SMALL COMMERCIAL CUSTOMER DIRECT LOAD CONTROL - IT WORKS AND IT'S COST EFFECTIVE

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Introduction

The Long Island Power Authority (LIPA) is completing its third year of LIPA Edge, the largest residential and small commercial direct load control (DLC) program in the United States using a two-way communications system. The LIPA Edge program was launched through LIPA's Clean Energy Initiative, a 10-year $355 million effort consisting of various energy efficiency programs as well as new demonstrations efforts of both clean generation and energy efficiency technologies. There are over 25,000 participants, of which 3,200 are small commercial accounts. The small commercial customers represent about 5 MW of demand reduction during summer afternoon system peak period. This program incorporates a programmable thermostat developed by Carrier Corporation with two-way communications via a pager network, and operates via Itron's EEM Suite. Installations and field servicing are provided by Honeywell DMC. The system offers some unique features, combining all the functions of a programmable thermostat with the ability of the business owner to control their thermostat over the Internet.

This paper will describe LIPA's specific experience with its small commercial customer base. We will describe the marketing, technical issues, implementation challenges, customer reaction to the technology and the utility control, resources required by the utility to deploy the program and the process, and impact results. With the technology used by LIPA Edge, commercial customers represent a much greater load impact potential than residential customers, but are about the same cost. This provides very favorable economics for a direct load control system that are comparable to current supply or generation options

Product Selection

In 2000, LIPA conducted a detailed study of commercially available DLC technologies for the control and monitoring of residential and small commercial central air conditioning. Our investigations found that there were two types of systems in use, (1) control boxes that mounted outside by the compressor and (2) advanced thermostats with communications capability, which replaced the existing thermostat. The major differences between these two types of technologies are that the control box provides no added value to the customer to offset the inconvenience of utility control, so typically an annual incentive, generally cash, is required to attract and maintain participants. For the advanced thermostats option, the thermostats themselves can serve as an incentive, which can reduce or eliminate the need for an ongoing cash incentive. This is an important factor in a long-term economic analysis.

The other major difference is in the area of data communications capability. Most systems use one-way pager-based communications, which allow a signal to be sent to the participant location but no return communications. The Carrier system uses two-way pager–based communications, which enables the system to obtain information back from the participant location, such as signal reception, overrides, and run time data for evaluation proposes. When compared to a standard one-way system, two-way communications is more expensive, requires a more complex installation process and has more

propagation issues. However, the benefits of this technology are substantial, especially for the small commercial customer.

These benefits are as follows:

1. Heartbeats – once a week the units produce a "heartbeat", which is transmitted back through the two-way communication network to the system server. In this way, the utility is assured that the unit is still operating and available for curtailment. With a one-way system, there is no way to remotely determine if the unit is receiving the signals and only visual confirmation can determine if it has been removed or stopped functioning for some other reason.

2. System testing – zero degree curtailment events can be conducted to exercise or test the system to ensure that it is operating properly. Such a test simulates all aspects of a control event without affecting the customer's equipment, including an indication to the customer that it is under control.

3. Confirmations – when instructions are sent to the thermostat device for a curtailment event, the device responds back to the system server that it received the control instructions. No such confirmations are possible with one-way communications.

4. Impact evaluation – traditionally, impact evaluations for one-way systems were conducted through end use metering of a statistically designed sample of participant units. While this approach can produce reasonably accurate estimates, it lacks the "measurable" standard that many Independent System Operators (ISO's) require. The two-way communications medium provides runtime data for all participants, eliminating the need for samples, extrapolation, and potential bias if the sample is not representative. In addition, to maintain an accurate sample, given changes in the participation population as new customers are signed up, the sample would have to be redesigned and new equipment installed or shifted each year.

Generating Recruiting Leads

Small commercial customer recruitment requires a very different approach then for residential. Direct mailings, print media, bill stuffers and telemarketing, which all work well for residential customers, are not as effective with the small commercial population. The major challenge in marketing residential customers is determining who has central A/C systems. The major challenge is marketing small commercial customers is getting to the decision maker. Over the three years that LIPA has implemented the program, we have found that door-to-door marketing is the most effective marketing approach. Going door-to-door provides a number of benefits, including pre qualification (examining the HVAC equipment to make sure it is compatible) and finding and speaking with the decision maker. Of the 3,200 installations completed to date, over 80% have been through door-to-door marketing. This marketing approach also lends itself to identifying franchise-type customers that have multiple locations in the service territory. These types of customers are especially valuable because they provide a significant number of leads through one marketing contact.

Customer Types

There are many different "commercial" customer types enrolled in the program. These include religious and educational facilities, banks, insurance, realtors, medical, law, recreation, health clubs, retail, trucking/shipping, hair salons, printing, and office buildings.

The average size HVAC unit for the 3,200 commercial LIPA Edge customers is about 6 tons. This equates to just over 6 kW of connected load. The size of the units ranges from as small as 1.5 tons to as large as 30 tons. The majority (94%) of the units are on rooftops. This makes it easier to identify qualifying customers since the equipment can be seen from the outside. Strip malls are excellent candidates for the program. Typically, if you can successfully install one of the stores in the strip mall you will likely be able to install all of them.

Overrides

A key component to the program design is allowing customers to override the controls. Allowing overrides makes it very easy to overcome prospective participant concerns about potential comfort impacts. Commercial customers, while willing to be good corporate citizens, will not risk their ability to conduct their businesses in whatever manner they deem necessary. Allowing overrides takes away this risk. While overrides can result in up to 30% of customer opting out of the control event, it significantly reduces the cost of marketing, keeps customers in the program without ongoing incentives, and maintains a high level of overall customer satisfaction.

Customer Reaction

As previously noted, over 3,200 LIPA Edge systems have been installed at small commercial customer locations. Customer reaction has been very positive. Regular follow-up surveys indicate that over 95% rated the program experience as excellent. Commercial customers also like the ability to control their thermostat over the Internet. Some customers have been very innovative in using this feature. For example, a number of customers with multiple locations have placed lock boxes over the thermostats and control them from a remote location. This provides the customer with an energy management system at no cost and prevents unauthorized operation. The Itron software allows the customer to view all of his locations on one screen.

In terms of utility control, LIPA fully activated the system on only two days in 2003, one of which was related to the East Coast blackout of August 14. In 2002, the system was activated 3 times in response to high system peak loads during very hot weather. Customers were typically controlled for four hours between 2 pm and 6 pm, using a 50% cycling curtailment strategy of 30 minutes on and 30 minutes off per hour. Customer overrides were in the mid 20% range. Most of the overrides occurred during the first hour of the curtailment event and stayed at that level for the remainder of the curtailment. With respect to comfort levels, customer that did not override were either not aware of the curtailment or did not experience any significant discomfort.

Installation

Honeywell DMC, with offices throughout the United States, has been the installation contractor since the program began in 2000. HDMC has engineered many installation solutions, which have allowed more customers to participate and has also significantly shortened the time required to complete an installation. One of the biggest challenges in installation is related to wiring the communication box (I/O Board) to the Carrier thermostat. While this issue continues to be of some concern with residential installations (although not nearly as significant since Carrier has reduced the number of wires needed for installation), commercial installations are not at all affected by wiring practices. Of more concern in commercial facilities is the condition of the HVAC equipment. Since many commercial customers rent their space, they do not own the HVAC equipment and therefore have no control over its condition. LIPA does not install its DLC system in facilities where the HVAC equipment does not meet electrical code, is in very poor condition, and is not operating properly.

Curtailment Manager Software

Itron provides and hosts the LIPA Edge Curtailment Manager (EEM Suite) software, which is the control system from which LIPA can program a control event. The software allows for the utility to specify the type of control (cycling versus temperature set point adjustment) and whether the customer can override the control. The system also provides real time confirmation of control signal reception, as well as customer overrides. The system has numerous reports and can be accessed from any computer with Internet access and the required password.

Impact Results

On July 3, 2002, temperatures neared all-time highs (over 100 degrees in New York City) and most utilities in the Northeast set all time summer peaks, which have yet to be exceeded. On that day, LIPA ran its entire load curtailment program including LIPA Edge. Load reductions are determined through the use of runtime data that can be downloaded directly from each thermostat. The runtime data provides hourly measures of the number of minutes that the compressor is actually operating. Figure 1 compares the load shape for the control day (July 3, 2002) with the load shape of the baseline day (July 29, 2002), expressed as a percentage of full-time operation (duty cycle). The baseline day was selected to most closely match the control day in terms of weather and load pattern. The difference between the load shapes between the 2 pm and 6 pm period equals the reduction in duty cycle attributable to the program.

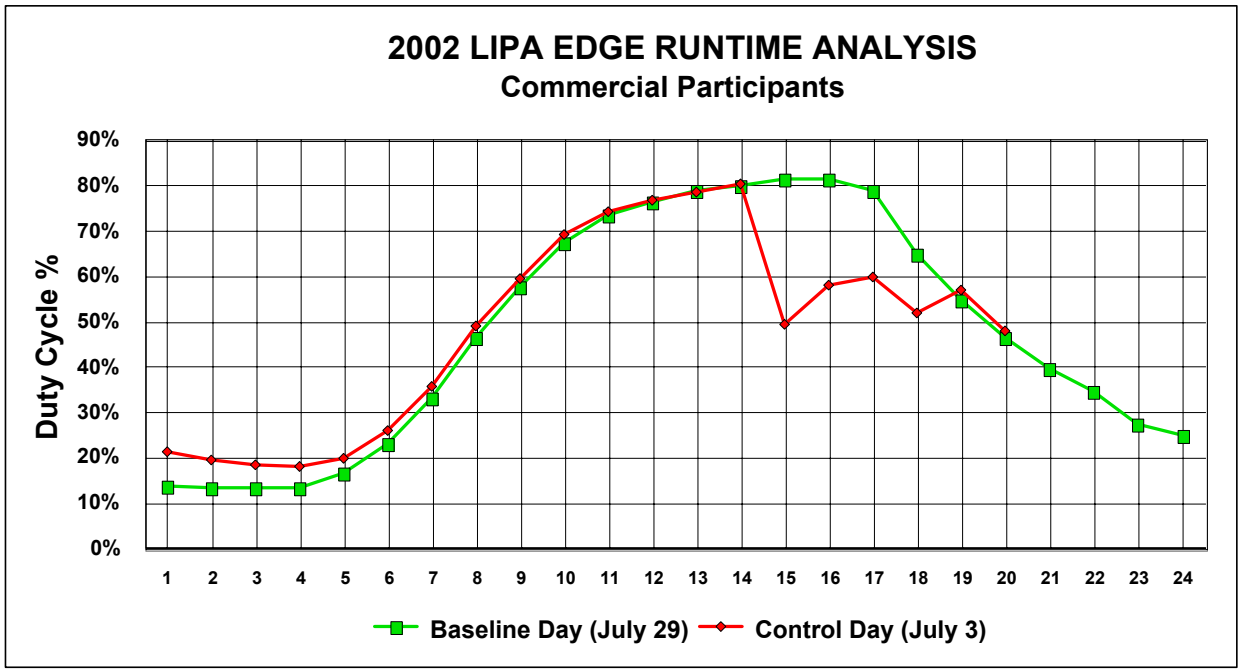

Figure 1

Combining this duty cycle data with connected load information produces kW impacts. Figure 2 compares the kW per unit load shape for the control day with the kW per unit load shape of the baseline day. The difference between the load shapes between the 2 pm and 6 pm period equals the kW reduction attributable to the program.

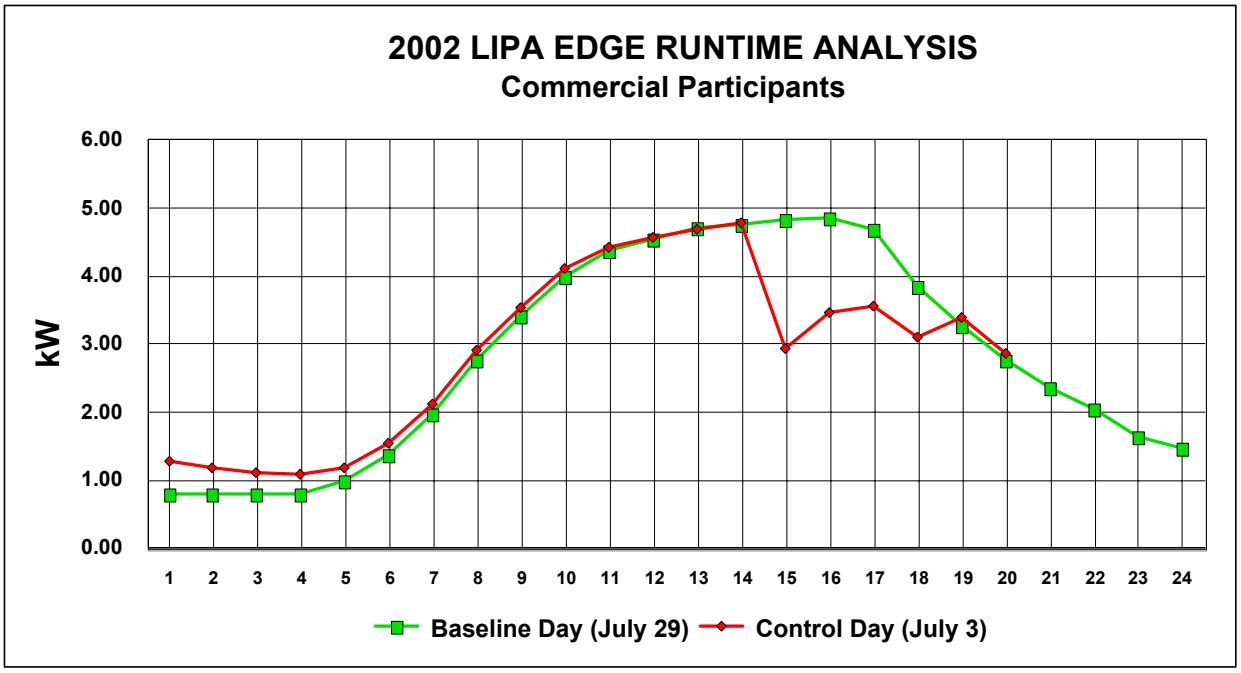

Figure 2

Table 1 summarizes the duty cycles and kW estimates by hour over the four-hour curtailment event.

Table 1

Hour ending	Weather adjustment baseline duty cycle	Controlled duty cycle	Connected load	Per unit adjusted net kW reduction
3 PM	0.81767	0.49545	6.375	2.2548
4 PM	0.81933	0.57833	6.375	1.6865
5 PM	0.78867	0.59633	6.375	1.3459
6 PM	0.64600	0.51200	6.375	0.9377

The methodology that is used to generate impacts has been reviewed and accepted by the New York ISO for small customer demand response during EDRP (Emergency Demand Response Program) events.

Cost Effectiveness

An approximate cost of a Carrier system installation is about $550 per installation, based on typical costs for all aspects of the project, including equipment, software, hosting, installation, project management, marketing, and communications. Note that this is not an actual LIPA-specific cost. This also assumes a large enough project (at least 5,000 installs annually) so that economies of scale can be realized. Given the typical size of a residential system (3 tons) and the associated impact (1 kW), it can become relatively expensive. Commercial installations cost about the same as residential. However, with an average size of 6 kW, and an associated impact of 1.5 kW or higher, the economics are significantly better. At these levels, the program begins to compare favorable to many other supply options, without accounting for the potential environmental credits that could be added to the benefits.

System Enhancements

In addition to Carrier's product, other companies are developing their own two-way communication based load control systems. As more companies get into the market, competition should drive costs down. In addition, Carrier and its competition will be developing other services to take advantage of the gateway that the system provides into the customer's home. Such enhancements might include connections to other end uses that could also be controlled, messaging, automatic meter reading, security, etc.

Conclusion

The system described in this paper for commercial customers has many positive aspects. Customers have indicated that they like the technology. The technology provides them with advanced control of their HVAC system and can provide significant energy savings through remote monitoring and control. Customers have the ability to override, which makes it easy to recruit customers. Allowing overrides also minimizes the number of dropouts in the program. The economics are favorable because the

system cost doesn't change from residential to commercial even though you are controlling equipment that is, on average, about double in size. In the three years that LIPA has operated the program, very few customers have dropped out (about 1.5%) even though there is no annual incentive. The two-way communications technology allows LIPA to ensure that all the equipment is operational and to check and service all non-responding equipment on a timely basis. Runtime data from all participants can be used to produce accurate impacts for the program. A program such as LIPA Edge for commercial customers deserves serious consideration as a cost effective demand response resource.

About The Authors

Mr. Michael Marks, Senior Vice President and Co-Founder of AEG, has 24 years of experience in the technical, management, and consulting aspects of the electric and natural gas utility industry. Mr. Marks' specialties are in the areas of demand side management program (DSM) planning, design, implementation, evaluation and regulatory compliance; statistical analysis; load forecasting; strategic issues consulting; and comparative economic studies. Mr. Marks's provides project management support for Con Edison and LIPA on their residential and commercial CAC direct load control program using Carrier Corporation's two-way communication platform. Mr. Marks has also provided consulting services internationally for utilities in Canada, South Africa, Bermuda and Thailand. Mr. Marks holds a MA Degree in Applied Economics from Binghamton University and a BS Degree in Mathematical Economics from State University of New York at Oswego.

Mr. Dan Zaweski is LIPA's Manager of Energy Efficiency and Distributed Generation Programs and is responsible for LIPA's Clean Energy Initiative, a 10-year $355 million program encompassing eleven energy efficiency programs as well as new clean distributed generation efforts. Mr. Zaweski works directly for the Long Island Power Authority and holds a Bachelor and Masters degrees with concentrations in Management.