U.S. DEPARTMENT OF ENERGY | Electricity Delivery & Energy Reliability

Smart Meter Investments Yield Positive Results in Maine

1. Summary

Since 2009, the U.S. Department of Energy (DOE) and the electricity industry have jointly invested over $7.9 billion in 99 cost-shared Smart Grid Investment Grant (SGIG) projects to modernize the electric grid, strengthen cybersecurity, improve interoperability, and collect an unprecedented level of data on improvements in grid operations and customer services. Central Maine Power's (CMP) SGIG project has produced innovations in customer services, improvements in business operations, and lessons-learned that will be used for guiding future smart grid projects. Because of the positive results so far, CMP is planning follow-on smart grid investments. Table 1 is a summary of the key results, which is based on data through December 31, 2013.

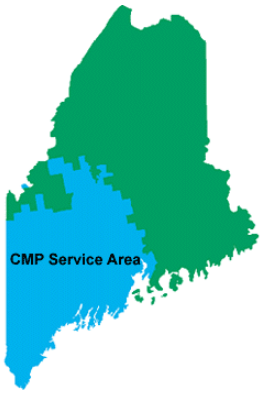
Table 1. Summary of Key Results

Customer Service Advancements	**i.**	Energy education program for the 7th and 8th graders with web access to on-line tools for managing consumption, costs, and bills.
	ii.	Service requests for reconnections completed in less than an hour instead of waiting until the next business day.
	iii.	Web portal for customers to monitor their electricity consumption and costs anytime.
Operational Improvements	**iv.**	Reduced meter operations costs by more than 80% with annualized savings of about $6.7 million.
	v.	Decreased truck rolls by 97% from 2012; with almost 121,000 fewer in 2013.
	vi.	Expected decrease in annual vehicle miles by about 1.4 million, which will result in lower vehicle emissions.
	vii.	Reduced the number of bills that have to be estimated by CMP due to inclement weather and other factors associated with manual meter readings by more than 90%.
Project Implementation Lessons-Learned	**viii.**	Communicate effectively with customers and regulators pre- and post-installations to address public concerns.
	ix.	Conduct comprehensive tests of equipment and systems before installation to mitigate integration and operational problems.
	x.	Use management systems for effective vendor and process oversight.
Follow-on Investment Plans	**xi.**	Build on existing cost-effective applications and evaluate new smart grid opportunities such as distribution automation and time-based rates.

2. Introduction

CMP serves more than 600,000 customers in the least densely populated state east of the Mississippi River. CMP's SGIG project involves territory-wide installation of smart meters, information and communications systems to support automated data collection and processing, and customer research to evaluate several new customer-facing programs.

The total budget for the project is $195.9 million, including $95.9 million in funding from DOE under the American Recovery and Reinvestment Act of 2009. This investment has produced new IT and communications networks that provide infrastructure for existing and future smart grid projects, including CMP plans for automating distribution system operations and enabling applications of time-based rates.

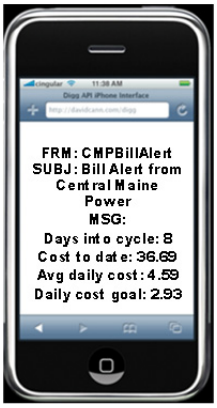


CMP's service territory covers Maine's major commercial and manufacturing centers and 78% of the population.

3. Customer Service Advancements Break New Ground

Among other capabilities, smart meters provide data on electricity consumption and costs that customers can review to better understand how to manage their bills. CMP provides all customers with access to a web portal that enables them to monitor their consumption and costs any time they want. Additionally, customers who have been disconnected for non-payment, can automatically reconnect their service using the web portal or telephone (through an interactive voice response system), once their bills have been paid. CMP can also reconnect service for any customer, for any reason, within an hour instead of the next business day.

CMP provided a test group of 3,000 pilot-program participants with weekly bill alerts that showed how much electricity they used and its corresponding cost. About 70% of the participants said they took actions to reduce their usage after receiving bill alerts. Overall, the participants lowered their electricity consumption by about 1.8%. About two-thirds of the participants expressed interest in continuing in the



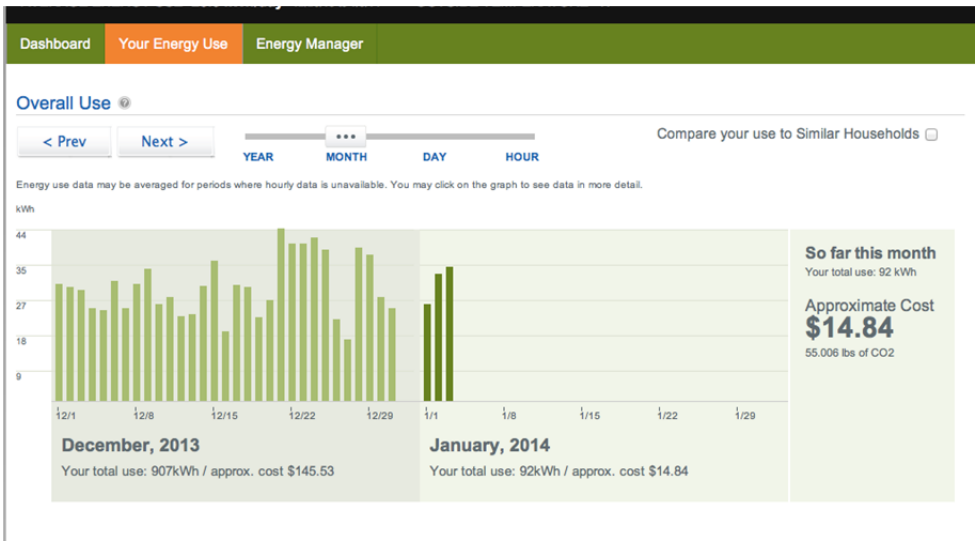
A pilot program provides weekly text messages with billing information.

program and CMP is currently assessing whether or not to continue and expand the program to all interested customers.

CMP's Power House program engages 7th and 8th graders in home energy management.

CMP is also supporting a new energy education program for the State's 7th and 8th graders called "Power House." When students enroll in Power House they gain access to an online, curriculum-based, web portal which enables them to monitor their family's electricity consumption, learn about various energy efficiency measures, and compare their consumption with other households.

The comparison feature has motivated families to reduce their energy use. Once families gain a better understanding of how they use electricity, they begin looking for ways to reduce their consumption and bills. Power House has also been effective in bringing "science to the dinner table," by encouraging whole-family discussions about how energy is used in their homes. CMP believes this program will help inspire a new generation of customers that is more knowledgeable and better equipped to make smarter decisions about their electricity consumption and costs.



A "screen shot" from a "typical" customer's web portal shows daily variations in electricity use.

4. Operational Improvements Save Money

The most significant cost savings from replacing electro-mechanical meters with smart meters result from the new ability to read meters automatically and accomplish remote service connections and disconnections. For example, in 2013 CMP saved about $6.7 million from these new capabilities, which was about 90% of the cost savings they projected they would achieve in their business case analysis. These savings were accomplished without laying-off any employees.

In 2013 these new capabilities also enabled CMP to avoid 121,000 truck rolls, which was a 97% decrease compared to 2012. Figure 1 shows the before and after effects of smart meters on truck rolls. Over a five month period in 2012, CMP rolled trucks for service calls more than 69,000 times. One year later, the number of truck rolls was reduced to about 2,300 for a comparable period of time. These improvements reduced costs and vehicle emissions due to about 1.4 million fewer annual vehicle miles traveled. CMP's mostly rural service territory covers 11,000 square miles (larger than the states of Massachusetts and Rhode Island combined).

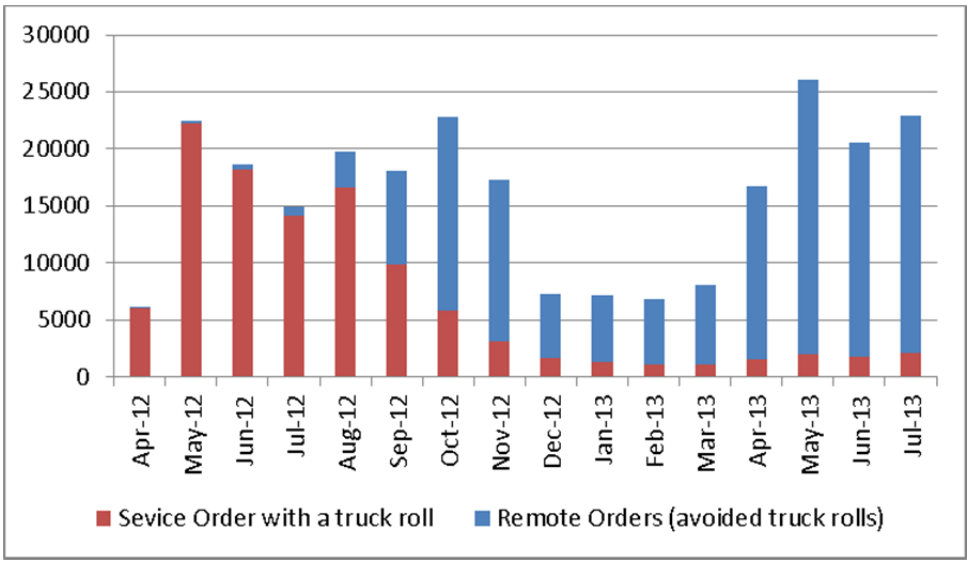


Figure 1. Effects of smart meters on truck rolls for CMP.

CMP's smart meter program also decreased the number of estimated bills. For example, in 2010, before smart metering, CMP had to estimate more than 309,000 bills due to inclement weather and other normal anomalies associated with manual meter reads. In 2013, after smart metering, CMP had to estimate about 29,000 bills, a reduction of more than 90%. In Maine, the Public Utilities Commission can penalize CMP if the number of annual estimated bills exceeds

6% of customers. In 2013, with smart meters in place, the percent of estimated bills was about 0.4%.

CMP has also decreased the number of calls from customers with high bill concerns. In 2013, these fell nearly 50% (from about 50,000 before smart meters to about 24,000 after.) This improvement reduces costs, decreases inconvenience, and boosts customer satisfaction. Overall, operational improvements from smart meters have enabled CMP to provide higher levels of customer service. Table 2 gives examples about how smart meters have improved CMP's responses to customer service requests.

Table 2. Examples of Customer and Operational Improvements from Smart Meters

Typical Customer Requests	CMP Response ***Before*** Smart Meters	CMP Response ***After*** Smart Meters
"I'm moving out today. Can you please take a final reading?"	No. We can close out your account with a final read next business day.	Yes. With no rolled trucks or use of field employees.
"I'm moving out at 2pm next Tuesday. Can you take a final reading at that time?"	No. We can close out your account on a future date but cannot guarantee any particular date or time.	Yes. With no rolled trucks or use of field employees.
"I paid my bill on at 11pm online. Can I get reconnected today?"	No. We can reconnect the customer the next business day.	Yes. With no rolled trucks or use of field employees.

5. Project Implementation Strengthened by Lessons-Learned

CMP, along with other SGIG project recipients, have acknowledged that investments in smart grid technologies and systems can be highly complex undertakings that require linking back office systems to hundreds of thousands of end points. CMP has learned that successful implementation involves addressing uncertainties and unanticipated issues, and managing relationships among multiple stakeholder groups including its own staff and customers, vendors, and regulators. To manage these implementation challenges, CMP focused on three core strategies: (1) customer engagement and outreach, (2) vendor partnerships, and (3) systems integration.

5.1 Customer Engagement and Outreach

Prior to installing smart meters, CMP implemented a replicable and measurable customer engagement and outreach process in each community or town. The process involved targeted

efforts to understand and address specific customer concerns about data privacy, home security, and perceived health effects. Prior to installation, CMP contacted 320 municipalities by mail or phone and completed 140 briefings with town councils and the public.

CMP's customer engagement strategy also included proactive communications with customers before smart meters were deployed and "rapid response" communications when customers raised questions and concerns during and after the deployment process. As a result, only one town imposed a moratorium on smart meter installations that was subsequently lifted. In fact, about 97% of the customers in this town eventually decided to participate in CMP's smart meter program. Results from a CMP customer satisfaction tracking study provided supporting evidence on the effectiveness of these efforts. For example, the number of customers who said they were aware of the smart meter installations went from 34% to 91% over a year and a half period between 2010 and 2012.

To expand customer choices more broadly, CMP is also including an "opt-out" provision in its smart meter program. CMP was among the first in the nation to do so. The program allows customers with smart meter objections to forgo installations by (1) retaining their existing electro-mechanical meter for $40 up-front and a monthly charge of $12, or (2) electing a non-transmitting smart meter for $20 up-front and a monthly charge of $10.50. CMP's opt-out rate for customers is currently 1.4%, and the percentage is declining every month.

5.2 Vendor Partnerships

To help ensure effectiveness and efficiency with procurements, CMP built partnerships with its vendors that included upfront performance metrics and financial incentives to help align vendor performance with CMP's business case objectives. Regular and frequent "check-in" meetings were held to identify and address problems in a timely and cost-effective manner. CMP also believes that having executive involvement on both sides – utilities and vendors –was another important success factor. CMP encourages its vendors to develop user groups for sharing deployment experiences. CMP participated in a user group operated by its smart meter vendor and applied lessons they learned from other utility experiences in structuring its own organizational and operational procedures.

5.3. Systems Integration

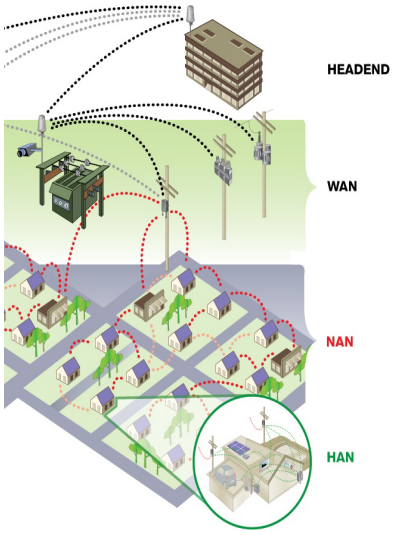
CMP sought to minimize systems integration issues during implementation by installing IT and communications infrastructures prior to meter installation. CMP began using smart meter readings for billing within six months of meter deployment, and they began using the data for

service order requests a few months after that. Additionally, CMP prepared for data management issues by creating repositories with multiple means of access for commonly used data to enable more effective data mining. CMP also conducted comprehensive testing of equipment and systems and planned for faster release cycles of software so that it could more easily make changes and upgrades.

6. Future Plans Include Follow-on Smart Grid Investments

The IT and communications infrastructure built by CMP (with assistance from SGIG funds) provides a platform for future smart grid projects. Distribution automation to improve reliability and resiliency is among CMP's smart grid priorities. For example, CMP plans to fully automate all of its distribution substations and 3-phase reclosers (serving 67% of customers) by 2019.

CMP's communications platform[1] is a wireless mesh, multi-tiered, network that provides meter-level and wide-area services across its entire service territory. The design and construction of the network was complicated by Maine's hilly terrain and its many heavily-forested areas. The deployed network makes CMP a major wireless provider in Maine. The network supports smart meter data acquisition and processing and has the capacity to support future grid- and customer-level applications.



CMP's new IT and communications infrastructure supports follow-on smart grid investments.

For example, CMP plans to fully integrate its new Energy Control Center (ECC) across the company's transmission and distribution systems to compile, assess, and optimize all automated network devices and smart meter data. This means CMP plans to link its Distribution Management System with its Outage Management System and its Geographic Information System. CMP expects these new ECC capabilities to provide better overall system monitoring and more efficient troubleshooting and dispatch.

[1] The graphic in the sidebar describes the overall architecture of CMP's new system. In the graphic the "headend" system at corporate headquarters communicates with WANs (wide-area networks), NANs (near-me area networks), and HANs (home area networks).

These efforts complement CMP's on-going distribution automation activities which have the 2018 goal of improving reliability and reducing outage-hours by more than 210,000 over a five-year period, resulting in a 0.4 percentage point reduction in the Customer Average Interruption Duration Index (CAIDI). CMP estimates about $20.7 million in five-year savings for customers from reduced outage-hours. Overall, CMP expects to save about $97 in operations costs per reduced outage-hour, which exceeds the automation investment of about $47 per reduced outage-hour.

CMP also plans to evaluate using smart meters to monitor voltage levels. Distribution engineers can use customer-level voltage data for troubleshooting problems, maintaining distribution equipment, and anticipating distribution network issues, such as power transformer malfunctions.

CMP's customer web portal software (Energy Manager), which is used in the Power House program, is now available to support the Green Button Initiative. The Green Button Initiative is an industry-led effort based on a common technical standard developed in collaboration with the Smart Grid Interoperability Panel. In the last year, the number of customers served by utilities participating in the Green Button Initiative doubled from about 12 million to more than 25 million, and these numbers are growing.

Using smart meter data, CMP is also planning to offer time-based rates and other new pricing and service options. And, once the new billing system is operational, CMP plans to offer customers the ability to choose their own billing dates. This feature can help customers manage their household budgets better by reducing the monthly bill variations that occurred under the manual meter reading cycles that were used before smart meters were deployed.

7. Where to Find More Information

To learn more about national efforts to modernize the electric grid, visit the Office of Electricity Delivery and Energy Reliability's website and www.smartgrid.gov. DOE has published several reports that contain findings on topics similar to those addressed in CMP's SGIG project and this case study. Web links to these reports are listed in Table 3 on the following page.

Table 3. Web Links to Related DOE Reports	
SGIG program, progress, and results	i. Progress Report II, October 2013 ii. Progress Report I, October 2012 iii. CMP Project Description iv. SGIG Case Studies
Customer service innovations	v. Lessons Learned: Customer Engagement, Updated January, 2014 vi. Voices of Experience, Insights into Smart Grid Customer Engagement, July 2013 vii. Analysis of Enrollment Patterns In Time-Based rate Programs, July, 2013 viii. Demand Reduction from the Application of AMI, Pricing Programs, and Customer Based Systems – Initial Results, December, 2012
Smart meter operational improvements	ix. O&M Savings from AMI – Initial Results, December, 2012
Distribution automation	x. Reliability Improvements from Application of Distribution Automation Technologies – Initial Results, December, 2012 xi. Application of Automated Controls for Voltage and Reactive Power Management – Initial Results, December, 2012