Emerging Technology Program

#1007: Small Commercial Building Energy Management and Information System (EMIS)

Public Project Report

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Full Report

The following executive summary is made publicly available by Nicor Gas as part of their Emerging Technology Program (ETP). The detailed Nicor Gas ETP report is available to qualified state and utility run energy efficiency programs upon request. Please contact the Nicor Gas ETP administrator at NicorGasETP@gastechnology.org to find out how to access the full report.

Executive Summary

Introduction

The Nicor Gas Emerging Technology Program (ETP), a part of the utility's ongoing energySMART Energy Efficiency Program (EEP), assesses new or underutilized technologies that have the potential to provide natural gas savings for the 2.2 million Nicor Gas customers in Northern Illinois. The Gas Technology Institute (GTI) implements the ETP for Nicor Gas. This report summarizes the findings from an evaluation of small commercial building energy management and information systems (EMIS) and their potential for utilization in Nicor Gas service territory and prospect for energy efficiency improvements with small commercial customers.

Background

Small commercial building EMIS utilize wireless communication inside each building to control heating, ventilating, and air conditioning (HVAC) thermostats, lighting, and other energy using equipment. From a gas utility perspective, the larger end uses such as space heating equipment would be targeted along with other gas using equipment, i.e., commercial kitchen equipment, and ancillary equipment such as exhaust fans that can impact the gas using equipment operation. The EMIS also integrates gas (and electricity) meter reading capabilities that can be retrofitted onto existing meter sets to provide the building owners/operators with real-time gas (and electricity) use information feedback. Two-way communication via a broadband internet connection in each building provides access to supporting cloud-based software and centralized control over multiple buildings by the owner/operator located remotely in a main office. The cloud-based software typically provides a dashboard interface with access to technical support to help act on the information presented and result in energy-saving actions by the owner/operator.

The product platform that was tested in this project is built with an open architecture that is meter and other hardware agnostic, creating flexibility in accomplishing gas, electric, and even water use feedback and equipment control. It provides scalable systems for small to medium-sized commercial business owners, as well as residential customers.

The objective of this pilot assessment was to provide a foundational understanding of energy savings approaches that are driven by the introduction of real time energy use information into an energy management system (EMS) in small commercial buildings. These energy management information systems (EMIS) are an emerging subset of building automation systems (BAS) that apply automated meter reading and end user, cloud-based interface enhancements to basic EMS.

Automated meter reading (AMR) is not widely practiced in Nicor Gas service territory and currently not at all for small commercial buildings. Hence, the present application of this and other EMIS technology must not only address the economics of the EMIS itself, but that of real-time access to meter information. So in that respect, the objectives of this project are somewhat different than conventional ETP pilot projects. While potential

gas savings and cost effectiveness of the technology are to be addressed, a primary focus is placed on understanding the steps necessary to provide the prerequisite access to real-time meter information presently in Nicor Gas service territory. Hence, this pilot should be viewed as yielding an initial understanding of current economics of small commercial building EMIS applications, in general, and key utility supporting practices for the required, accompanying real-time meter information access.

Results

The site selection process took place over 2012 and 2013. A charitable, not-for-profit agency serving individuals with disabilities in metropolitan Chicago, was selected as the end user. This end user had four available buildings sites located in Nicor Gas service territory, three of which received the EMIS. These four low-rise building sites included:

1. Site #1 is a 4,000 square feet building with forced air gas heating systems controlled by two thermostats;
2. Site #2 is a 3,500 square feet building with forced air gas heating systems controlled by two thermostats;
3. Site #3 is a 3,800 square feet building with forced air gas heating systems controlled by three thermostats.

The building EMIS installations were completed before January 2014. Those installations included the manufacturer's replacement of existing thermostats with DDC thermostats including wireless communication capability, and the utility's retrofit of existing gas meters with pulsing wireless readers, allowing those devices to send/receive information to/from the "cloud" based EMIS software through an internet gateway placed in each building by the manufacturer. With EMIS operations underway in January 2014, the year-long pilot was conducted over the second half of the 2013/2014 heating season through the first half of the 2014/2015 heating season to monitor gas usage.

It is important to note that no data acquisition system (DAS) was placed on-site at any of the buildings by ETP. ETP access to data and reporting on gas use was exclusively via cloud-based software provided by the manufacturer. Historical billing data from Nicor Gas was used to establish baseline gas usage, as well as to confirm and augment gas usage provided by the manufacturer during the monitoring period.

As previously noted, the intent of this project was not the same as in traditional ETP pilots. While EMIS gas savings and resulting EMIS economics were addressed, it was not the primary basis for the research. Rather, the overall EMIS application approach to the Nicor Gas service territory was being addressed. This includes establishing:

1. utility procedures and costs for providing EMIS access to the billing meter;
2. foundational/conceptual-in-nature understanding of both:
    a. small commercial building owner/operator EMIS needs and energy savings practices and

   b. EMIS manufacturer (often a smaller, startup company) capabilities and provisions for support of small commercial building owners/operators; and
3. preliminary insights into the cost effectiveness potential for small commercial building EMIS.

There were several features cited by the pilot end user that improved the day-to-day building HVAC control operations after deploying the EMIS system. These included:

1. remote interface and access to building controls
2. increased feedback from building occupants
3. faster deployment of HVAC professionals for service issues
4. potential for energy savings

However, several issues were encountered over the course of EMIS installation and monitoring. These issues speak to the significant barriers present for implementing small commercial building EMIS at this time, especially in conjunction with smaller, startup manufacturers, in the Nicor Gas service territory. These issues included:

1. precedent setting EMIS and billing meter integration practices with utility
2. wireless/internet connectivity failures at building sites
3. malfunctioning thermostats/other EMIS equipment
4. end user communication problems with manufacturer technical support staff
5. lack of manufacturer support locally
6. corruption of manufacturer data downloads
7. lack of ongoing manufacturer energy efficiency coaching for end user and user feedback on energy savings to manufacturer

Unfortunately, none of the three buildings demonstrated gas savings with the EMIS. In fact when normalized to heating degree day values at a common temperature base the EMIS operation showed essentially no change in gas usage or higher gas usage for all three buildings per Table 1. As indicated earlier, there were several issues encountered during the EMIS operation that impacted these results. Specifically, those operational issues included:

1. at Site #1, one of the EMIS thermostats was malfunctioning (periodically inactive, as reported by end user) and was ultimately replaced with a conventional thermostat by the end user by the conclusion of the EMIS monitoring period;
2. at Site #2, the overhead doors were left open much more frequently (as reported by the end user) during the EMIS operating period;
3. at Site #3, one of the EMIS thermostats was malfunctioning (resetting setpoint without end user intervention, as reported by end user) and was ultimately replaced with a conventional thermostat by the end user by the conclusion of the EMIS monitoring period; and

4. at both Site #1 and #3, the communication link with the building's gas meter was lost 3 months into the EMIS monitoring period and never restored (Nicor Gas billing data was subsequently used for the gas usage and savings analysis).

The end user reported long delays and difficulty in securing technical support from the manufacturer in attempting to remedy these EMIS operational issues.

Table 1: EMIS Gas Savings

	Site #1	Site #2	Site #3
Annual Building Gas Savings (therms/yr)	-15	-1802	-330
Percent Building Gas Savings (%)	-0.1%	-34.4%	-6.8%
Annual Space Heating Gas Savings (therms/yr)	-235	-1775	-324
Percent Space Heating Gas Savings (%)	-2.3%	-35.2%	-7.4%

An analytical evaluation of necessary building energy and operating cost savings to pay back the EMIS equipment, installation, and service costs are included in the full report.