



U.S. DEPARTMENT OF
ENERGY

Electricity Delivery
& Energy Reliability

SGIG Accelerates Grid Modernization in Minnesota

Headquartered in Duluth, Minnesota Power (MP) serves approximately 144,000 customers and manages almost 9,000 miles of power lines and over 160 substations. Grid modernization is a top corporate priority and is driven by needs to upgrade the company's electric distribution and metering systems, load control programs, and customer engagement strategies for improved reliability and energy efficiency, lower costs, and more certain peak demand reductions.

MP's strategy is focused on small-scale smart grid investments in key areas to first test the efficacy of technologies and systems and then scale-up when cost-effective solutions are verified. MP's \$3 million grid modernization project, with \$1.5 million from the U.S. Department of Energy's Smart Grid Investment Grant (SGIG) program, has made progress in determining the best approaches for addressing MP's reliability, cost, and efficiency goals. The project includes deployment of smart meters, automated feeder switches, load control devices, and a web portal to support enhanced feedback about usage, a residential time-based rate and energy efficiency programs. "MP has been making prudent investments in a smarter grid for more than 30 years," according to Chief Operating Officer, Brad Oachs. "The grant and current AMI investments are a great opportunity to put us on the leading edge of technology to realize operational benefits and increase our business intelligence while improving customer service."

According to Daniel Gunderson, P.E. Supervisor and Project Manager of MP's SGIG project, "We are pursuing a deliberate and focused smart grid strategy and have identified several promising areas where expansion plans are already underway. We view our SGIG project as the foundation upon which our future grid modernization investments will be based." Mr. Gunderson notes that the SGIG funds have been an "accelerator" for MP's long term grid modernization plans. For example, he points out that the SGIG funds have allowed them to move up planned distribution automation investments by three to four years, compress four years of work to replace outdated load control devices into one year, and tackle software integration challenges involving billing and outage notification data coming in from smart meters at least five years ahead of schedule. And, based on results, MP has decided to move ahead with grid modernization investments now, and has already made improvements above and beyond the scope of its SGIG project.

Automating Electric Distribution Systems

As part of its SGIG project, MP automated a single distribution feeder in Duluth with automated switches that are networked and able to communicate with one another and with grid operators. The newly automated feeder is now able to respond to faults by rerouting power flows when necessary to avoid outages and to minimize the duration and impact of outages to affected customers when outages do occur. In fact, Mr. Gunderson says that the company is now able to re-configure key segments of the

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feeder such that 400-500 hundred customers may lose power in the event of a downed line instead of 3,000-4,000 customers that would have been previously impacted. In addition, he says that grid operators now have visibility into power levels and flows and can monitor the smart switches for voltage and current levels. This new capability is an important part of MP's overall grid modernization strategy.

However, the path to a modernized grid for MP so far has required a few re-adjustments along the way. For example, the company experienced "learning-curve" issues in testing and configuring the automated feeder switches and in implementing systems in a customized manner to meet MP's particular needs. Mr. Gunderson says that MP learned that there is no single way to implement smart systems and that "one size does not fit all." A significant requirement learned from this experience is that it is important to spend time working with vendors to understand how the equipment operates under real-



world conditions. Another important lesson the company has learned is that it is important to train installers and service personnel so that the devices operate in a predictable manner and when anomalies do occur, troubleshooting can be accomplished quickly.

With these key lessons learned, MP has been able to realize measurable improvements in operating the upgraded feeder line. As a result, MP has decided to automate a second feeder line in Duluth outside of the SGIG project. The company's investment has produced immediate dividends for MP and its customers. As an example, a new commercial customer with needs for ultra-high reliability chose a Duluth location served by the second feeder. With automated feeder switches now on two feeders, MP has been able to ensure that the customer will have "100% up time" through its new capabilities to reroute power flows in the event of faults or downed lines, ensuring that the customer will have reliable service at all times.

Mr. Gunderson says, "While we didn't upgrade the feeder line for this particular customer, we are pleased to be able to offer the level of reliability they need. We see further opportunities to attract new customers who also have needs for ultra-high reliability and if we are successful, it could mean new jobs and business opportunities for Duluth, and other localities in our service territory."

Modernizing Residential Electric Heat Load Control

For many years, MP has been managing a load control program for about 1,000 residential customers that allows the company to reduce home heating loads during times of system need in exchange for a discounted rate that provides the opportunity for lower customer bills. Depending on weather and other

conditions, this direct load control program provides approximately six megawatts of peak demand reduction, which is a valuable demand-side resource option for MP.

Previously, the MP direct load control program encountered failure at higher than desired rates due to the equipment being outdated. MP deferred making investments in new load control devices until the next generation of equipment was ready. With SGIG funds, MP has been able to replace about 1,000 of the outdated and failing load control devices with new smart meters. The smart meters accomplish load control by connecting them to a subset of heating loads in the customer's premise and using the remote connection/disconnection feature of the smart meters to turn on and off the heating loads when system conditions require reductions in peak demand to meet cost savings or reliability needs.

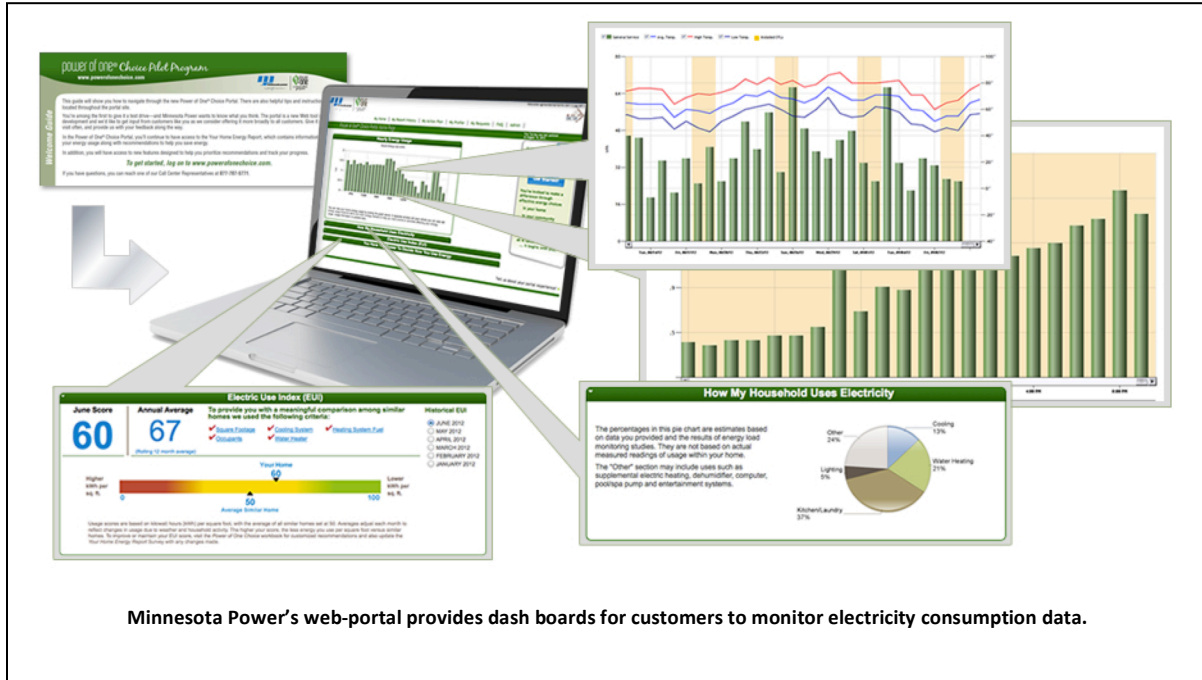
The SGIG investment has saved MP about \$300,000 in capital costs compared to what it would have spent if the old system was still in place. With those savings in upfront costs, MP has also been able to realize a 70% reduction in overall costs, which includes savings in operations and maintenance. In addition, with the data collection and communications capabilities that are part of smart meters, MP is now able to verify the magnitude of the load reductions for every customer soon after load control events have been implemented.

Innovations in “Customer-Facing” Programs

MP views customer engagement as a key ingredient in its grid modernization efforts. According to Tina Koecher, Manager, Billing & Energy Efficiency, “We are pleased to implement enhanced customer-facing programs and this is a natural and timely extension of our successful *Power of One*[®] conservation program. What's really exciting is that this project integrates technology, information, and tools to help customers make informed choices about how they use energy. It allows us to engage customers in new ways and it sets the stage for offering new time-based rates and other demand-side programs. We get high marks from our customers today and we want to honor that by involving customers in the process.”

MP's *Power of One*[®] energy conservation program encourages customers to work with MP to achieve energy savings and get the most for their energy dollars. Ms. Koecher says that follow-up surveys and analysis are planned to determine what customers like and dislike about the new programs. To date, she says, customer responses to the web portal and other program elements have been promising. For example, a 46% portal access rate has been experienced in some of the customer groups already. Ms. Koecher says, “We believe we are just scratching the surface of the potential for empowering our customers to take a more pro-active role in managing their consumption and costs. We are in a learning process and are encouraged by the number of customers who appear interested in making use of our web-based and other tools to save energy and money. We are conducting detailed studies to see what our customers want and are willing to do. As we consider these investments, it's important to understand our customers' perspective and factor that in with the operational benefits. This will be great insight for the months ahead.”

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Next Steps

In determining next steps, MP has already started implementing the “post-SGIG” phase of its grid modernization plans, and the company believes its results-based strategy has worked well. For example, Mr. Gunderson says that MP has already decided to automate two additional feeder lines. This investment decision was made easier, he said, because “We’ve seen significant price decreases since we initially purchased the equipment for the SGIG-funded feeder upgrade in 2010, and we expect prices to drop 15-20% more in the next year or so. In fact, we expect to see the day when there is little difference in costs between smart systems and traditional ones.” If correct, the pace for system-wide upgrades could accelerate not only for MP but for other power companies too.

Learn More

The American Recovery and Reinvestment Act of 2009 provided DOE with \$4.5 billion to fund projects that modernize the Nation’s electricity infrastructure. For more information visit www.smartgrid.gov or www.oe.energy.gov. There are five recent reports available for download:

- *Smart Grid Investment Grant Progress Report, July 2012*
- *Demand Reductions from the Application of Advanced Metering Infrastructure, Time-Based Rates, and Customer Systems – Initial Results, December 2012*
- *Operations and Maintenance Savings from the Application of Advanced Metering Infrastructure – Initial Results, December 2012*
- *Reliability Improvements from the Application of Distribution Automation Technologies and Systems – Initial Results, December 2012*

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- *Application of Automated Controls for Voltage and Reactive Power Management – Initial Results, December 2012*