Not All Measures Are Created Equally: Using M&V Data for Strategic Program Design

Michael Ihesiaba, Con Edison, New York
Jacqueline Phelon, ERS, New York

ABSTRACT

Faced with the challenge of soaring electric demand in the diverse and heavily populated boroughs of Brooklyn and Queens, Con Edison launched an in-depth measurement and verification (M&V) study to identify the customers and measures with the greatest potential for electric demand reduction during peak hours. While it is often advantageous to recycle programs from one territory to the next, Con Edison faced a unique challenge in that the network most in need of peak demand reduction had a significantly different demand profile than those observed in other regions. Because the network-specific peak period is unique, recycling load profile assumptions and program offerings from other networks was deemed inappropriate.

In order to successfully achieve savings goals, targeted demand management requires a customized approach based on in-depth knowledge of the customer base and an understanding of the equipment usage profiles. The Con Edison enhanced metering study was designed to determine the following: 1) what equipment is most prevalent within the target territory, and 2) when the equipment is used throughout the day. Data collected from over 325 sites throughout Brooklyn and Queens was analyzed to illustrate which types of equipment are most common among various facility types. Additionally, metered data collected from over 2,700 loggers was used to determine how equipment operates throughout a typical day. The results from the study are being used by Con Edison to strategically design new programs for customers in Brooklyn and Queens. Additionally, study results are being used to improve demand reduction estimation accuracy and reduce ongoing M&V costs.

Introduction

As infrastructure continues to expand throughout Brooklyn and Queens, Con Edison is faced with the approaching challenge of electric demand reaching and exceeding substation capacity. This issue is not new or unique to a particular territory or utility, but it is a common area of focus for utilities in urban areas throughout the country. One way to address peak demand constraints is the implementation of traditional demand response (DR) programs. A staple for many utilities, DR programs incentivize participants to turn off non-critical equipment during peak hours to temporarily shed load. Although such programs can be effective for emergency load reduction, they are not sustainable in areas with persistent electric demand growth.

Con Edison has adopted a forward-looking mentality, identifying and addressing rising electric demand in New York City before substations reach capacity. With support from its forecasting department, Con Edison has taken a fresh approach to peak demand reduction by using equipment upgrades and replacements to achieve permanent demand reduction. More specifically, Con Edison's Brooklyn Queens Demand Management (BQDM) program has identified and aggressively implemented both utility-sided and customer-sided demand management solutions within a particular constrained network. The BQDM program is not a DR program, but rather, it features efficiency measures that are strategically selected due to their high energy-reduction potential during the peak period. These non-wires alternatives are expected to delay and possibly eliminate the requirement for new substations serving the BQDM territory.

Planning and delivering reliable customer demand reduction at critical and specific hours requires an in-depth and high-resolution understanding of how customers use energy. In order to effectively target equipment that will generate substantial energy savings, program designers must understand what the existing equipment conditions are and what periods of the day the equipment is being used. Electric load profiles are important for both program savings quantification and demand forecasting. As is the case with all programs, the quantification of efficiency impacts will be used to verify the success of the BQDM program; load reduction calculations rely on an accurate understanding of equipment operating hours. More importantly, however, if the Con Edison forecasting department plans to use efficiency impacts in load-projection calculations, then supremely reliable demand reduction results must be calculated on an hourly, rather than an annual, basis.

An analysis of historic substation demand data revealed that the peak demand period was unique within the network of interest; more specifically, the BQDM territory's peak demand period has a12-hour duration, with the most constrained hours between 7:00 p.m. and midnight. As such, hourly electric load profiles from other networks do not apply to the facilities within the BQDM network. Furthermore, the electric load profiles currently in use are speculative in nature, using simulation data rather than actual metered data. Therefore, the development of previously unavailable network-specific hourly load profiles was required. Such load profiles could not be created using historic billing data because hourly usage resolution was not available for many customers, particularly small business (SB) owners and multifamily (MF) residents. In some instances, 15-minute interval data, or AMI data, was available for BQDM customers. While this high-resolution data is certainly a powerful tool for the development of network-wide load shapes, AMI data cannot reliably provide answers about which end-use loads and equipment types are using energy during specific hours of the day – an important characteristic to consider when designing targeted demand reduction programs.

Another important program design element is the understanding that different customers have different product requirements. It is the explicit goal of program designers to tactically select efficiency measure offerings that will both appeal to customers and reduce electric demand. Granular equipment-level data educates the program designers and administrators about the differences in customer requirements, thereby allowing them to select and promote efficiency measures that will be most appealing to targeted customers. Neither monthly billing data nor AMI data can provide information about the equipment characteristics (e.g., frequency, vintage, condition) in each targeted network. Therefore, Con Edison launched a large-scale study that aimed to fill critical knowledge gaps.

Con Edison's enhanced metering study was designed to gather a comprehensive and representative data set including a) characteristics of all electric energy-consuming equipment and b) the corresponding hourly load shapes through equipment-level metering. This paper presents the findings and results of this study, which provided equipment characterization data and load shapes for three important segments within the BQDM network: the multifamily in-unit (MFIU), multifamily common area (MFCA), and SB segments. The resulting load shapes, in conjunction with detailed equipment inventories, were analyzed to develop an understanding of how BQDM customers consume electricity.

The equipment- and network-specific load profiles produced through the enhanced metering study will be immeasurably powerful tools for Con Edison. Not only will the load profiles aid in the selection of BQDM measure offerings, but they will also be used in the following ways:

- Better estimate program-sponsored hourly demand reductions for current and future measure offerings
- Identify cost-effective and reliable methods to achieve further demand reduction during the constrained hours
- Quantify the cost-effectiveness of efficiency measures
- Improve forecasting by providing equipment-specific coincidence factor (CF) data on an hourly basis
- Reduce future M&V work by building a database of load profile and equipment characteristics data
- Leverage collected data for the planning and forecasting of future network-targeted demand management initiatives

The BQDM program designers will combat load constraints with a suite of offerings, including energy efficient equipment replacements and controls installations, load shifting, and customer education. As discussed in the subsequent sections of this paper, the enhanced metering study will help inform the selection of customers and equipment to target for efficiency improvements and load reductions during the network-specific peak demand period.

Data Collection & Analysis Overview

Con Edison's enhanced metering study began with a high-level examination of the BQDM network to identify which customers should be included in the study. The analysts segmented customers according to their rate category, collective demand on the grid, and eligibility for existing energy efficiency programs. This initial analysis revealed that focus should be placed on SB customers,[1] MFCAs), and MFIU residents. Each of these customer segments represents a significant portion of territory demand, but due to their relatively small individual demand, little was known about how the customers use energy and what types of equipment should be targeted for demand reduction upgrades. Additionally, Con Edison was interested in increasing the accuracy of hourly demand reduction estimates for preexisting program measure offerings available to SB and MF customers.

After selecting the customers to focus on, strategic sampling was performed to reduce the study completion time and cost. The sample within each customer segment was designed to represent the population within the BQDM territory. Stratified sampling was completed to account for equipment diversity and historic billed demand. The equipment end-uses were expected to vary substantially by business type in the SB customer segment. For example, refrigeration equipment was expected to be highly prevalent in grocery stores but uncommon in offices. To correctly capture this equipment variety, the enhanced metering study was designed to provide results that are specific to each business type, allowing for the future application of results to the same business type within different networks and populations. Five independent business types were selected for research due to their dominance within Con Edison's territory. The five business types (grocery, industrial, office, restaurant, and retail) represent 96% of the BQDM SB population's billed demand. SB sites were further stratified by their annual electric consumption to ensure that the range of business sizes was captured within each independent sample.

Unlike the SB segment, the equipment end-uses were expected to be relatively homogeneous among both the MFCA segment and the MFIU segment. As such, no further division was required for either of these two customer segments. To ensure that size variation within the MFCA population was characterized, annual building electricity consumption was used as a stratification variable. Conversely, energy use was found to be relatively homogeneous among MF tenants; therefore, there was no stratification by size for MFIU customers.

Past program participation was considered for its potential to bias the results of the study. In the case of SB customers, study sites were selected from the pool of Small Business Direct Installation (SBDI) adder program[2] participants. The team determined that it was appropriate to pull the study sample from past SBDI program participants because the program has a very low refusal rate, and the participant population is therefore expected to be very similar to the nonparticipant population. Similarly, the MFCA sample was drawn from buildings that participated in the common-area portion of the BQDM Multifamily Energy Efficiency (MFEE) adder program. Again, MF building MFEE participants were expected to have similar equipment and operating profiles as nonparticipating buildings. In contrast, the

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[1] At the start of the study, BQDM SB customers were defined as commercial accounts with an average billed monthly peak demand of less than 110 kW. During the study, the eligibility for participation in the BQDM Small Business Direct Installation (SBDI) adder program was expanded to include commercial accounts with an average billed monthly peak demand of less than 300 kW.

[2] The "adder" programs are subsets of existing Con Edison efficiency programs such as SBDI and Multifamily Energy Efficiency (MFEE). An additional incentive is added to the efficiency incentive to account for the claimed peak demand reduction.

enhanced metering team recognized that most in-unit program participants are recruited on weekdays between 8:00 a.m. and 5:00 p.m. Therefore, apartments selected for in-unit M&V included both participant and nonparticipant tenants, thereby reducing the potential bias associated with collecting data from a non-representative sample of apartments that are occupied during the day.

Recruitment proved to be a challenge for study implementers, despite offering monetary incentives for study participation. Although SB customers and MF building managers had previously participated in Con Edison's energy efficiency programs, many customers were skeptical about the objectives of the enhanced metering study because they were unsure of how the results would ultimately benefit them. Therefore, unique recruitment strategies were developed to promote study participation. Customers were contacted in a variety of ways, including phone calls, letters, drop-in visits at varying times of day, and leave-behind flyers. To highlight their affiliation with Con Edison, third-party study implementers wore Con Edison attire in addition to their contractor badges. Additionally, study implementers attended tenant association meetings to introduce the study to MFIU residents. The multi-pronged recruitment approach ensured that a diverse group of customers was included in the study, further minimizing bias.

The on-site data collection consisted of up to four different types of visits at each site. The first visit for all sites took place during the summer of 2015 and included a comprehensive equipment inventory and deployments of light and plug-load metering devices. During these initial visits, field staff attempted to inventory all electric-using equipment at each facility. Additionally, non-electric space heating systems and domestic hot water heaters were inventoried for possible future reference. Segment-specific data collection tools were developed for the three segments of interest. These tools allowed field staff to efficiently and consistently collect relevant data for each type of equipment. Although the targeted data varied by segment and equipment type, field staff collected the following data when possible:

- Equipment type (e.g., lighting, refrigeration, space conditioning)
- Quantity of equipment
- Location/space(s) served by equipment
- Manufacturer ratings (e.g., size, vintage, V, A, kW)
- Control type

In some cases, complete end-use inventory data could not be collected due to a lack of access to the equipment, missing or unreadable nameplates, or time constraints imposed by the tenant or business owner. In such cases, field staff noted equipment types and quantities, which were later used to estimate the equipment-rated load based on observations of similar equipment in the sample.

After completing equipment inventories, the field engineers deployed light and plug-load loggers. Lighting loggers were installed to capture the lighting operation of each space type at the site; plug-load loggers were installed on a variety of 120-volt equipment at each site using sampling quotas by equipment type, estimated by the expected saturation, size, and contribution to the peak network load by the equipment. The use of on-site sampling reduced the study costs by decreasing both the quantity of loggers required and the time spent at each site.

Particular attention was paid to the organization of equipment characteristics and metered data. Not only was meticulous data organization critical to the efficient execution of the enhanced metering study analysis, it also ensured that all collected information could be aggregated and used to reduce sample sizes and, ultimately, costs for future M&V efforts. To make collected data more versatile, the team also conducted customer interviews to acquire demographic, socio-economic, and occupant information to post-stratify the results and identify key variables for translation of results to future networks and populations.

During the initial visit participants were asked if they would agree to the installation of amperage loggers inside their electrical panels. If the participant agreed, field staff returned to the site for a second time with a licensed electrician to install loggers inside the panel(s). The full facility load was targeted at each site and captured by installing an amperage logger on each leg of the main electric feed. Additionally, field staff also logged the amperage of large loads that were isolated on individual circuits.

At the conclusion of the summer of 2015, a third site visit took place in which logged data was retrieved and study participants were asked if they would agree to the installation of replacement loggers to collect data beyond the summer season. If amenable to continued study participation, customers received an additional incentive and loggers remained in place through the shoulder and winter seasons to gain an understanding of how energy use patterns within the studied segments changed throughout the year. The fourth and final site visit consisted of retrieving all loggers and filling any remaining gaps in the equipment inventory from the initial visits. In total, over 2,700 loggers were deployed for the enhanced metering study. A summary of the collected data is shown in Table 1.

Table 1. BQDM Metering and Equipment Characterization Data Collection Summary

Segment	Sites Visited	Loggers Deployed				Pieces of Equipment Inventoried	Customer Surveys Completed
		Lighting	Plug Load	Amperage	Total		
MFIU	108	537	416	86	1,039	3,100	62
MFCA	42	376	16	117	509	3,400	0
SB	127	530	285	397	1,212	4,200	94
Total	**277**	**1,443**	**717**	**600**	**2,760**	**10,700**	**156**

The analysis of the data collected for the enhanced metering study was two-pronged. First, the equipment characteristics collected via facility-wide inventories were aggregated for each customer segment to gain a better understanding of the most prevalent electric-consuming equipment types and their respective conditions. Results of this analysis can be used by program designers to select measure offerings that will appeal to a large percentage of targeted customers. The second analysis effort consisted of developing segment-specific electric consumption load shapes for each of the most dominant equipment types.

The CF of a piece of equipment is the percent load (0%–100%) at which it will operate during a given hour. For the enhanced metering study, a load shape is defined as the 24-hour plot of hourly CFs. In the case of end-uses that are not weather-dependent, the load shape was constructed using metered data from all summer non-holiday weekdays. All weather-dependent load shapes were constructed using an average of the five highest peak demand days within the summer metering period. The analysis resulted in load shapes representative of MF and SB segments within the BQDM territory.

The enhanced metering team developed load shapes using two stages of weighting to appropriately expand results back to the population: 1) within-site weighting to accurately represent the distribution of equipment within the sampled site, and 2) between-site weighting to represent the number of sites in the population that the particular sampled site represents. Load shapes were developed for each major equipment type in relation to these two weighting concepts. Hourly CF calculations were repeated for all 24 hours to create a full load shape.

As can sometimes be the case with studies of this magnitude, the enhanced metering team was concerned that busy stakeholders may not have the bandwidth to take full advantage of the study outcomes if they were presented in a typical report format. To combat this concern, results were presented in an easily digestible dashboard format. Not only did this unique presentation aid in the disaggregation of findings, but it also facilitates efficient updates to load-shape values as additional data is collected over time. Furthermore, the dashboard features filtering and slider-bar abilities that allow the data to be easily viewed in different contexts (e.g., current achieved demand reduction, forecasted demand reduction). As an added benefit, the costs associated with reporting the achieved demand reduction and program recommendations will decrease as stakeholders become more familiar with the succinct dashboard format.

Using the Results

The BQDM program designers are tasked with selecting equipment and controls upgrades that will reduce the demand on the grid during peak periods. One factor that is considered during program measure selection is the total load contribution of targeted equipment within the network. The equipment load contribution of any given end-use equipment category is a function of the three key variables listed below:

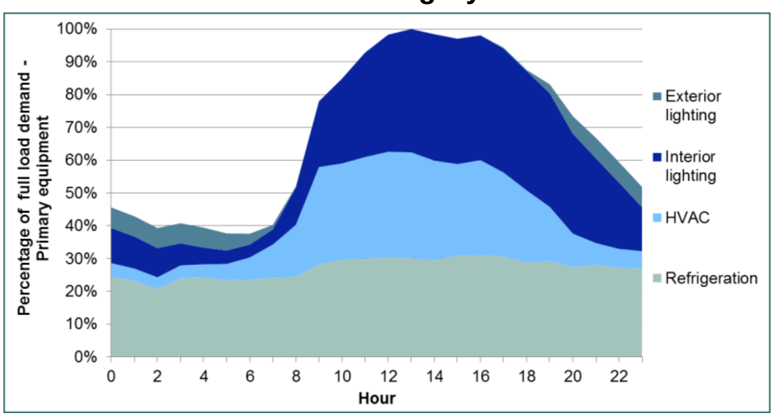
1. The rated load of the equipment, collected via facility-wide equipment inventories
2. The saturation of the equipment in the BQDM population, as determined by aggregating the total number of equipment observations across the sample
3. The load shape, derived from metered data

The product of the equipment's rated load (#1) and saturation (#2) is applied to that equipment's load shape (#3) to determine equipment-specific demand in a given hour. Load profiles were created for the dominant equipment categories in each of the three customer segments included in the enhanced metering study. The results have since been used to identify specific equipment and customers of interest, improve energy efficiency forecasting, and reduce the need for extensive on-site data collection, thereby allowing for more real-time and economical M&V.

Identifying Equipment and Customers of Interest

The enhanced metering study found that the SB segment, composed of more than 14,000 service addresses in the BQDM territory, features the largest variety of mechanical equipment. The study sought to provide clarity about the saturation and operating profiles of the most prevalent equipment used throughout this diverse customer segment. Energy-using equipment by SB customers was grouped into four major categories: lighting; heating, ventilating, and air conditioning (HVAC); refrigeration; and miscellaneous electric loads. Figure 1 illustrates the hourly demand contributions of key end-uses for the average SB customer during a peak day.[3]

Figure 1. BQDM Small Business Peak Day Load Profiles per Customer by Primary End-Use Category



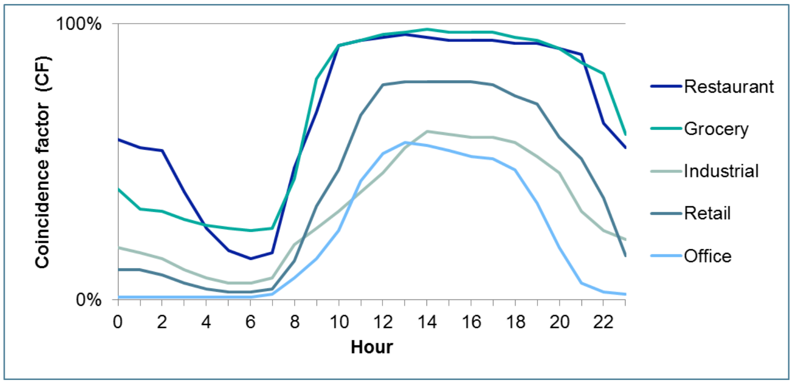
The enhanced metering study revealed that refrigeration loads were relatively flat, even on peak demand days. This finding allows Con Edison to offer refrigeration measures with greater certainty about when demand savings will be achieved. Additionally, the study confirmed that interior lighting is a major contributor to the SB segment's demand, even in the evening hours. In contrast, HVAC loads were found

[3] The peak-day load was calculated for the enhanced metering study to be the average usage observed on the five highest peak demand days in 2015.

to decrease during the network-specific peak demand period, indicating that funds may be better spent on non-HVAC measures in order to maximize the peak demand reduction among SB customers.

The study uncovered significant differences in equipment operation and saturation among each business type. For example, Figure 2 presents the interior lighting load shapes for each of the five business types.

Figure 2. BQDM Small Business Interior Lighting Load Shapes by Business Type

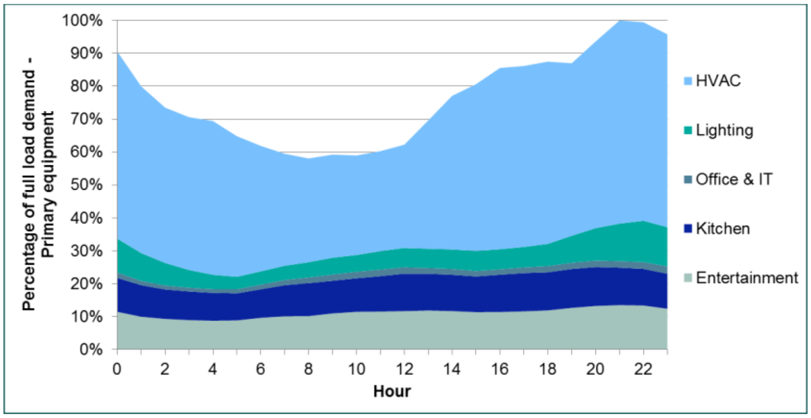


Restaurant and grocery store lighting showed the largest CFs during the late evening hours, whereas office lighting demonstrated the lowest CFs during this period. Analysis revealed that the potential savings from interior lighting upgrades at a SB can differ by a factor of ten during the 9:00 p.m. system peak, simply based on business type. While a program that exclusively targets restaurants and groceries is not necessarily the solution to achieving network-specific demand reduction, this information can be used by program designers to optimize current programs based on other sector-specific constraints (e.g., costs per upgrade, ease of engagement, market potential). For example, the enhanced metering study provided Con Edison with evidence to support the exploration of tiered incentive structures for various customer types; implementation of such incentive tiers could increase the cost-effectiveness of BQDM peak demand programs. This information also allows Con Edison to more efficiently direct the efforts of its implementation contractors for targeted measure deployments.

Improving Energy Efficiency Forecasting

With approximately 170,000 apartments located within MF buildings in the BQDM territory, the MFIU segment is another major contributor to the BQDM territory's peak demand load. While Con Edison was already providing efficiency upgrades to these customers through the in-unit portion of the MFEE program, results of the enhanced metering study allow for better demand reduction forecasting by quantifying the hourly contribution of each equipment type to the apartment's full-load demand. Figure 3 provides an average 24-hour peak day load profile of the major electrical end-uses within BQDM apartments.

Figure 3. BQDM Multifamily In-Unit Peak Day Load Profiles per Customer by Primary End-Use Category



Load shapes developed for the MFIU customer segment revealed that kitchen, entertainment, and office/IT equipment operates at relatively flat base-load profiles, while both lighting and HVAC usages fluctuate substantially, peaking at a late-evening hour coincident with the overall network peak. Although field engineers comprehensively inventoried equipment that does not fall into the aforementioned categories, the load profiles for the other equipment showed that it was not a significant contributor to an average apartment's daily electrical consumption. This finding confirms that there is little peak demand reduction potential for small appliance controls measures, such as smart strips, due to their highly intermittent use. Therefore, Con Edison can appropriate funds to other measures that will have greater potential for peak demand reductions.

Conversely, the enhanced metering study proved that the main contributor to the summer peak period is HVAC equipment, largely driven by window air-conditioning (A/C) units, which account for 62% of the peak summer load. None of the apartments surveyed had central A/C, while 80% had at least one window A/C unit. Furthermore, there was a strong correlation between the quantity of window A/C units per apartment and the number of bedrooms; a 42% increase in A/C unit quantity was observed in apartments with three or more bedrooms. Armed with the knowledge that residential window A/C unit usage is highest during the late evening network-specific peak period, Con Edison could justify the addition of A/C upgrade programs that may have otherwise been cost-prohibitive.

Results from the enhanced metering study can be used to forecast the demand reduction of potential energy efficiency measures. For example, the team estimated the impacts of offering an A/C upgrade program to MFIU customers throughout the territory. Almost the entire population of window A/C units observed through the study are considered inefficient compared to the ENERGY STAR minimum efficiency standard of 12.0 CEER for new room A/C units.[4] The demand reduction potential from a window A/C unit replacement program was estimated using the A/C quantity, capacity, and efficiency data collected from the comprehensive equipment inventories. Given the vast number of apartments and the observed unit size and efficiency distribution, replacing all MFIU A/C units with new ENERGY STAR units (CEER of 12.0) could provide a total of 15 MW of demand reduction in the BQDM territory at the 9:00 p.m. hour. This finding is certainly compelling, prompting further investigation by program designers.

[4] CEER is the combined energy efficiency ratio (the 2014 addition of the "C" to the standard accounts for standby energy use). The ENERGY STAR minimum CEER of 12.0 is applicable to the sizes and types of room A/C units most present in the BQDM territory, including units that have louvered sides, are less than 14,000 Btu/hr, and have no heat pump.

Contributing to Ongoing Real-Time M&V

In addition to aiding BQDM program designers, the results of the enhanced metering study have been used to calculate more accurate demand reduction estimates through the application of network-specific hourly CFs. Because the equipment-specific load shapes are readily available through the dashboard, demand reduction estimates can be calculated on a rolling, real-time basis. For instance, the enhanced metering study showed that many facilities within the BQDM territory are using old, inefficient lighting technologies. As such, lighting upgrades will continue to be a source of demand reduction in the BQDM territory and the hourly profiles obtained through the enhanced metering study will be used to improve the tracking savings estimates of current and future lighting programs. Figures 4 and 5 provide the average CF profiles for lighting fixtures located in the primary space types of MFIU and MFCA sites, respectively.

Figure 4. BQDM Multifamily In-Unit Lighting Load Shapes by Space Type

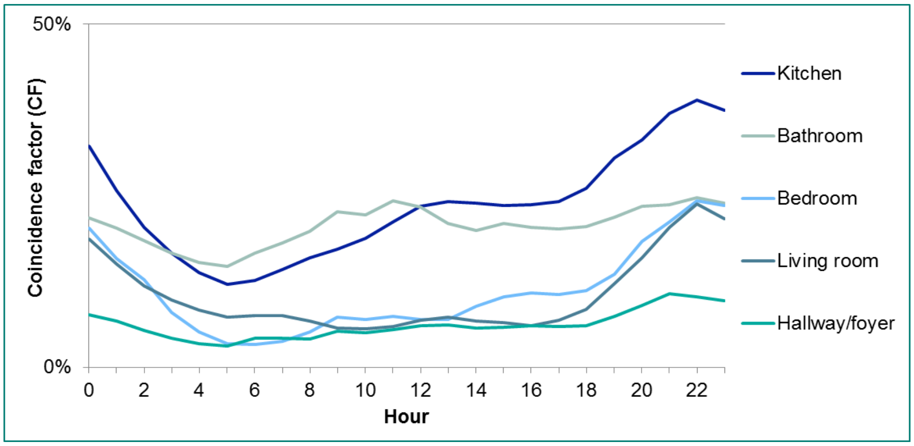
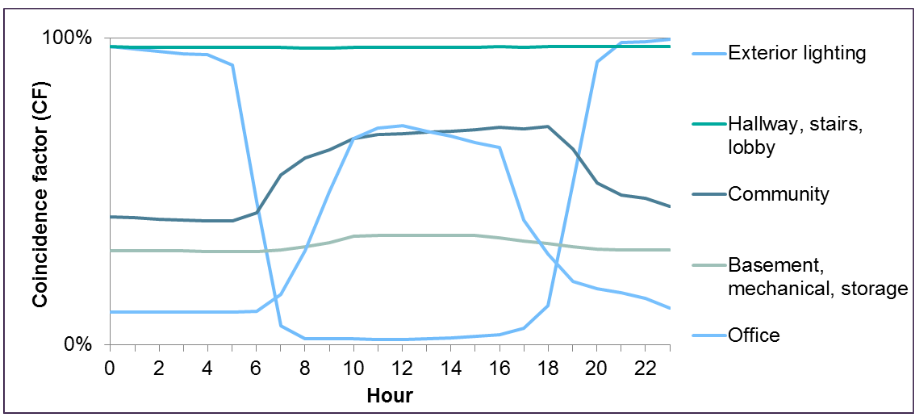


Figure 5. BQDM Multifamily Common Area Lighting Load Shapes by Space Type



It is evident that lighting is used intermittently in MFIU spaces, with the kitchen lighting showing the highest CF during the peak period. In contrast, MFCA exterior fixtures operate fully during the late evening hours, while interior lighting operates at a consistently high level, particularly in hallways, stairwells, and lobbies. The enhanced metering study provided accurate hourly CFs that will be used in demand reduction calculations moving forward. Additionally, the enhanced metering study affirmed the MFEE adder program's focus on common-area lighting at the more than 13,000 medium-sized MF buildings within the BQDM territory.

Ongoing M&V costs and completion timelines have been reduced in the months following the enhanced metering study due to the readily available abundance of metered data collected at SB, MFIU, and MFCA sites. While some level of on-site M&V is still required to verify measure installations and identify behavioral and/or operational anomalies, the field work reduction has proved to be an added benefit of the study completion. Con Edison also expects that other networks in need of a similar study will require a smaller on-site sample size, thereby reducing the cost of future studies.

The results of the enhanced metering study allow Con Edison to better appoint prescriptive values to measures, thus reducing the “sticker shock” some customers have historically experienced after M&V. Furthermore, Con Edison requires the creation of “most conservative curves” to better inform the technical reference manual; as more M&V data is added to the database, conservative network- and measure-specific load curves will begin to take shape.

Conclusions

Unlike traditional efficiency programs, targeted demand management programs must be strategically designed so that the maximum savings can be achieved during network-specific peak demand periods. Prior to this effort, Con Edison relied on outdated and ineffective load curves generated from the Commercial Buildings Energy Consumption Survey (CBECS) of 2012. These load curves were neither measure specific nor sensitive to nighttime peaking networks. Planning and delivering reliable customer demand reductions at critical and specific hours of need requires an in-depth and high-resolution understanding of how customers use energy. To achieve demand reduction goals, program designers must account for the facility-specific usage profiles of targeted equipment and select the appropriate suite of energy efficient equipment and controls upgrades, load shifting measures, and customer education offerings. Additionally, the program implementers have limited opportunities to engage customers, and it is therefore imperative that program offerings are immediately attractive because they provide significant improvement over the existing equipment. The enhanced metering study reduced the unknowns that were previously associated with the demand profiles and efficiency opportunities available throughout Brooklyn and Queens. The creative use of M&V data collected from a representative sample of the target territory has empowered Con Edison to explore new measure offerings that might have otherwise been ignored.

Information from end-use inventories was particularly valuable to convert CF load shapes into load profiles that account for equipment demand. The resulting end-use load profiles enable Con Edison to understand how BQDM customers consume electricity. When used in conjunction with the equipment saturation data determined from the on-site inventories, the end-use load profiles allow Con Edison to estimate the network-wide savings potential for any measure mix. This customer-specific understanding of equipment prevalence and usage profiles facilitates improved forecasting, better program-sponsored demand reduction estimates, and the identification of cost-effective and reliable methods to achieve further reduction during the constrained hours.

Armed with the statistically representative load profiles for the selected customer segments, Con Edison is now in an exciting position to strategize a data-driven approach to customer-level demand management. The equipment inventories revealed that the BQDM service territory has significant untapped potential for demand reduction. As indicated in the Using the Results section above, there is significant peak demand reduction potential for lighting, HVAC, and refrigeration upgrades. Furthermore, savings can be optimized through creative and information-based program design, such as targeting SB customers with high lighting use in the constrained hours of need.

The enhanced metering study’s load shapes and end-use inventories represent data from hundreds of customers in Brooklyn and Queens and thousands of pieces of equipment. This unprecedented research elucidates how energy is consumed for each segment overall, as well as at the individual customer and equipment levels within these segments. Load shapes by business type, space type, end-use, or other indicative variables are now available to Con Edison for the computation of measure-demand reduction.

Using these factors to calculate demand reduction in real time will lead to more accurate tracking estimates, giving program implementers a much better indicator of actual program savings in real time.

The budget for this work was carved out of the BQDM program allocation for M&V work. Significant effort was made to ensure that this study was not only completed as economically as possible, but that the achieved results would be leveraged to reduce the costs of ongoing M&V. To that end, Con Edison has been able to reduce sample sizes for on-site work due to the availability of equipment-specific load shapes. Additionally, the use of an easily editable and accessible load shape database has increased the cost-effectiveness and timeliness of ongoing M&V. As Con Edison continues to investigate non-wires alternatives to peak demand reduction, the results of the enhanced metering study can be used to justify the addition of new program offerings and incentive structures.