Wireless Real-Time Energy Monitoring for Demand Management and Grid-Edge Intelligence

Startup
Copper Labs
Boulder, CO

Host
Xcel Energy

Technology Solution

With the growing deployment of renewable energy and distributed resources, as well as the increase in extreme weather events, understanding when and where electricity is used is becoming increasingly important. In 2020, the number of U.S. homes equipped with advanced metering infrastructure (AMI) surpassed 100 million. While smart meters can capture high-resolution usage data, they typically deliver data to the utility once daily. Other electric meters—as well as most gas and water meters—generally only transmit data every 30 days, via drive-by automated meter reading (AMR). Actively tracking real-time use and demand across multiple infrastructures is essential in meeting decarbonization targets and other resource management objectives.

Wireless hardware deployed at the meter and inside buildings supplies real-time usage data to support analysis, visualization, and informed interventions by customers and utilities.

This pilot explored the use of wireless, web-based energy monitoring technology developed by Copper Labs for informing demand-side management at customer and utility scales. Copper Labs' hardware collects usage data in 30-second intervals from smart meters (AMI) and from meters designed for drive-by AMR, including for electric, gas, and water service. It also conducts in-home voltage and frequency measurements. Near-real-time data are delivered to the utility through a web-based portal for customer targeting and grid-edge intelligence, enabling utilities to engage targeted consumers when load flexibility is required. A customer app displays real-time energy usage in charts, identifies anomalies relative to historic patterns, supports goal-setting for ongoing energy conservation, and provides real-time community comparison feedback during demand response (DR) events.

Project Overview

This project, hosted by Xcel Energy, was driven by broad corporate goals related to leading the clean energy transition, enhancing the customer experience, and keeping bills low. Long an industry leader in wind energy, Xcel Energy is also looking to solar, storage, and other technology advancements—including in the area of demand-side management—to achieve an 85% reduction in carbon emissions by 2030 and a 100% carbon-free goal by 2050. In Colorado, the company is currently transitioning to AMI meters. This project sought to evaluate how real-time data from existing AMR electric meters can impact customer energy use in behavioral DR programs for the benefit

Copper Labs' app characterizes energy use and provides notifications about DR events to promote energy-saving behaviors.

of the grid and individual consumers. The findings may inform future demand-side management programs, as well as customer engagement features for AMI meters with home area network support.

More specifically, the project involved deployment of Copper Labs' wireless real-time energy monitors in more than 1100 new homes in a master-planned community southwest of Denver known as Sterling Ranch. With an emphasis on sustainability, this community was identified as a key market for clean energy technologies and a potential example of future developments with a high adoption of rooftop solar and electric vehicles that may pose unique grid-edge challenges. Each resident was provided access to real-time electric, natural gas, and water usage insights delivered via mobile app. Xcel Energy leveraged that new mobile channel for ongoing customer education and behavioral DR messaging enabled through Copper Labs' web-based utility portal.

Results & Learnings

Findings summarized below reflect both experiences during this project and comparisons to similar wireless real-time energy management projects involving other utilities and Copper Labs:

- **Deployment:** As this pilot involved new residential construction, field technicians involved in other tasks were leveraged to install Copper Labs' devices inside homes. While efficient, this required unique process adjustments to update WiFi connections when ownership transitioned from the builder to the new residents. In a typical program for existing homes, Copper Labs' devices are distributed directly via the mail, with energy kits, through retail marketplaces, or as energy audit leave-behinds, with a simple process for homeowners to connect and configure the device using a smart phone.
- **Customer engagement:** This lesson, while also related to the new construction aspect of this project, is broadly applicable. The community deployment of Copper Labs' technology—where consumers self-install hardware—leads to more awareness about how to use the system and also sets expectations for notifications from the utility related to DR events. In the future, Copper Labs and Xcel Energy plan to send a pre-season notification to customers to set expectations and explain why they are receiving messages.
- **DR reductions:** This project provided consumers with no-cost access to real-time data through Copper Labs' in-home device. While the DR events did involve timely messages and enable real-time community comparisons, no rebates or performance incentives were offered for reducing usage during peak periods. Similar to bring-your-own-thermostat programs, design variables for behavioral programs also can be adjusted to incentivize enrollment, ongoing connections, and participation in energy-saving events. Experiences elsewhere show that Copper Labs' technology can enhance peak time rebate, time-of-use, conservation voltage reduction, and other performance-based programs.
- **Project scale:** Copper Labs' technology is designed to support low-cost, real-time customer engagement, demand management, and grid-edge intelligence at substantial scale. As demonstrated in this pilot, the capability to initiate DR notifications with a randomized control from the utility portal provides an opportunity to quickly assess results using revenue-grade meter data. However, sample sizes—in terms of numbers of events and participants—need to be large enough to account for anomalies and inherent biases.

Implications & Next Steps

This wireless real-time energy monitoring pilot generated important insights in areas such as technology

deployment, program design, and customer usage. Xcel Energy continues the ongoing work in the Sterling Ranch community, including installation of Copper Labs' technology in every new home, customer surveys, and evaluation of electricity DR event results. Additionally, Xcel Energy is planning to test natural gas DR in Winter 2022.

Xcel Energy also has selected Copper Labs to participate in a natural gas study designed to understand DR opportunities and gain insights into load curves in a growing Colorado mountain community where some pipelines are constrained. This will help the company and its customers access gas usage data every 30 seconds instead of every 30 days, providing the lead time required for creating the load flexibility needed to accommodate supply constraints due to peak demand.

Copper Labs is actively delivering real-time energy usage data for multiple electric, gas, and water utilities across North America, with and without smart meters. The company continues to refine its recommendations for customer program design and will soon launch new neighborhood-level data collectors to complement in-home devices in supporting larger deployments for customer engagement, demand management, and grid-edge intelligence based on the results and learnings above.

TESTIMONIAL: Copper Labs

Copper Labs was proud to be selected by the innovative companies participating in Incubatenergy Labs and is leveraging this experience and EPRI's expertise by applying technical insights to inform product design and value delivery for utilities and customers through wireless real-time energy management.

TESTIMONIAL: Xcel Energy

New knowledge and experience developed by Xcel Energy through Incubatenergy Labs supports our continued work with Copper Labs to gain better insight into customer energy usage and behavioral demand response across electric and gas infrastructure.

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3002023018

March 2022

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