>Residential Air Conditioners and Heat Pumps</p> 
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Solution

- ▶ **Scope:** Tools are being developed that allow building owners and utilities/grid operators to identify, quantify, and control virtual storage assets.
- ▶ **Audience:** Commercial and residential building operators, energy service providers and control system vendors who provide transactive grid services.
- ▶ **National lab partners:** PNNL, Oak Ridge National Laboratory.
- ▶ **Industry/academia partners:** University of Florida, United Technologies Research Center, Tennessee Valley Authority Bonneville Power Administration.
- ▶ **Project duration:** April 1, 2016 – March 31, 2019.
- ▶ **Funding:** \$4.5M.



Objectives:

- ▶ Perform national opportunity assessment to quantify potential (GW/GWh) of virtual storage resources
- ▶ Develop flexibility screening tool to quantify regional potential of virtual storage resources
- ▶ Perform cost-benefit assessment for using virtual storage to provide grid services complementary to physical storage
- ▶ Develop controls for virtual storage assets to provide grid services using VOLTTRON™
- ▶ Test and validate virtual battery performance using realistic scenarios based on input from utilities and building owners

Timeline:

- ▶ Performed national opportunity assessment (Sept 2016)
- ▶ Developed first version of flexibility screening tool that enables users to assess regional power and energy limits from virtual storage assets (Feb 2017)
- ▶ Completed preliminary benefit assessment study for California, including revenue assessment and physical storage requirements (March 2017)
- ▶ Develop control apps in VOLTTRON and deploy in at least one test site (Dec 2017)
- ▶ Complete techno-economic assessment of virtual building and dedicated grid storage systems (Feb 2018)