

Marblehead Municipal Light Department

Integrated AMI System with Real-Time Pricing Pilot Program

Scope of Work

The Marblehead Municipal Light Department (MMLD) project involved town-wide installation of a fully integrated advanced metering infrastructure (AMI) system. MMLD deployed a two-way communications network, over 10,000 AMI meters, an energy management web portal, and demand response equipment. The project also included a pilot program to assess the effectiveness of critical peak pricing (CPP) and automated in-home load management, as well as a study of consumer behavior in response to the CPP pilot.

Objectives

The project aimed to reduce peak electricity demand, overall energy use, and operations and maintenance costs while increasing distribution system efficiency, reliability, and power quality.

Deployed Smart Grid Technologies

- **Communications infrastructure:** Wireless radio frequency (RF) mesh communication devices form the backbone of the AMI network. MMLD leveraged the town's existing network of street lights to mount these devices. This secure two-way infrastructure, strengthened by the meter mesh network, supports current energy management programs and allows for future integration with distribution automation, smart appliances, and home area networks. Data is carried back to the head-end system via fiber optic backhaul.
- **Advanced metering infrastructure:** The project implemented a system-wide rollout of 10,215 residential, commercial, and industrial meters. AMI meters provide the capability for a variety of current and future time-based rates and customer service options. New AMI features such as outage and restoration notification enable MMLD to respond to outages and customer requests more efficiently.
- **Direct load control programs:** A group of residential customers participated in a time-based-rate pilot study. Qualified volunteers were offered either programmable communicating thermostats (PCTs) or electric water heater control devices to aid their ability to curtail load during high-price periods. The load management devices were controlled by customers via the online web portal.
- **Advanced electricity service options:** Offered in conjunction with the direct load control programs, PCTs allow customers to better manage their energy consumption. An energy management web portal was made available to all customers with new smart meters and includes tools and tips that can help lower monthly bills. MMLD also conducted community outreach initiatives, including development of marketing and education materials such as bill inserts, a website, direct mail, and press releases.

At-A-Glance

Recipient: Marblehead Municipal Light Department
State: Massachusetts
NERC Region: Northeast Power Coordinating Council
Total Project Cost: \$2,819,440
Total Federal Share: \$1,346,175
Project Type: Advanced Metering Infrastructure
Customer Systems

Equipment

- 10,215 Smart Meters
- Advanced Metering Infrastructure
 - Meter Communications Network (RF Mesh)
 - Backhaul Communications Network (Fiber)
- Web Portal (for smart meter customers)
- 32 Programmable Communicating Thermostats
- 5 Direct Load Control Devices (Water Heaters)

Time-Based Rate Program

- Critical Peak Pricing (Pilot Program)

Key Benefits

- Reduced Operating and Maintenance Costs
- Increased Electric Service Reliability and Power Quality
- Reduced Costs from Equipment Failures, Distribution Line Losses, and Theft

Marblehead Municipal Light District *(continued)***Consumer Behavior Study**

MMLD introduced CPP to a subset of customers on an opt-in basis. The goal was to assess how residential customers accept and respond to pricing signals designed to help reduce peak loads on the system during the summer months. The study consisted of a single treatment group of residential customers on a CPP rate. MMLD could declare up to 12 CPP days over the period of June, July, and August. CPP days were announced one day in advance, with notification to customers that the cost of electricity during a subset of hours the following day would be higher. Throughout the entirety of the study, participating customers were provided with access to a web portal providing detailed information on their electricity consumption. In the second year of the two-year study, enabling technologies such as PCTs and electric water heater control switches were offered to qualified customers (those with central air conditioning and/or electric water heaters) to help further curtail energy use during peak periods. The study evaluated the incremental impact of these technologies on peak load reduction.

Benefits Realized

- **Reduced operating and maintenance costs:** From project start through December 2013, MMLD saved over \$50,000 due to reduced meter reading costs. Also, remote meter reading and preventative system maintenance have resulted in savings due to significantly fewer truck rolls.
- **Increased electric service reliability and power quality:** Near-real-time monitoring of distribution transformers has allowed MMLD to preemptively address potential outages. MMLD experienced 10–15 transformer outages per heat wave in 2010; that number was reduced to 3 in 2011 (affecting 60 customers) and to 0 in 2012 and 2013. Voltage monitoring at all meters provides early warning of power quality issues.

Lessons Learned

MMLD allowed customers to hire their own electricians to install load shedding control devices, such as PCTs and water heater controls, which resulted in an unexpected number of installation errors and delays. MMLD recommends using company crews or pre-selected and trained contractors to install in-home demand response equipment.

During the consumer behavior study, MMLD never overrode customer settings in response to CPP events; this non-interference was by design, as the goal of the study was to assess how customers would utilize the technologies without utility intervention. A more traditional utility-controlled demand response program may have yielded greater peak load reduction but would have been less customer-friendly in this small municipal territory. MMLD felt that this customer-friendly approach was the correct choice for a small municipal utility, and helped assuage customer concerns.

Future Plans

MMLD is considering deployment of a full-scale demand response program, pending analysis of the results of the consumer behavior study.

Contact Information

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