Scaling of Building Transactive Control and Coordination to Support Grid Operations

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RD&D Challenge

Traditional approaches of supporting grid reliability can be expensive when the grid is fully decarbonized. Scalable grid services (GSs) using behind-the-meter distributed energy resources (DERs), including storage can:

- Increase the grid’s hosting capacity and allow for reliable integration of distributed renewables.
- Be more efficient at mitigating the supply-demand imbalance and absorbing variability and uncertainty of renewable energy generation compared to reserve generation.
- Deliver demand flexibility for short duration (< 4 hours) without significant impact to service levels.
- Simultaneously improve operating efficiency of buildings, resulting in reductions in energy, emissions, and cost.

Goals

Develop and validate a scalable multi-layered transactive control and coordination (TCC) reference design to support reliability and resilience of the power grid while simultaneously capturing energy efficiency in commercial buildings.

- GS solutions will result in electricity cost reductions of at least 10% without impacting service levels while supporting electric grid reliability.
- Energy efficiency (EE) solutions will reduce energy consumption and cost between 10% and 20%.

Approach

- Developed and deployed EE and GS applications to meet the project goals and objectives.
- EE: Automated Fault Detection and Diagnostics (AFDD) for air-handlers and Automated Identification of Re-tuning™ or Retro-commissioning (AIRCx) measures.
- GS: Intelligent Load Control (ILC), TCC, and transactive energy network template.
- Developed transactive controls, a market-based approach, to encourage competition amongst DERs for “commodities.”
- Each DER is represented by an “agent,” which bids for commodities based on DER flexibility to maximize “profit” while maintaining service levels.
- Highly automated deployment process to achieve scalability and delivered using Eclipse VOLTTRON™ – a distributed sensing and controls platform.
- Proved scalability in a simulation environment, followed by testing in multiple buildings on multiple campuses.
- Worked with Edo, deployment partner, to evaluate scalability of the reference design in the field.

Impact

- Showed EE applications (AFDD and AIRCx) and GS applications (ILC and TCC) can be scalably deployed.
  - EE applications can reduce energy consumption and cost between 10% and 20%.
  - Electricity cost reductions of at least 10% without impact to service levels while supporting electric grid reliability.
- Expanding field test to a full-blown demonstration as part of the Spokane and Salt Lake City Connected Community Projects.
- Released EE and GS applications as open source.

Status

Developed and tested fully automated diagnostic Re-tuning™ algorithms in real buildings. Tested GS applications both in simulated and real buildings.

Working with Edo, solutions were field-tested to show benefits to building owner, utility, aggregator, and society.

Developed process to “easily” integrate wide range of DERs, including storage devices (thermal and battery), with flexible building loads into the transactive network system by developing agents to represent all the DERs listed below:

**Project Partner: Edo**

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