Pacific Northwest Smart Grid Demonstration Project
SUCCESS STORIES

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NORTHWESTERN ENERGY

Small steps to a smarter grid

Listen to a planning meeting at NorthWestern Energy and you'll likely hear: *deploy at the speed of value, and stay on right side of the repair-versus-replace curve.* Decisions here are made very carefully. After all, this award-winning, investor-owned utility serves one of the largest, most geographically diverse territories for its size. With an infrastructure that spans over 28,000 miles of transmission and distribution lines across three states, planning ahead is important. Especially as the 500,000 poles, components and wires get older.

A plan to upgrade its basic distribution system was already in the works when the opportunity arose to take part in the $178 million Pacific Northwest Smart Grid Demonstration Project. Improving upon existing infrastructure using smart grid technologies just made business sense.

"We weren't quite ready for it," said George Horvath, manager of automation and technology for NorthWestern. "We expected that the technologies would advance, change and be improved over two to three times during the course of the project."

So going small-scale was NorthWestern's solution.

With its $2.1 million investment, NorthWestern also planned to learn from the other participants, which included 11 utilities across five states, five technology firms and two universities. Battelle Northwest leads the project. Using the American Recovery and Reinvestment Act stimulus, the Department of Energy matched the participants' funds, including the Bonneville Power Administration's $10 million contribution.

NorthWestern Energy
Delivering a Bright Future

NORTHWESTERN ENERGY
Butte, Montana

- Serving 349 communities across Montana, South Dakota and Nebraska
- One of the largest service territories in the Northwest
- 28,000 miles of lines
- 400,000 metered customers

INVESTMENT IN PNWSGDP:

- $2.1 million

HIGHLIGHTS:

- Demand response program
- Distribution Voltage Reduciton
- Advanced AMI communicatons network
- In-home energy displays

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Customer side of the meter

A perfect urban area to test new technologies turned out to be Helena, Mont. With 30,000 customers and an electric load of 90 megawatts, Helena had the right mix of customers and basic systems.

FIRST STEP: recruit participants. Around 200 residential customers and two commercial buildings from the State of Montana were enlisted to take part in the nation's largest test of new smart grid technologies. It took two marketing campaigns and extending the area beyond Helena to reach recruitment goals.

NEXT STEP: install equipment. Residents' homes were fitted with switches to control appliances, outlet-type switches that turn regular electrical outlets on and off, as well as programmable thermostats and energy system display devices.

Installing the equipment was easy.

Educating customers and learning from the experience took more time.

Working closely with customers

"We hired a company to work directly with our customers and teach them how to benefit from the equipment in their homes and to learn to use it effectively," said June Pusich-Lester, NorthWestern's demand side management engineer.

Training included how to program the equipment and use a Web portal. A Web portal is another name for a dedicated website that has special functionality. The portal showed past energy use, as well as the energy consumption of every device connected to the network. A monthly electronic newsletter was also sent to educate customers.

The benefits were twofold. Customers could see their energy use to better understand ways to save, and Northwestern gained insight into what customers want and what they are willing to do to conserve energy.

Would customers respond to a reward?

Time of use and demand response

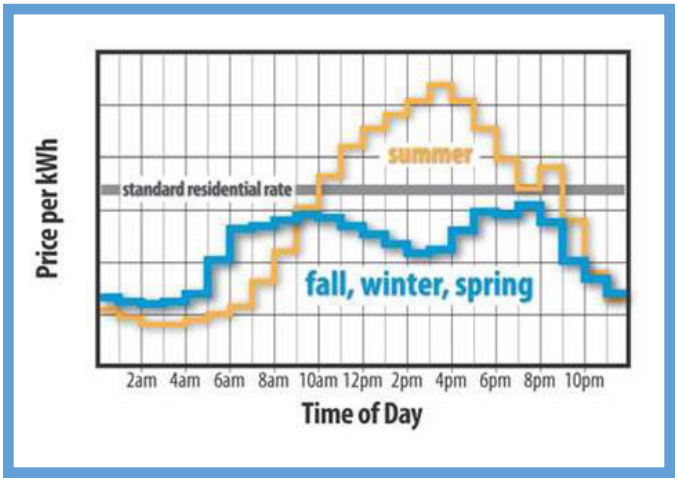
Residential customers were set up for time-of-use pricing. Time-of-use pricing programs help the utility to control some of the consumers' electrical load in response to grid conditions and the price of electricity.

Here's how it worked:

Montana has a flat residential rate, but the demonstration project offered a regional price. So for testing purposes, the rate fluctuated. Each customer received a signal that displayed the price of electricity as 'low, medium or high' depending on the time of day, the day of the week and the month or season.

Customers responded by adjusting and programming the equipment, attached to a home area network, based on the pricing schemes. As a result, load decreased during peak times-of-use.

"We rewarded our customers for energy savings," said Pusich-Lester. "With the smart meters and the communication network working together, we could read energy usage in 15-minute increments."



If a customer used less energy when prices were high, Northwestern credited the customer's monthly bill. As of September 2014, total savings from the time-of-use pricing totaled $13,787 for all customers.

The system also gave the utility direct control over some residential customer loads.

"Now we are able to send demand response events directly to the homes." said Pusich-Lester.

With the ability to control home appliances using two-way communications, Northwester reduced home temperatures or turned off appliances when the price was high in the middle of the day. Demand response and time-of-use methods provide flexibility while saving money.

Other technologies focus on overall efficiency.

Voltage reduction = efficiency

We're all familiar with the concept of energy efficiency. Consumers reduce power consumption through choices in lighting, insulation, appliances and many other methods. Utilities have been working with customers to improve energy efficiency for more than 30 years.

But there's a new player in town.

Distribution voltage optimization, or DVO, lowers the energy consumption on a whole feeder — the line that delivers electricity from a substation to a home. By dropping the voltage on a circuit — while staying above the minimum level necessary to operate electric devices — the customer's energy costs decrease. "We flatten the voltage profile, make voltage adjustments, and save energy for the whole feeder," said Horvath.

According to industry data, a potential exists to shave one to three percent of circuit load using this technique.

Utility side of the meter

Keeping the lights on is a mission of every utility. Until smart grid technologies came along, distribution systems were in the dark. Utilities were unaware of an outage until a customer called to report it. Now, new technologies on the utility side of the meter use automation to improve reliability by detecting a problem, isolating it, and then restoring as many customers to service as possible.

This type of system is called distribution automation or self-healing technology. Computer systems quickly react to electrical issues in the system, like a fault in a feeder, without intervention from an operator or line worker. NorthWestern tested Fault Detection, Isolation and Restoration, or FDIR, software.

"We configured circuits with remote capabilities, to monitor circuits with central software, and to be able to reconfigure circuits in case of issues," said Horvath.

Since October 2012, the system has already automatically reconfigured and mitigated customer service on the feeder for two outages in Helena. That means shorter outages for customers and resource savings for NorthWestern.

Testing technologies to solve real-time, real-world problems is what the demonstration is all about. Still, many lessons were also learned in the research and development initiative.

Lessons to share

NorthWestern's goal was to make slow improvements to prepare for larger business objectives and to learn how to invest in products and services that have longevity.

"We definitely realized our objectives," says Pusich-Lester.

One unexpected lesson was in selecting vendors. Some vendors evolved or went out of business, leaving the utility stranded with products that didn't work. The complexity of integrating components from different vendors while building the systems was also unexpected.

> **"We're going to have the benefit of all the other, much larger projects from the demonstration, reading through their evaluations, and learning from them. It's an important part of our project, what we've learned and accomplished, so now we can better communicate about the smart grid with our regulators and customers in the future."**
>
> — GEORGE HORVATH,
> MANAGER OF AUTOMATION AND TECHNOLOGY

Other notable lessons from NorthWestern:

- Start with a small project — it makes the business case analysis easier
- Emphasize the importance of customer education with project stakeholders
- Integrate a customer information system to smart grid at the start
- Work closely with customers to understand new system enhancements and in-home display features
- Billing system integration for new programs requires significant planning effort
- Build distribution management system first, then add smart grid
- Allow sufficient time and money cushion for communication backbone
- First-time equipment roll-outs have engineering, IT systems, communications and business program learning curves
- In your risk analysis, consider the possibility of a vendor going out of business during your deployment

"The project has helped to mold our thinking on how we plan on a larger scale," said Horvath. "We might do things differently now from the big picture perspective."

WHAT'S NEXT for NorthWestern?

During the project, NorthWestern kept a clear focus on its basic infrastructure and worked to remain on that right side of that repair-versus-replace curve. Outcomes from the project will inform future smart grid improvement processes and projects.

"We will continue to invest in the basic infrastructure and incorporate new technologies where they make sense," said Horvath. "This project provided a foundation for us to evaluate something much larger going forward."

That includes keeping customers engaged.

For both the utility and the customer, the chance to become better informed, educated and experienced with the technologies will prepare everyone for the utility of the future, whatever that may bring.