Demand Reduction in the Forward Capacity Market: Expectations & Reality

Kathryn Parlin, West Hill Energy and Computing, Chelsea, VT
Jennifer L. Chiodo, Cx Associates, LLC, Burlington VT

ABSTRACT

The Forward Capacity Market (FCM) is a mechanism developed by New England's Independent System Operator (ISO-NE) to purchase future power capacity from a variety of suppliers, including the demand reductions that result from energy efficiency programs. ISO-NE has instituted rigorous verification protocols to ensure the reliability of demand reduction bids.

The first round of Vermont's FCM verification is now complete and the second is well under way. This paper covers the lessons learned in developing detailed evaluations of over 100 custom commercial and industrial (C&I) projects, most of which received individual M&V Plans, on-site metering for a two week period and custom analysis to comply with the ISO-NE verification protocols.

The guidelines provided in the ISO-NE FCM manual can be loosely broken out into three areas: roles and responsibilities, statistical requirements for the overall portfolio evaluation and guidelines for site-specific M&V. The approach to addressing each of these broad components of the ISO-NE standards has evolved through our experience with the initial FCM evaluation.

The level of rigor used in this custom verification including customized M&V Plans, on-site metering, custom analysis and individual project level reports is essential to ensure the reliability of the demand resources being bid into the FCM. On-site verification provided unanticipated information regarding the use of the efficient equipment that was critical for verifying the peak demand savings. This paper describes methods used, findings and lessons learned from verifying the custom C&I component of Vermont's efficiency portfolio for the FCM.

Introduction

New England's Independent System Operator (ISO-NE) designed the Forward Capacity Market (FCM) to promote investment in system capacity and meet the forecast for the region's peak electric demand, and, for the first time, efficiency was included as a capacity resource. This innovative strategy, developed through a settlement with utilities, generators, state regulators, and other regional stakeholders and approved by the Federal Energy Regulatory Commission, is designed to support the commitment to long-term supply resources through capacity payments and allow sufficient lead time and financial support for the development of new resources. State regulators directed Efficiency Vermont (EVT) to participate in the FCM on behalf of ratepayers and the Vermont Department of Public Service (VDPS) was designated as the independent third party auditor of the demand claims. The VDPS evaluation team, led by West Hill Energy and Computing, verified EVT's demand savings claim for the first FCM auction, including measures installed from January, 2007 through April 2010.

Participation in the FCM has created a fundamental change in focus of the evaluation of efficiency programs in at least two key areas. Prior to the FCM, energy savings were the performance metric used to evaluate Efficiency Vermont's portfolio, and both the program implementers and evaluators were primarily concerned with improving the estimates of energy savings. While winter and summer peak demand savings were calculated and verified, the peak periods did not correspond to the ISO-NE peak periods and the use of standardized load profiles developed from numerous sources and professional judgment was considered acceptable. In addition, the VDPS relied on a paper verification of EVT's claimed savings, which is clearly not compliant with the current ISO-NE FCM standards.

Moving the emphasis from energy savings to peak demand reduction and increasing the rigor of the evaluation required a different approach to calculating and verifying savings. This paradigm shift presented some initial hurdles to evaluators as we struggled to adapt to the new requirements. Through this initial evaluation effort, we learned how to simplify our approach to meet the ISO-NE standard, both for overall evaluation planning and project-specific M&V.

The guidelines provided in the ISO-NE FCM manual can be loosely broken out into three areas: roles and responsibilities, statistical requirements for the overall portfolio evaluation and guidelines for site-specific M&V. This paper provides an overview of the FCM process, a discussion of the issues that we encountered in implementing the M&V plan for custom C&I initiatives and the solutions adopted. The remaining sections of this paper cover the background, roles and responsibilities, sampling, project-level M&V, findings and conclusions.

Background

In 2006, ISO-NE created the Forward Capacity Market (FCM) as a procurement mechanism for future grid capacity. This market-based initiative allows for demand resources, including energy efficiency, to compete directly with generation resources to provide capacity. In order to participate in the market, providers of energy efficiency resources must demonstrate that their efficiency related demand reductions are reliable through a rigorous verification process described in the ISO-NE Measurement and Verification standards established for this purpose (ISO New England 2010).

Vermont Energy Investment Corporation (VEIC) bid the Efficiency Vermont (EVT) efficiency program portfolio into the FCM and submitted a detailed measurement and verification (M&V) plan delineating the Vermont evaluation process and its compliance with ISO-NE standards (VEIC 2007). The VDPS was assigned the responsibility for conducting the independent evaluation required by the ISO-NE standards.The evaluation was designed to establish realization rates to apply to EVT's estimated winter and summer kW savings reported to ISO-NE from July 1, 2010 until the completion of the next evaluation cycle.

The ISO-NE manual provided detailed specifications for all aspects of the evaluation, from metering accuracy to statistical precision and was regularly referenced throughout the process (ISO New England 2007). The methods were designed to result in a high degree of reliability for the resources purchased through the forward capacity market and represent a far more rigorous evaluation than the VDPS's annual verification of EVT's savings through paper review.

ISO-NE required verified kW values to be reported no later than July 1, 2010 and the contract for this project was awarded in the fall of 2009. Beginning in early 2009, Efficiency Vermont, the Vermont Department of Public Service and the Public Service Board Contract Administrator worked together to determine the roles and responsibilities associated with implementing the approved M&V Plans. Contracting for the FCM evaluation was unable to be completed in time for summer 2009 meter deployment. Thus, the VDPS hired a team of in state engineering firms to conduct a pilot effort to meter a set of HVAC projects requiring summer metering.

Roles and Responsibilities

While the M&V Plan submitted by EVT to ISO-NE laid out the overall strategy for conducting the evaluation, there were numerous strategic details to be determined in the actual implementation. EVT, the VDPS, and the Public Service Board Contract Administrator engaged in discussions to determine the scope of the work and the division of responsibilities between parties; the results of this effort were documented in a summary implementation report (Chiodo 2008).

EVT's M&V plan identified the VDPS as the entity responsible for conducting independent assessment of EVT's FCM claims. Through the initial meetings, it was determined that the VDPS would have the primary responsibility for metering the randomly-selected small and medium projects, in addition to the overall management of the verification process as envisioned in EVT's M&V plan. For the projects that fell into the small and medium strata, the VDPS's contracted engineers reviewed the project documentation, developed metering plans where appropriate, installed and retrieved the meters, analyzed the meter data, and calculated the verified savings.

EVT accepted the responsibility for conducting the metering of large projects in the census stratum and providing the metered data to the VDPS for analysis, including the development of site-specific metering plans. A number of safe guards were put in place to ensure that the evaluation met the standards for independent evaluation. First, EVT provided the M&V plans to the VDPS for review and comment prior to starting the metering, as possible within the time constraints. In addition, each large project was assigned to a review engineer on the VPDS's evaluation team who reviewed EVT's project documentation, analyzed any metering data that was collected by EVT, and independently verified the savings for the project.

The verified savings, independently calculated for each project in the sample, were documented in site-specific project reports that were sent to EVT to provide an opportunity for clarification and a final check for errors and omissions. The project reports were then finalized and the VDPS developed the realization rates for the overall portfolio. In the event that the VDPS and EVT could not agree on a substantive matter of judgment, the parties agreed that the dispute would be settled by the Public Service Board (PSB) in its capacity as the contracting agent of Efficiency Vermont. However, there were no disputes that required resolution by the PSB in this evaluation cycle.

Sampling

The sampling plan for the C&I projects was developed through collaboration between EVT and the VDPS. The sample design was quite complicated, with four levels of stratification: type of project (new construction or market opportunity v. retrofit), end use (HVAC, lighting or other), size (small, medium, large) and metering period (summer or winter). For retrofit measures, the submitted M&V Plan specified that the VDPS would conduct pre-installation metering for retrofit projects where necessary to determine baselines. Thus, the sampling process consisted of two major components:

- after-the-fact sampling of completed projects – typically new construction (NC) and market opportunity projects (MOP)
- "real-time" sampling for retrofits projects in the pipeline (to obtain pre-installation metering data)

The approach to developing the sampling frames is summarized in Table 1 below.

In practice, real-time sampling was found to be highly problematic and yielded few benefits. Some of the issues are described below:

- it was not possible to establish the sample frame prior to selecting the sample, requiring the use of systematic sampling for the retrofit projects with real-time sampling
- the option to conduct pre-installation metering for some selected projects was lost due to the timing of the measure installation
- some selected projects did not move forward to completion, rendering the pre-installation metering useless

- it was necessary to establish size cut offs for the entire sample frame prior to completion of the projects and thus the number of projects in each stratum was unknown until after the sampling was completed; consequently the number of projects in the large size stratum was much higher than anticipated and a census of these projects needed to be reviewed
- tracking projects in the pipeline and correctly characterizing the likelihood of completion and the size of the savings (for stratification purposes) was highly problematic

Of the 23 projects/end use selected through real-time sampling, seven (7) were included in the final sample used to estimate the realization rates. The VDPS's evaluation team was unable to conduct pre-installation metering on any of these projects within the time frame of this evaluation. Four projects selected through the real-time sampling process were not completed in 2008, and pre-installation metering had been conducted on two which will be used in the next FCM evaluation.

Table 1: Definition of Sample Frames for Completed Projects and Real-Time Sampling

Sample Frame	Market Group	End Uses
Completed Projects	New Construction (NC) and Market Opportunity Projects (MOP)	All
	Retrofit	Lighting efficiency
Real-Time Sampling	Retrofit	HVAC and REST (including lighting controls); sample supplemented with completed projects to obtain required sample sizes

Project-Level M&V

Project-level M&V was designed to meet the ISO-NE requirements and provide sufficient documentation to demonstrate that these requirements were met. Challenges at the project-level were varied, ranging from issues associated with the compressed time frame to faulty electric panels at the site. This section covers a brief description of the overall M&V process, some of the challenges we encountered and our approach to resolving them.

Process

The ISO-NE guidelines provide a high level of detail on the requirements for site-specific M&V (ISO New England 2010), including specifying the required measurement accuracy, approved M&V methods, definition of baselines, and methods for addressing seasonal variations and measures with temperature-dependency, among many other aspects of M&V. The following strategies were implemented to ensure that the ISO-NE requirements were met to the extent possible:

- M&V planning templates were developed and each of the engineering firms was responsible for developing project specific M&V plans and performing on site sampling, as necessary. The M&V plan specified the ISO-NE-compliant verification method to be used for each project.
- Individual engineering analysis and a detailed project report that outlined the metering and analysis approach was prepared for every project. These reports also summarized the results and the reasons for deviations between program saving estimates and verified savings.

HVAC data analysis included correlation of the metered kW values to the local weather station data and normalization of the curves to TMY3 data.

Each project was reviewed individually to determine the best approach given the specific characteristics of the project. For small and medium projects, savings were estimated based on site measurements, most often direct metering of the kW or lighting levels. Projects were verified using the IPMVP verification options as specified by ISO-NE. The approach was dependent on the characteristics of the project, as described below.

- Option A (partially measured retrofit isolation) was typically used for lighting projects. The coincidence factors were developed from metered light levels or taken from the RLW lighting study and the baseline and efficient equipment were verified at the measure level (RLW Analytics 2007).
- Option B (retrofit isolation/metered equipment) was used on most other projects, including, HVAC and all other end uses. These projects included development of M&V plans, in project sampling where appropriate, on site metering for two weeks, measure specific data reduction and analysis.
- Option C (whole facility) was used where interval meter data was available for a project and the load reduction was a high enough percentage of the load to be readily discerned from interval data analysis. These projects included temperature correlation of the data to eliminate temperature dependant impacts on demand and interviews of site staff to identify other changes which could impact the loads.
- Option D (calibrated simulation) was used for a couple of large new construction projects with comprehensive measures. Measure level metering and utility data was used to calibrate the models.

The VDPS's evaluators coordinated with Efficiency Vermont to facilitate the contact with the participants. EVT has a policy of informing participants that they may be contacted for evaluation after the completion of the measure installation, which seems to improve the process of working with the participants. In most cases, Efficiency Vermont's project lead contacted the customers prior to the contact by the review engineer, thus paving the way for the evaluators. There was a very high degree of customer acceptance of the on-site work.

Of the 72 small/medium projects in the sample, the team was able to complete metering and analysis on all but four projects. Two were server projects which could not be metered due to security issues; one was a widely dispersed lighting project with incomplete information regarding the locations of the installations and the fourth was intended to be analyzed through interval data analysis which proved infeasible.

Project-Level M&V Issues and Approaches

Through the implementation of the FCM evaluation, the evaluation team found numerous challenges in developing effective approaches for addressing project-level issues. Some of these project-level issues are discussed below, including the compressed time frame, metering safety, meeting the ISO-NE standards, the economic downturn, and determining baselines.

Compressed Time Frame.

Seasonal metering was often difficult to arrange and implement due to the constricted time frame, particularly for the winter performance period (December and January). Seasonal variations in electric consumption are generally due to two underlying sources: schedule changes (such as schools, some manufacturing plants and resort areas) and temperature-dependent applications. Metering every project twice (once during each performance period) would be prohibitively expensive and also unnecessary in most cases. For temperature-dependent measures, metering during the correct season is critical to establish the relationship between temperature and kW use, which can then be extrapolated to the summer or winter performance period using TMY3 weather data. For schedule-driven changes, selecting the metering period to cover a change in use (low use days and high use days) often provides sufficient information to verify savings for both performance periods through a careful review of the schedule and interviews with the participant.

Our approach was to review each project carefully and separate them into three categories: 1) projects with temperature-dependent measures that require seasonal metering, 2) projects with schedule-driven seasonal variations, and 3) projects with no seasonal variations. This process then led to prioritization of projects and developing the schedules for metering. By separating the temperature-dependent variations from seasonal changes due to scheduling, we were able to expand the metering period and construct more tractable schedules.

Metering of school lighting projects illustrates our approach to accounting for schedule-driven changes in use. The metering period was designed to cover periods when school was not open as well as times during which school was in session. Information gathering included the site specific metering to determine run hours during the meter period and site interviews to determine how representative the metered period was of typical operation and the expected variations in operation during the performance months.

Meeting ISO-NE Requirements.

The ISO-NE manual provides direction on a wide range of implementation details, from the accuracy of the equipment to the interval periods and measurement of proxy variables. The RLW report on ISO-NE-compliant metering equipment provided a key resource to identify meters that meet the standards (RLW, 2008). Meeting Section 5.2.2 Option B 2 of the ISO-NE manual, which requires that measurements must be taken over sufficient time to represent the measure across the performance period and over the life of the measure, was particularly challenging for applications with highly variable schedules. The team used metered data, published schedules and interviews to develop comprehensive load profiles.

Perhaps due to the wide range of types of projects to be metered, the team found that some meters simply disappeared, most likely either stolen or discarded. In addition, meters failed or bad data was collected either due to equipment or installation/set-up problems. Consequently, the team typically built some redundancy into the metering plans and increased sample sizes for within-project sampling to ensure that there would be adequate meter data for the analysis.

For HVAC temperature-dependent measures, the team normalized to NOAA weather stations which have TMY3 data rather than local weather data. While this decision resulted in using weather data that may not reflect the exact temperature variations for a specific location, this approach increases the accuracy of the savings over the life of the measure.

Metering Safety.

The sample included over thirty projects requiring metering on end uses other than lighting. These projects frequently required power data logging on the affected equipment for a period of two weeks or more. For many projects, current transformers needed to be installed in the wiring sections of panels; the tight space and frequent need to work live presented potential risk to the facility and the team.

Electricians were typically engaged to assist with meter installation and were able to perform meter retrieval independently to help control costs. Use of licensed electricians to assist with meter installation has been cost effective, has increased the overall safety and end user comfort with the metering portion of the project and in some cases has provided unanticipated benefits to the customer. In general, the team selected electricians recommended by the owner as they brought additional knowledge of the site to the installation and, when things went wrong, were able to respond effectively.

On a recent project, the electrician noticed blackening on a wire connected to a circuit unaffected by the project. This situation clearly presented a fire hazard and having the electrician on site provided the opportunity to avert a potential crisis.

Economic Downturn.

The economic downturn has impacts on several of the facilities in the sample. There is always some uncertainty in project savings over the measure life, since many factors affecting use can change over time in unpredictable ways. The VDPS team used a range of information to estimate savings for projects with expected short-term impacts from the recent economic downturn.

For some facilities, the approach was clear; for example, plants were closed and/or equipment was mothballed. A potential tenant for a 75,000 sq ft office building decided to relocate to another state after the building HVAC systems had been specified and installed to meet the unique requirements of that tenant. After losing the tenant, the building owners removed the unused energy efficient equipment and installed more conventional building mechanical systems. In these cases, the VDPS team determined that the equipment cannot be presumed to operate during future ISO-NE performance hours.

In other situations, customer interviews and meter data showed that the economic downturn had an observable impact on the use or load on efficient projects in the sample, but the duration of that impact was less clear. If pre- and post- installation data were available, the VDPS conducted interviews with the participant and used that information to develop blended the load profiles from before and after the downturn to provide a representative load profile over the equipment life.

The economic downturn did not consistently result in lower savings. The lighting retrofit of a refrigerated warehouse that included occupancy sensors was analyzed using interval meter data and found to have substantially higher savings than expected. A site survey was conducted to determine whether other changes might account for the observed demand reduction and this investigation indicated the additional savings resulted primarily from reduced operating hours due to the recession. Even though the savings were partially due to changes in building use patterns, the baseline facility demand was not affected as metered data and interviews showed that the baseline lighting system was in continuous use and interviews with the participant regarding the current operating conditions indicated that no changes in use were expected in the foreseeable future.

Baselines.

Establishing baselines for NC/MOP and retrofit projects is problematic on a number of levels. NC/MOP projects are required to be compared to state or federal code, where applicable, or standard practice, whichever is more stringent (ISO New England 2010). Applicability of the code to MOP projects is questionable in a state like Vermont where there is minimal code enforcement, and establishing code as the baseline may tend to understate actual program impacts.

Standard practice is difficult to determine without a detailed baseline study. While Vermont is currently in the process of conducting a baseline study, it was not available during this initial FCM impact evaluation. In the absence of such a study, the VDPS and EVT have worked to develop baseline characterizations for MOP projects that reflect the parties' best understanding of standard practice, and these baselines are used for the purposes of determining EVT's progress in meeting its performance goals. However, these baselines are often less stringent than the Vermont Energy Code and the supporting documentation does not meet ISO-NE standards, creating a situation in which the basis for the FCM-verified savings estimates are different from the savings claimed under EVT's performance contract.

In addition, programs have clearly impacted the market and, since EVT reports gross savings to ISO-NE which do not incorporate free-ridership or spillover adjustments, efficiency programs may potentially lose credit as the market responds rapidly to a favorable efficient technology. A common example is high-bay fluorescent in gymnasiums, where metal halide lighting is rapidly losing market share.

The VDPS evaluation team has applied the ISO-NE guidelines to determine the baseline for NC/MOP projects, typically by applying the Vermont Energy Code. Often this approach has resulted in an independent assessment of code-compliance baseline equipment that would suit the particular situation, which may be different from the baseline assumed by the program staff.

For retrofit projects where the baseline is the existing condition prior to the efficiency upgrade, the baseline cannot always be directly measures as the evaluation team most often comes in after the fact. Baseline determination for occupancy sensors, a common measure installed through the program, can be particularly intractable. Very few of these projects had pre-installation metered data that could be used to establish baseline operating hours. In these cases, the VDPS team often used the metered data to determine the timing of the "first on" and "last off" daily use of the lights combined with participant interviews regarding schedules and review of the hourly operating profiles from the RLW report on lighting coincident factor to establish the pre-installation load profile (RLW Analytics 2007).

Findings

The evaluation was completed in the summer of 2010. Due to the strategy of post-installation on-site metering for most projects and applying the ISO-NE guidelines regarding establishing baselines, the verified savings were almost always different from the original claimed savings. The economic climate also affected the resulting realization rates, due to plant closings and other events that often tended to negate the intended effects of the program interventions. This section discusses the evaluation results in the context of the ISO-NE standards and also the trends in the realization rates across a variety of types of projects.

Meeting the ISO-NE Statistical Standards

ISO-NE requires that the sampling precision meet the 80/10 confidence/precision target for the entire portfolio. The custom C&I component accounts for about 42% to 50% of EVT's entire portfolio. Overall, the evaluation exceeded the ISO-NE standard with a relative precision of less than 7% for both the winter and summer kW peak reduction.

The ISO-NE manual also specifies that actions must be taken to mitigate bias. This issue turned out to be more significant than the sampling precision due to the number of large projects that could not be evaluated for a variety of reasons, including uncooperative participants and the inability to obtain sufficient information to verify to the ISO-NE standards. Among the 2007 and 2008 completed projects, there were 103 projects/end use in the large stratum and the intention was to verify all of these projects. However, of the 103 projects/end use, the VDPS evaluation team completed verification on 81.

The possibility of bias resulting from the removal of these large projects was investigated through a sensitivity analysis. A Monte Carlo simulation was conducted for random groups of 22 verified projects to determine the realization rates for each group, which indicated that less than 10% of the random groups had realization rates that varied sufficiently from the overall values to affect the results. Given the results of this sensitivity analysis and the fact that EVT used the same strategies and QC process for estimating savings from both the unverified and verified projects, the potential for bias due to the removal of these projects from the calculation of the realization rate is quite small.

Realization Rate Trends

Due the sampling stratification, it is possible to compare the realization rate by category, which provides some insight into the degree of variation associated with the end uses and project types. The highest level stratification was the project type, i.e., retrofit or new construction/market opportunity.

Retrofit projects tend to be driven by site-specific characteristics whereas new construction and MOP projects are more likely to have prescriptive baselines reflecting standard practices or code requirements.

In reviewing these results, one factor to consider is that the program implementation period of 2007 to 2008 was a transition period for EVT during which the definition of the peak periods and all of the standard load profiles were changed. Previously, the primary focus for EVT was to meet its performance goals, generally defined in terms of annualized energy savings. With the FCM bid, the ISO-NE peak period definitions were adopted and additional attention was turned toward the methods used and assumptions supporting the peak reduction estimates. Thus, the variability of the realization rates during this period reflect this period of transition.

The realization rates by project type are presented in Table 2 below. The values of the realization rates do not show a clear trend, in that the winter peak for the retrofit projects was lower than for the NC/MOP and values of the summer peak realization rates were reversed. However, the variability among the NC/MOP projects is substantially higher, as shown by the higher standard errors and error ratios. This result is likely to reflect the more prescriptive approach to estimating savings for NC/MOP projects.

Table 2: Realization Rates by Project Type for Custom C&I Measures

Project Type	Total Number of Projects	# of Projects in Sample	Realization Rate	Standard Error	Relative Precision[1]	Error Ratio
Retrofit						
Winter Peak kW	571	73	0.706	0.047	0.085	0.49
Summer Peak kW	571	74	0.734	0.061	0.106	0.58
NC/MOP						
Winter Peak kW	1,002	59	0.831	0.088	0.135	0.71
Summer Peak kW	1,002	64	0.673	0.075	0.143	0.89
Combined						
Winter Peak kW	1,573	132	0.774	0.045	0.074	0.66
Summer Peak kW	1,573	138	0.713	0.045	0.080	0.71

Table 3 shows the realization rates by size category. The smallest projects had the lowest realization rates and also a high degree of variation, an unexpected result that was directly contradictory to previous experience with the annual verification through paper reviews. Of the twenty-three verified small projects, on-site verification and measurement determined that six had no savings or savings that were less than 5% of the original estimate.

[1] Relative precision was calculated at the 80% confidence level, as is consistent with the ISO-NE standard.

Table 3: Realization Rates by Project Size for Custom C&I Measures[2]

Season/Project Size	Total Number of Projects	# of Projects Verified	Realization Rate	Standard Error	Relative Precision	Standard Deviation
Winter Peak kW						
Small	914	23	0.574	0.110	0.245	0.551
Medium	559	39	0.846	0.091	0.137	0.624
Large – Census	103	79	0.738	0.000	0.000	0.475
Summer Peak kW						
Small	914	23	0.438	0.151	0.441	0.644
Medium	559	43	0.710	0.081	0.146	0.535
Large – Census	103	81	0.794	0.000	0.000	0.356

Since the sample was stratified by end use, it is also possible to compare realization rates and variability across the three end use categories, i.e., HVAC, lighting and all other end uses. This analysis, shown in Table 4, indicates that the highest variability is found among HVAC projects. The summer HVAC realization rate is the lowest, due to the results of the metering which demonstrated that mechanical cooling systems do not run as much as expected. Lighting showed the least variability, as would be expected.

Table 4: Realization Rates by End Use for Custom C&I Measures[3]

Season/End Use Category	Total Number of Projects	# of Projects Verified	Realization Rate	Standard Error	Relative Precision	Error Ratio
Winter Peak kW						
HVAC	286	21	0.818	0.150	0.234	0.85
Lighting	706	72	0.830	0.057	0.088	0.57
Rest (All Other End Uses)	584	48	0.692	0.078	0.144	0.74
Summer Peak kW						
HVAC	286	28	0.482	0.091	0.241	0.95
Lighting	706	72	0.736	0.054	0.094	0.49
Rest (All Other End Uses)	584	47	0.750	0.099	0.168	0.72

As illustrated in Figure 1, the graph of the realization rates by project shows a number of projects with zero savings across most end uses and a few projects with substantially higher savings than claimed. For the summer peak kW, many projects grouped around a realization rate of 1.0. There does not appear to be a pattern to the winter realization rates other than the preponderance of projects with lower verified savings than the original estimates.

Verified peak period reductions were found to be smaller than expected for a variety of reasons, many of which were beyond the control of the program implementers. Some of the common issues are

[2] Since the large projects were evaluated on a census basis, and thus there is no sampling error, the standard deviation rather than the error ratio is presented in this table. One outlier with a realization rate over 87.0 was removed from the medium group to calculate the standard deviation. The high variation in this project was due to an error in which the incorrect load profile was inadvertently applied.

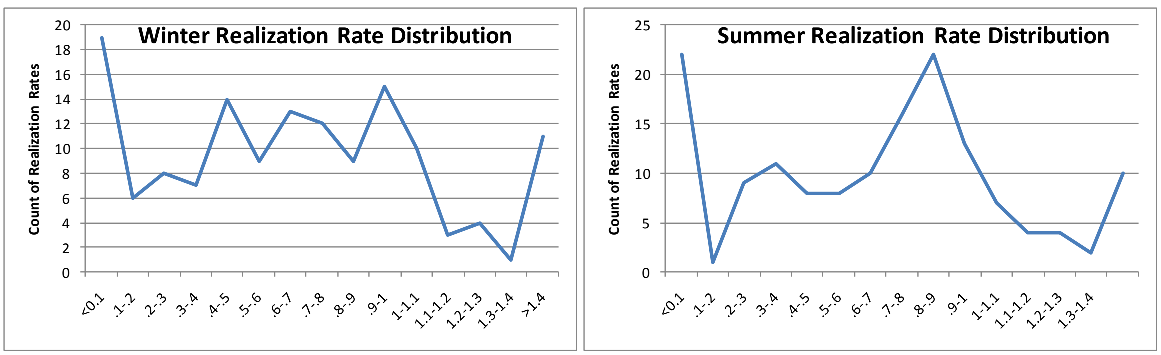
[3] The outlier was also removed from the summer HVAC sample. See previous footnote.

briefly listed below:

- changing economic conditions led to plant closings, discontinued production lines, lower production and reduced use of equipment
- operating conditions were not as expected and efficient equipment did not perform as expected; in one case the equipment was found to be disabled by the participant due to comfort issues
- lower than expected demand savings for lighting projects was typically a result of lower hours of use than the hours assumed in the program savings estimate
- baseline assumptions were not consistent with ISO-NE standards or did not match the actual application
- standard load profiles did not accurately reflect site-specific conditions
- cooling equipment was found to run less than expected

Overall, the site-specific verification provided a wealth of information about how the efficiency measures are actually operating. This process can then be used to inform future implementation efforts.

Figure 1: Distribution of Realization Rates



Conclusions

The increased level of rigor required for verification of EVT's FCM portfolio is essential to ensure the reliability of the demand resources being bid into the FCM. The foundation of the impact evaluation was a carefully designed sample, customized M&V plans, on-site metering, custom analysis and individual project level reports. ISO-NE precision standards for the portfolio were exceeded through careful planning in the initial stages of the evaluation. A few of the lessons from the first round evaluation are summarized below:

- solid and well-documented site-specific M&V provided the foundation for the evaluation
- flexibility on-site is necessary to address unforeseen situations, including safety issues
- on-site measurement was necessary to identify additional factors affecting energy use and yielded unanticipated and critical information for verifying savings
- the complex real-time sampling process was unwieldy and did not produce useful results
- HVAC and NC/MOP projects were shown to exhibit the greatest variability in realization rates

The experience from the first round FCM evaluation was used to inform the second round currently in progress.

Conducting an independent, third party impact evaluation for the FCM has positive benefits beyond the ISO-NE requirements for the FCM, both in terms of developing a more nuanced comprehension of the issues that affect the performance of energy efficiency upgrades and from the wider policy and planning perspective. While program staff rarely returns to participants to check on installed measures, VDPS team made on-site visits to most of the small and medium projects and conducted participant interviews in addition to analyzing data from on-site metering for many of the large projects. Through these site visits and direct measurement, evaluators developed a deeper and broader understanding of the on-the-ground issues that affect the performance of energy efficient equipment, thus providing a wealth of information that could be used to understand how participants use efficient equipment and tailor program implementation accordingly.

From a policy perspective, energy efficiency is still often perceived as a marginal, unreliable resource. As discussed at the previous IEPEC conference, power planners in Vermont have expressed skepticism regarding the actual magnitude of efficiency savings and previous verifications based on paper reviews did little to alleviate these concerns (Parlin 2009). In addition, in an environment where greenhouse gases tracking and reduction are statewide goals, greater certainty provides assurance that reductions in green house gas emissions are being realized. Rigorous, third party impact evaluation increases the reliability of the EEUs' savings claim, and thus provides a sounder basis for power and infrastructure planning as well as enhances the credibility of energy efficiency as a resource.

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