

Sacramento Municipal Utility District *SmartSacramento® Project*

Scope of Work

Sacramento Municipal Utility District's (SMUD's) SmartSacramento Project involved system-wide deployment of advanced metering infrastructure (AMI) integrated with new and existing information technology systems, as well as deployment of distribution automation (DA) equipment on selected SMUD distribution circuits and substations. The project also involved customer programs and pilots that provide electricity usage and cost information to customers, enabling them to better control their energy usage and participate in demand response. Project scope included a field test of plug-in electric vehicle (PEV) charging stations to assess their technical performance, charging patterns, and impact on electric distribution system operations.

Objectives

The objectives of the project were to implement an AMI solution for all residential and commercial customers that would improve customer service; enable the introduction of new energy efficiency, demand response, and pricing programs; and provide tools for SMUD and its customers to reduce their environmental impact. In addition, the advanced technologies are expected to reduce operational costs. This project established a foundation on which to build future smart grid functionality.

Deployed Smart Grid Technologies

- **Communications infrastructure:** Wireless networks deployed throughout the SMUD territory provide two-way communication for smart meters, customer devices, and DA equipment. Software platforms for meter data management and analysis were installed to organize, analyze, and make AMI data accessible to other enterprise systems. These systems provide SMUD with expanded capabilities to leverage interval consumption and voltage data to improve distribution system operations and overall grid reliability.
- **Advanced metering infrastructure:** SMUD deployed over 617,000 smart meters covering the entire service territory. This system enables automated meter reading, improved bill accuracy, remote service connect/disconnect capability,

At-A-Glance

Recipient: Sacramento Municipal Utility District

State: California

NERC Region: Western Electricity Coordinating Council

Total Project Cost: \$307,697,792

Total Federal Share: \$127,506,261

Project Types: Advanced Metering Infrastructure
Customer Systems
Electric Distribution Systems

Equipment

- 617,000 Smart Meters
- AMI Communications Systems
 - AMI Meter Communications (RF Mesh)
 - AMI Backhaul Network (Cellular)
- Meter Data Management System
- Customer Web Portal
- Customer Systems for nearly 10,000 Customers
 - Home Area Networks
 - In-Home Displays/Energy Management Systems
 - Programmable Communicating Thermostats
 - Direct Load Control Devices
- Distribution Automation Equipment for 171 out of 644 Circuits*
 - Distribution Automation Communications Network (RF Mesh and Fiber)
 - SCADA Communications Network
 - Automated Distribution Circuit Switches
 - Automated Capacitors
- 80 Electric Vehicle Charging Stations

*128 are 12 kV, 18 are 21 kV, and 25 are 69 kV

Time-Based Rate Programs

- Time of Use
- Critical Peak Pricing

Key Targeted Benefits

- Reduced Operating and Maintenance Costs
- Improved Electric Service Reliability
- Reduced Costs from Distribution Line Losses
- Reduced Truck Fleet Fuel Usage
- Improved Energy Management and Control Opportunities for Customers

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enhanced outage management, and improved theft detection. AMI data analytics improves load forecasting and capital investment planning.

- **Time-based rate programs:** SMUD has offered rate programs based on time of use (TOU), critical peak pricing (CPP), and TOU combined with CPP. Selected customers could opt into the new rate programs or choose to keep their existing rates. Additional customers were placed on the new rates but were able to opt out. The goal was to evaluate the relative merits of these programs in terms of load impacts, customer acceptance, and cost effectiveness. The aim was to provide customers with greater control over their electricity bills and reduce peak electrical loads.
- **Advanced electricity service options:** The project has provided enhanced web portal services and tools for customer information and energy management, control, and automation. SMUD installed nearly 10,000 residential and small commercial home area network (HAN) devices to provide customers with options to more conveniently manage their energy use. In addition, the project implemented advanced energy management control systems with automatic demand response (AutoDR) capability at customer facilities.
- **Direct load control devices:** SMUD deployed programmable communicating thermostats and load control switches that support load reduction or load shifting during periods of peak demand. Participating customers received financial incentives in return for allowing the utility to cycle major appliances and equipment during peak events. SMUD installed the software platform for a demand -response management system to provide more effective and centralized control of direct load control operations and to enable two-way communication and feedback with customers.
- **Distribution automation systems:** SMUD deployed automated sectionalizing and restoration (ASR) equipment, reclosers, capacitor banks, and remote fault indicators integrated with the energy management system on 171 distribution circuits. This equipment automatically responds to power disruptions by isolating faulted sections of circuits and rerouting power to customers. SMUD has reduced the frequency and duration of outages and can more efficiently dispatch service restoration crews.
- **Distribution system energy efficiency improvement:** Efficiency is achieved through integrated voltage control from capacitor controllers and the energy management system. The capacitors improve volt-VAR control and power quality; distribution capacity is increased through reduced energy losses on the distribution system.
- **Plug-in electric and hybrid electric vehicle charging stations:** Stations that provide charging for PEVs and PHEVs have been deployed at 20 parking spaces on college campuses and 60 residences across the SMUD service territory. The charging stations include meters and monitoring equipment to evaluate performance and charging patterns and their impacts on the distribution system.

Consumer Behavior Study

See SMUD's Consumer Behavior Study Plan for details.

Benefits Realized

- **Reduced operating and maintenance costs:** SMUD's AMI system allowed SMUD to avoid approximately \$31,787,600 in meter operation costs from project initiation through March 31, 2014. The AMI system helped SMUD significantly reduce the need for manual meter operations, mainly through automated meter reading and automated service switching.

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- **Reduced truck fleet fuel usage:** Thanks to the new automated systems, SMUD avoided an estimated 1.2 million vehicle miles from project initiation through March 31, 2013. SMUD previously used gasoline cars and light-duty trucks to read meters. Assuming 23.4 miles per gallon per vehicle, SMUD avoided consuming 51,000 gallons of gasoline.
- **Improved distribution system reliability:** The ASR system has helped SMUD reduce both the number of customers affected by outages and the duration of outages. SMUD estimates that if the ASR system had been implemented in 2007–2012, it would have reduced the impact of outage events by 37% in terms of customer-minutes interrupted (a measure of the total number of customers and the minutes they were without power), based on historical reliability performance of SMUD’s distribution grid and the observed performance of the ASR system.

Lessons Learned

- Executive support is essential for successful project implementation. When implementing projects that require staffing and resources from multiple departments, executive support paves the way for cooperation between departments that may normally act in silos.
- Good communication with customers is critical to project success, especially with AMI implementations. Proactive customer communications, including the training of utility staff to make presentations and answer questions is important in the early stages of project development. As projects progress, it is important to develop tools that make it easy for customers to enroll in and exit programs and marketing materials that describe offerings and answer questions.
- Communicating with employees is important to obtain project buy-in and acquire the necessary inter-departmental support required to implement large scale projects. Further, if employees will be displaced as a result of the project (meter readers), early communication and working to provide alternate opportunities is essential.
- Many technologies proved to be immature and some vendors overpromise and under deliver. Investigate new technologies to ensure they are ready for implementation. In a few cases, SMUD needed to close projects for example controllable appliances initiative, when technologies did not provide the claimed benefits.
- Robust design and testing of the AMI network and meters is important. Testing should verify that meter reads are coming through, especially in difficult-to-read areas such as dense urban settings, where meter signals can be blocked by walls or other obstacles, and in rural areas, where meters are far apart. Verification of meter accuracy is also important for responding to customer inquiries about meter accuracy and for high bill complaints.

Future Plans

SMUD plans to continue developing its smart grid and will invest resources to implement projects that enhance customer service, improve grid reliability and provide a reasonable return on investment. SMUD will continue to provide customers with reliable electricity at affordable rates through the implementation of additional smart grid projects that improve grid performance and provide better customer service.

Contact Information

Jim Parks
Program Manager
Sacramento Municipal Utility District
Jim.parks@smud.org