Pacific Northwest Smart Grid Demonstration Project
SUCCESS STORIES
SEPTEMBER 3, 2014

MILTON-FREEWATER

Milton-Freewater: A frontier for new technology

Oregon's oldest city-owned utility is far from old-fashioned. In fact, it's a power pioneer in the Pacific Northwest. Since 1985, Milton-Freewater City Light and Power has reduced peak energy use with a technique called demand response. Demand response may not be the talk of the town, but it's still a big deal to this homegrown utility. And it's one of the many technologies the Pacific Northwest Smart Grid Demonstration Project intends to advance.

Milton-Freewater is the only public utility in Oregon chosen to take part in the nation's largest smart grid test. The project spans five states and includes 60,000 metered customers. Battelle's Pacific Northwest Division leads the collaborative effort between eleven utilities, five technical firms and two universities. The Bonneville Power Administration is contributing $10 million, also matched by DOE.

With Milton-Freewater's $1.8 million investment and DOE's matching funds, the rural utility upgraded its historic demand response program and tested some newer technologies, such as voltage reduction and voltage-sensing water heaters.

Of the 60,000 metered-customers involved in the regionwide project, Milton-Freewater City Light and Power is the smallest participant with only 4,550 customers. The utility did not hire any additional staff except for a contractor to perform installations, because the utility's only electrician had retired.

Blazing the trail for demand response

When not at his cherry orchard, retired city electrician Bill Saager enjoys the cowboy shooting range just outside of town. The 75-year-old bandana-wearing quick-draw installed the city's original

LOW COST UTILITIES
MILTON-FREEWATER
WATER-SEWER-ELECTRICITY
Since 1889

MILTON-FREEWATER CITY LIGHT & POWER
Milton-Freewater, Oregon

- Locally-owned and operated since 1889
- Average annual sales: 118,000,000 kilowatt hours
- 4,550 customers

INVESTMENT IN PNWSGDP:

- $1.8 million

HIGHLIGHTS:

- Completed AMI rollout
- Direct load control/DR
- 5 megawatt reduction
- Conservation voltage reduction

FOR MORE INFORMATION:

Tina Kain 541-938-8238
www.mfcity.com/electric

demand response units — all 500 of them.

But getting and using a contractor's license wasn't easy. Saager convinced the State of Oregon Construction Contractors Board to forgo the insurance and bonding requirement because he was only doing work for the utility, not the customer. Clearly, Saager is a fan of smart technology.

"I think that utilities are really missing the target if they don't pursue some type of DR in the future," said Saager. "You can really extend the capabilities of your system."

Milton-Freewater's original demand response program used a radio energy management system, or REMS, to control electric water heaters and electric heating and air conditioning systems. A centralized computer system monitored the power demand and sent a radio signal to the REMS units to cycle off connected loads to reduce energy when the peak demand set-point was reached.

The city's goal of the Pacific Northwest Smart Grid Demonstration Project has been to enhance its already highly successful demand response program.

Listen. Respond. Repeat.

To do that, the newer technology must go one step further, by listening and responding from both sides of the communication. With a smart meter system that uses two-way communications, the utility confirms that the demand response units receive the signal and controls the amount of time the electricity is shut off. The goal is for the entire demand response process to go unnoticed.

Water heaters, electric heaters and air conditioners are connected to the demand response system to trim energy use when a certain set-point is reached. Up to three megawatts can be reduced by shaving the energy used in 754 customers' homes, businesses and even churches.

Replacing the old units with the newer models spurred a lot of questions. Many customers didn't know the units existed. A few were suspicious of the utility installing new, more intelligent units. But only a few opted out.

"We found that many homes had changed tenants," said Tina Kain, engineering technician for the city. "New residents were unaware of the DR units, which is a great sign. The undisruptive units helped residents save money without even knowing it."

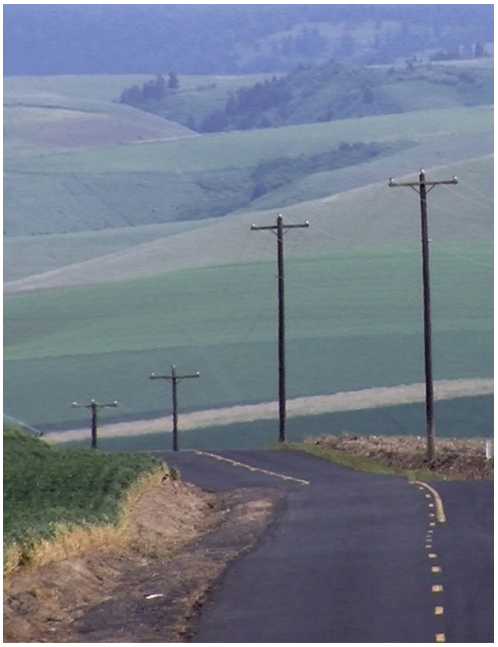
To entice participation, a rate discount was offered to customers:

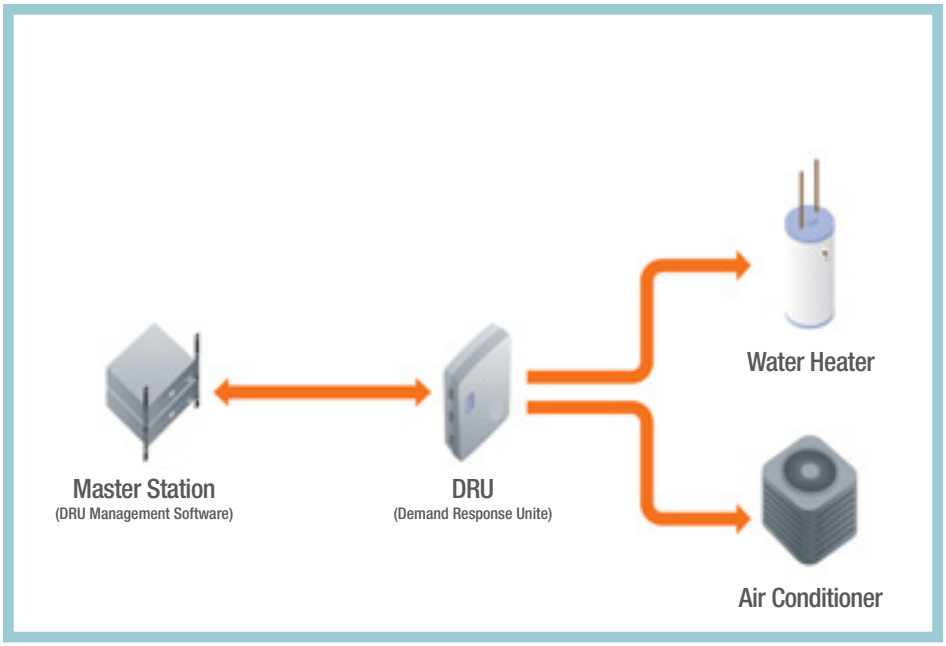
- 2.5 percent for water heaters
- 2.5 percent on electric heating
- 1 percent for air conditioning

DR is used as a last resort in the peak shaving process. When the system begins to approach its peak energy use, the first step is to reduce voltage by 4.5 percent. Next, the city shuts off the wells that are connected to the centralized computer system. Finally, DR units are employed. Reverse order restores the system to its original state.

The incredible value of the smart meter

Every customer of Milton-Freewater City Power and Light is now set up with a smart meter that uses two-way communication over the power line. With these





> **“You can see from our history that Milton-Freewater’s City Light and Power is innovative and forward thinking. It’s about planning ahead. We all know that electric rates probably aren’t going to be going down any time soon, so if a new technology pencils out now, it’s going to be more beneficial in years to come.”**
>
> – RICK RAMBO, THE CITY OF MILTON-FREEWATER ELECTRIC SUPERINTENDENT

more advanced meters, energy use is monitored every fifteen minutes. That means better customer service, such as helping homeowners troubleshoot high bill complaints and remote meter reading. On selected meters, a device called a disconnect collar, which allows for a remote disconnect or reconnect, was installed.

One of the biggest benefits is a smart meter’s ability to quickly detect an outage. Previously, the utility wasn’t aware of an outage until a customer called it in. A crew was then dispatched to investigate and do the repairs. Often, the process could take hours. Now, many outages are fixed in minutes, saving the utility both labor and transportation expenses as well as providing better service to the customers.

Conservation voltage reduction

Conservation voltage reduction is Milton-Freewater’s first step to address a peak on the system. Substation voltage regulators lower the system voltage by 1.5 volts on four feeder lines out of the Milton Substation. This reduces the megawatts used on the entire system while still maintaining adequate distribution voltage.

To test the theory that every 1 percent in voltage reduction leads to a 1 percent reduction in kilowatt-hours used, Milton-Freewater reduces voltage one week, and then returns it to the status quo the next. By alternating weeks, the utility will be able to compare the two datasets and calculate the benefits once the demonstration is complete.

Specialized water heaters

To further test possibilities with conservation voltage reduction, Milton-Freewater installed 100 demand response units on water heaters that operate when the city’s voltage reduction occurs. The demand response units are programmed to sense voltage and turn off connected load.

Although the water heaters worked well with the voltage reduction system, they didn’t work so well with another part of the project — the transactive control signal. This signal is being tested as part of the demonstration across a multiple utility footprint to assess the feasibility of automating the trade of energy based on many conditions, such as the availability of wind or solar power, for a regional benefit.

When the transactive control signal activated a voltage reduction, the demand response units turned off the connected water heaters, and they stayed off until the voltage reduction ended. When the signal lasts longer than five or six hours, the customer may run out of hot water, resulting in customer complaints and countering the city’s goal of ensuring demand response goes unnoticed.

Sizing up the study

Even though the city has been doing demand response for three decades, testing new technologies presented challenges.

First, differences between the original and new demand response systems were disappointing. The old REMS units operated 20 minutes on, 15 minutes off, so Milton-Freewater could reassure customers that their water heaters would be turned off no longer than 15 minutes. But the new units turn on and off in an inconsistent, unpredictable pattern, which is a little more difficult for customers to accept.

And that wasn’t the only challenge with the units. They all cycled on or off at the same time, creating their own peaks and valleys. Innovative solutions were needed to stagger the units.

Data storage is also a problem. Unless the data is manually extracted from the unit before its next operation, the data is lost. That means the utility cannot determine how well the unit worked for that cycle. To work around this issue, the research laboratory will analyze meter data to determine load fluctuations from the demand response units.

Overall, lack of resources has been one of the largest challenges for the small rural utility — the employees had to learn a whole new system while doing their regular jobs. But that also demonstrates the city's dedication to keeping rates low.

"Every little bit counts," said Bill Saager, the retired electrician-turned cowboy.

WHAT'S NEXT

for Milton-Freewater?

As a result of the lessons learned from the project, the city plans to discontinue conservation voltage reduction. Even though it has provided some benefits, operating more than one voltage reduction system at the same time on different feeders was confusing for work crews.

Furthermore, once the project is concluded, the city will explore transactive control opportunities based on the needs of the city and the potential benefits.

Other ideas for the future include a customer pre-pay system so that energy use can be managed based on an individual family budget.

"We're at the point of trying to learn what we can do with the system." said Rick Rambo, the electric utility's superintendent. "I know we're not using it to its full potential."

Still, the tried and true prevails. Demand response will continue as it has since 1985 across the city's entire electrical system, with fine-tuning of the operation as needed and with very little impact on the customer.