Demonstrating Coordinated Resources in the Pacific Northwest

Successes from Battelle's Smart Grid Demonstration Project

Introduction

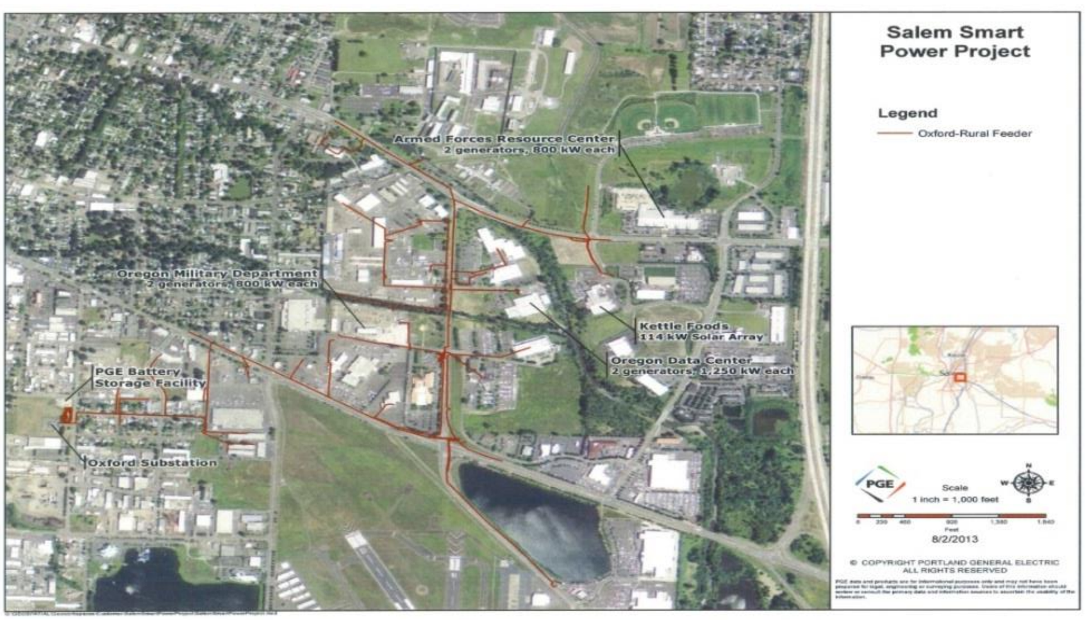
Battelle led 11 regional utilities, six technology partners and two universities under one smart grid project with $89 million from the U.S. Department of Energy's Smart Grid Demonstration Program. The funding, derived from the American Recovery and Reinvestment Act, was matched by the project participants, and allowed for:

- Modernizing distribution infrastructure with smart-grid-enabled components.
- Deploying transactive control to bring market incentives to smaller producers and consumers of electricity, thereby providing a level playing field for new entrants and business models.

Project Objectives

To create a sustainable regional smart grid that will grow after this project's completion, Battelle's objectives were to develop and validate an interoperable communication and control infrastructure; measure and validate smart grid

Figure 1: Overhead map of PGE storage and microgrid assets



costs and benefits for customers, utilities, and regulators; help develop standards and transactive control methodologies; and apply smart grid capabilities to support the integration of a rapidly expanding portfolio of renewable resources in the Pacific Northwest.

Of the project's 11 regional utilities, this case study focuses on Avista, Portland General Electric, Idaho Falls Power, and Flathead Electric Cooperative.

Avista Successes

The Avista territory has 359,000 customers (meters) and serves a population of 1.5 million people in Eastern Washington, northern Idaho and eastern Oregon. Avista used voltage optimization and has shown energy savings of 2.5 percent, a greater reduction than the 1.86 percent originally estimated. Using voltage optimization, the utility can lower the voltage on the feeder — the line from a substation to the home or business — to minimize the losses of electricity from customer loads. Additionally, consumer equipment is protected by keeping the voltage within tight bounds.

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Demand response is also an area to save both consumers and the utility money mainly by reducing peak demand. With its smart thermostat pilot, Avista also found that customers who participated in the project reduced their energy consumption from between 4.5 to 9 percent. The vendor and its smart thermostat product (including an online public interface) were independent of Avista.

Smart circuits installed by Avista are now helping to reduce energy losses, lower system costs and improve reliability and efficiency in its electricity distribution system. The improvements in system efficiencies are expected to save about 42,000 megawatt-hours per year, enough to power 3,500 homes and prevent 14,000 tons of carbon from being released into the atmosphere from power generation. Based on the size of the territory, this is a relative energy savings of one percent.

Potential faults and other problems on the grid are instantly identified by the utility's advanced distribution management system, whose predictive applications and auto-restoration technology serves one-third of the customer base. This unique installation displays a whole new level of information, and it can be operated manually or be fully automated around the clock. The distribution management system increased reliability, according to Heather Rosentrater, the Avista director of engineering. "A year and a half after the distribution management system went live, we hit our one-millionth avoided outage minute. That's a tangible benefit for our customers.[1]"

Washington State University was a centerpiece of Avista's smart city in Pullman: The campus has dozens of facilities that can now be operated together as a microgrid to control both loads and generation, as well as respond to a transactive control request from Avista based on regional grid needs.

[1] A compilation of success stories, Pacific Northwest Smart Grid Demonstration Project, p.9, http://www.bpa.gov/Projects/Initiatives/SmartGrid/DocumentsSmartGrid/A%20Compilation%20of%20Success%20Stories.pdf, accessed 3/10/15

Portland General Electric Successes

Portland General Electric (PGE) installed a microgrid that will allow about 500 business and retail customers to maintain power during blackouts (see Figure 1). This sub-project also employed energy storage as the backbone of the microgrid, with a 5-megawatt lithium-ion battery system installed at the PGE substation in Salem, Oregon. The microgrid is housed in the new, 8,000-square-foot Salem Smart Power Center.

In addition, Battelle deployed the distributed, transactive control system, which member utilities used to connect to their demand responsive assets.

Portland General Electric tested microgrid technologies, using energy storage as a way to transition to operation detached from the grid. To do this, they installed the Salem Smart Power Center, a five-megawatt, 1.25 MWh lithium-ion battery system that is grid-tied and is "very rare in the electricity business," said Wayne Lei, director of R&D for PGE. "It's one of just two owned and operated by an investor-owned utility."

> "We were able to demonstrate the ability of the computers on both sides to learn and get better at optimizing power for the least cost to customers."

The battery responds to an outage by supplying electricity to all residential, commercial, and industrial customers for 15–20 minutes — ample time to start standby power—six customer-owned distributed diesel generators—and synchronize them on the line. Once the feeder is isolated from the utility grid, the generators start up, and the circuit becomes an islanded microgrid.

To ensure reliability across its territory, PGE and its customers have built the nation's largest distributed generation program which shares customer generation with the utility in times of need. Many of PGE's large customers have local diesel generation on site to prevent a power outage in case of an emergency. PGE can tap into this standby generation during an outage situation, resulting in a highly resilient system.

In addition, PGE is using automation and artificial intelligence to optimize asset dispatch. "We've proven that we can dispatch resources at the command of the transactive node," said Kevin Whitener, the lead engineer for the PGE project.

The transactive node, which PGE calls the Smart Power Platform, is the main computer program that optimizes the economic decisions about the smart grid assets: when to dispatch, when to charge or discharge the battery, and when to use the demand response capability. The node responds to a signal from Pacific Northwest National Laboratory in Richland, Wash. To interact with the signal, PGE developed an artificially intelligent software program. Neural networks analyze the thousands of data points in the system and respond to the transactive signal. The computer absorbs all that information, synthesizes it, and makes a decision.

"We were able to demonstrate the ability of the computers on both sides to better optimize power, at the least cost to customers," said Lei. "It's literally a monetary estimation in terms of the value to deliver and the value to acquire that power."

Idaho Falls Power Successes

Idaho Falls Power (IFP) incorporated distributed generation, in this case solar panels, into electric vehicle charging stations. During the day, the system uses the solar panels to charge a 10 kW-capacity stationary battery, which is connected to the car-charging stations. When a car is plugged in, it draws 3.35 kW for four hours from the stationary battery, which means that two or three electric vehicles can be plugged in to receive a full charge.

"The integration work was outstanding," said Mark Reed, the Idaho Falls Power superintendent. "The AMI interface was really fantastic."

Flathead Electric Co-Op

Flathead Electric Co-Op successfully implemented demand-response programs, which helped cut peak time electricity usage through a consumer education program. Instead of the term "smart grid," Flathead's management chose a name they felt would better describe the pilot's purpose and resonate with members: *Peak Time*.

"I think that worked well for us," says Teri Rayome-Kelly, Flathead's demand response coordinator. "We wanted to be very clear about what we were trying to do as a cooperative, and we also stressed what was in it for them — what they would gain for participating. We basically used any kind of communication tool available and talked to every community group that would listen. We did a lot of boots on the ground activities."

Next Steps

IFP and Flathead are formulating plans for leveraging their involvement in the project to advance their respective systems.

IFP will evaluate the feasibility and cost-benefit analysis of the smart grid technologies for purposes of determining scalability across the utility's service area.

With a toolkit of expertise and lessons learned, Flathead is ready to get started with a demand response program that makes sense to the bottom line.

Further Reading

For more information on Battelle's project or the Smart Grid Demonstration Program in general, visit smartgrid.gov. The project website has an informational video and tabs about transactive control and smart grid, along with other resources. There is also a compilation of success stories from which many of the success stories in this case study were drawn.

Under the American Recovery and Reinvestment Act of 2009, the U.S. Department of Energy and the electricity industry have jointly invested over $1.5 billion in 32 cost-shared Smart Grid Demonstration Program projects to modernize the electric grid, strengthen cybersecurity, demonstrate energy storage, improve interoperability, and collect an unprecedented level of data on smart transmission, distribution operations, and customer behavior.