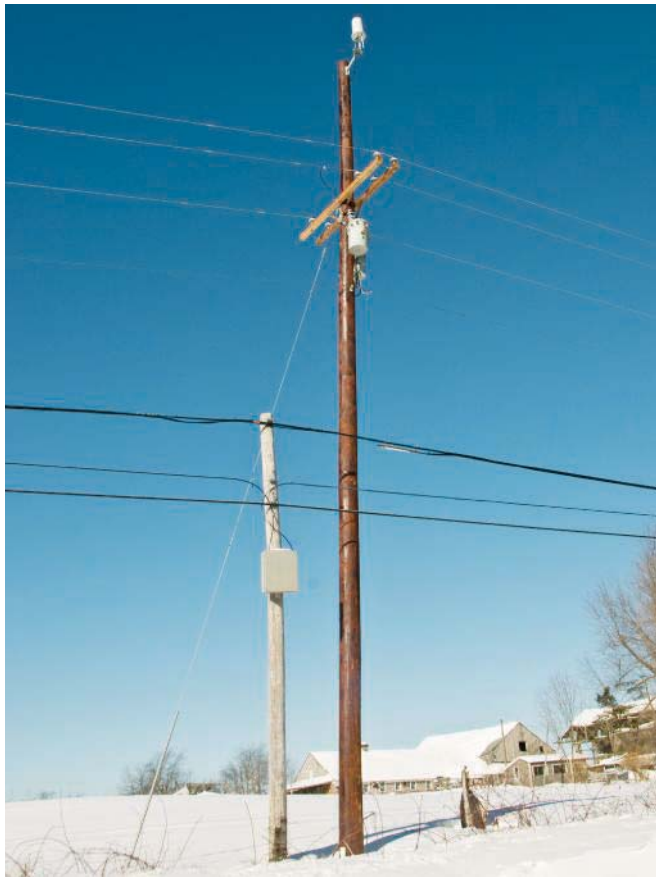
Bold Strides Toward Grid Transformation

Central Maine Power pursues energy excellence by implementing a scalable, reliable and modern grid.

By **Laney Brown**, *Central Maine Power Co.*

Though it had been planning to deploy smart grid technology since 2007, Central Maine Power Co. (CMP), a subsidiary of Iberdrola-USA, did not begin to realize some of the benefits of a smarter grid until recently. The utility's ability to restore power to 364,000 customers following Tropical Storm Irene in August 2011 was recently recognized by the Edison Electric Institute with an emergency recovery award. This award is presented each year for outstanding response in restoring electric service disrupted by severe weather conditions or other natural events. Although not yet fully implemented at the time, the smart grid system assisted CMP with its rapid restoration efforts by helping to clear repair orders.



The extender bridge installation on the top of this distribution pole is a typical part of the AMI communications infrastructure.

The Path to AMI

Back in 2007, CMP, which delivers about 9 billion kWh of electricity annually to more than 600,000 homes and businesses, had been planning a smart grid with a bold advanced metering infrastructure (AMI) implementation, but decided in 2008 not to proceed. This choice was based on the challenge of operating in a fully unbundled environment where customers purchase their electricity from various competitive power producers. This meant demand response — a primary benefit of the smart grid — yielded no financial benefit to CMP's business case, undermining the economic case for the investment.

In 2009, however, smart grid investment grants became available from the U.S. Department of Energy (DOE) under the American Recovery and Reinvestment Act. CMP's DOE grant represented the third-largest grant in the country and proved to be the catalyst to moving the utility's AMI project forward. The Maine Public Utility Commission (MPUC) quickly and unanimously authorized CMP to proceed with its planned smart grid project, contingent on receipt of such a grant. The MPUC called the project "… an important technology that will ultimately reduce utility operational costs, improve customer service and provide customers with necessary tools to use electricity more efficiently and lower their electricity bills."

CMP's AMI deployment was to incorporate state-of-the-art technology, data management, cyber security and functionality. Before these benefits could be realized, the utility faced several challenges as the project went from design to deployment. However, these unique concerns were overcome through the aid of strong, strategic partners, a purpose-built smart grid solution and a community engagement program — ultimately, all of which helped to ensure the program rolled out on time and on budget.

A Bold Approach

Maine, the Pine Tree State, is nearly 90% forested, creating unique trials for smart grid deployment. The geography of CMP's 11,000-sq-mile (28,490-sq-km) service area in cen-

tral and southern Maine meant a multipronged approach was needed to efficiently connect urban and rural areas in both dense forests and islands. Adding to the challenge of how communications would successfully connect across this diverse landscape, CMP also had the goal of implementing a full rollout to more than 620,000 customers in a relatively short period of time — a schedule that is one of the quickest to date for a project of this size — while ensuring the project stayed on budget and on time.

These factors led CMP to develop a bold and aggressive strategy for the smart grid deployment, seeking the implementation of an intelligent communications backbone to serve as the central nervous system. The underlying communications platform needed to meet today's demands for advanced metering, powerful demand response and enhanced outage management, as well as have the flexibility to anticipate tomorrow's needs for advanced distribution operation applications and integration of distributed energy resources.

To identify successful partners, CMP conducted a meticulous request for proposal process focused on finding a partner that could provide complete coverage of the utility's complex territory, meet the required bandwidth and performance, ensure the system provided future-proof scalability and deliver robust security protections — all at a competitive cost. After a rigorous selection process, only one solutions provider stood out for its ability to offer the most advanced capabilities at a competitive total cost of ownership. In July 2010, CMP finalized agreements with Trilliant for the development of a complete smart grid communications network and AMI solution.

Trilliant provided the best combination of communications and metering technology to suit both initial and long-term needs. Starting in the summer of 2010, with anticipated completion in July 2012, CMP implemented a SecureMesh multi-tier network, part of Trilliant's overall Connected Energy Platform, in three tiers:

- A wide area network (WAN) operating in the unlicensed 5.8-GHz spectrum for the backhaul of AMI and future system-wide applications; the WAN delivers up to 54 Mbps of throughput and a maximum latency of 12 msec per roundtrip hop with up to 10 miles (16 km) between nodes
- A neighborhood area network (NAN) operating in the unlicensed 2.4-GHz spectrum for the AMI network and other future field applications; the raw data rate of 250 kbps exceeds the DOE's 80-kbps smart grid investment grant requirement
- A future wireless home area network (HAN), already integrated into the smart meters, to support demand response and home energy management applications.

This multi-tier network approach enables CMP to partition applications according to the required bandwidth and latency, thereby ensuring the most effective and efficient use of each network. For example, in addition to serving as the high-bandwidth reliable backhaul for advanced metering, Trilliant's broadband network can be used to support real-time applications such as distribution automation, substation monitoring, and connectivity to renewables and plug-in hybrid electric vehicles. Similarly, the SecureMesh NAN collects meter data and enables other advanced metering applications.

The service entrance was inspected at each meter installation to ensure connections were all good. That is why the installation contractor required installers to wear flash protection.

For the majority of the private AMI network, CMP was able to rely on its own facilities (for example, poles, service centers and substations). Trilliant played a major role in the deployment, acting as the prime contractor for network installation and meter procurement. CMP also worked closely with several partners to complete this deployment, including GE, Landis+Gyr, Black & Veatch, Itron, IBM and Siemens.

To ensure the success of the project, CMP took one more key step. The utility created an AMI project governance plan that identified mitigating measures for eight separate risk areas:

- Technology performance
- Supply chain
- IT integration
- Field exception
- Records exception
- Dynamic pricing acceptance
- Regulatory
- Financial.

From the outset, the AMI team met weekly to review the project status in all eight risk areas.

Engage Customers and Community

CMP takes consumers' safety, privacy and security very seriously. In addition to working around the technical and physical constraints of the landscape, it was important for CMP to engage with its customers and community leaders, educating them about the benefits of the deployment. A winner of the J.D. Power customer satisfaction award for four years in a row, CMP is dedicated to understanding and effectively communicating with customers. CMP's success is based on understanding customers through a focus on customer research and analysis.

Through this research, CMP was able to identify and work with customers to address a series of challenges many utilities across the country face today or will likely encounter in the near future. For example, during the deployment of the smart grid network, the MPUC required the development of an

opt-out program for customers who did not wish to have smart meters on their property. CMP offered customers the option of leaving an analog meter in place or turning off the transmitter in the smart meter.

While these options are important steps in responding to customer concerns, CMP also undertook an extensive community outreach and education program. The utility hosted community presentations throughout its service area to discuss the benefits of an AMI network directly with customers. During these community forums, CMP invited customers and community leaders to participate in discussions about how information from smart meters empowers users to better understand their energy usage. A commonly discussed study focused on a 2010 analysis by the American Council for an Energy-Efficient Economy that found this type of information, coupled with a consumer feedback program, can encourage voluntary savings between 4% and 12%.

This education program played a key role in addressing another issue. Toward the end of 2011, a small group of customers — less than 0.05% of customers who received the new meters — reported radio-frequency interference from their 2.4-GHz wireless-compatible meters with some electrical appliances, personal computers and communications devices. Taking a proactive approach, CMP posted detailed, step-by-step information online to inform users how they could correct this type of interference easily. In the event the simple solutions did not remedy the issue, CMP fully committed to working with customers to resolve the problem by sending out a technician to help troubleshoot or install new equipment.

By choosing the global 2.4-GHz IEEE 802.15.4 standard solution with high bandwidth and low latency, CMP is making future-proof investments in the electric grid. Broad industry support for the 802.15.4 standard reduces long-term risk by ensuring interoperability, while higher bandwidth and lower latency provide room for growth to support future advanced smart grid applications, such as distribution automation and various consumer applications.

Future Developments

Having navigated a complex series of deployment requirements, unique geographic challenges and customer concerns with its smart meters, CMP is now making more plans for a smarter grid and preparing for additional applications:

- Replacement of two separate meters for customers now generating wind or solar energy with a single bidirectional meter to support distributed generation
- Distribution and substation automation throughout CMP's grid
- Demand-response programs from power providers, including the MPUC dynamic pricing initiative in the first quarter of 2013
- Support through the HAN (included in the smart meters) for in-home displays, programmable communicating thermostats and direct load control
- Intelligent charging for electric vehicles to avoid additional strain on the grid.

Current Benefits

Ahead of these future developments, CMP already has begun realizing benefits from its AMI deployment. In August 2011, high winds and torrential rain from Tropical Storm Irene struck Maine, causing substantial damage to CMP's delivery infrastructure. In the days following the storm, washed out roads, flooding and downed trees compounded the challenges of the restoration effort. In addition to invaluable assistance from the industry's mutual assistance program, the AMI team quickly developed an ad-hoc process to help CMP to clear repair orders rapidly, aiding in the speedy restoration. Overall efforts were so successful CMP restored power within four days to more than 90% of customers who had lost power.

Based on the experience of other utilities, the Electric Power Research Institute estimated the economic costs of power outages in the U.S. total approximately US$120 billion. A reduction of 10%, for example, could be expected to reduce the economic costs of outages for customers in CMP's territory by hundreds of millions of dollars. Greenhouse-gas emissions are expected to be reduced substantially based on improvements in efficiency and increased consumer conservation, as well as from the elimination of nearly 2 million annual vehicle miles for meter reading and connections and disconnections. CMP estimates long-term annual reductions of 42,000 tons of carbon dioxide, 46,000 tons of nitrogen oxide and 107,000 tons of sulfur dioxide.

Finally, additional savings in payroll and telecommunications costs are being realized with the reduction in estimates, read-related exceptions and billing adjustments, and the reduction or elimination of certain types of calls by giving customers online access to their energy use on CMP's web portal.

Keys to Success

CMP's AMI deployment overcame complex challenges like adapting to a challenging geographic service area, designing a flexible communications network and delivering on a bold rollout time line. The key to the utility's award-winning execution came from developing rigorous implementation plans early on and partnering with innovative companies to deploy adaptable technology — including an intelligent communications backbone. In part, these factors have enabled CMP to respond more rapidly to power outages, helping to keep the lights on for thousands of customers and businesses throughout Maine.

While the flexible AMI technology used in this deployment is certainly key, customer engagement also is critical to any successful smart grid deployment. Community outreach and education programs can help utilities to turn skeptics into supporters and ensure a grid-upgrade project results in more than simply new electricity infrastructure, but rather empowers the community to take advantage of the savings possible with smarter energy. TDW

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Companies mentioned:

American Council for Energy-Efficient Economy | www.aceee.org
Black & Veatch | www.bv.com
Central Maine Power | www.cmpco.com
Electric Power Research Institute | www.epri.com
GE | www.ge.com
IBM | www.ibm.com
Itron | www.itron.com
Landis+Gyr | www.landisgyr.com
Siemens | www.siemens.com
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