# Demand Reduction in the Forward Capacity Market: Verifying the Efficiency Power Plant

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## ABSTRACT

ISO-New England, in a Federal Energy Regulatory Commission approved settlement, recently designed the Forward Capacity Market (FCM), a unique market design that is structured to encourage investment in system capacity sufficient to meet the region's forecasted peak electric demand. The FCM encourages new capacity by providing a long-term commitment to electric supply resources affording project developers adequate time and money to construct or install resources to fulfill new obligations.

The FCM has created a paradigm shift for efficiency program evaluation as peak demand savings have become a critical indicator of program success. Placing the focus on peak demand reduction requires new strategies for estimating savings, moving away from review of engineering algorithms and billing analysis toward demand metering or other direct data collection techniques. Adding to the challenge, ISO-NE specifies allowable methods for verifying peak demand reductions, the required precision for the portfolio, and the level of statistical analysis required.

This paper provides a broad overview of the FCM process and the requirements for verifying demand savings, and discusses the planning and initial implementation of the Vermont Department of Public Service's evaluation, including the challenges and potential solutions. Four specific aspects of the evaluation planning are covered in more detail, i.e., sampling, baselines, metering issues, and policy implications.

## Introduction

ISO-New England, in a Federal Energy Regulatory Commission approved settlement with utilities, generators, state regulators, and other regional stakeholders, recently designed the Forward Capacity Market (FCM), a unique market design that is structured to encourage investment in system capacity (including efficiency) sufficient to meet the region's forecasted peak electric demand. The FCM encourages new capacity and the reduction of peak loads by providing a long-term commitment to electric supply resources in the form of capacity payments, affording project developers adequate time and money to construct or install resources to fulfill new obligations. State regulators directed Efficiency Vermont (EVT) to participate in the FCM on behalf of ratepayers, and Burlington Electric Department (BED) also chose to submit a claim in the market. The Vermont Department of Public Service (VDPS) was designated as the independent third party auditor of the demand claims.

The FCM has created a paradigm shift for efficiency program evaluation in Vermont as peak demand savings have become a critical indicator of program success. Placing the focus on peak demand reduction requires new strategies for estimating savings, moving away from review of engineering algorithms and billing analysis and toward demand metering or other direct data collection techniques. Adding to this challenge, ISO-NE specifies allowable methods for verifying peak demand reductions, the required precision for the portfolio, and the level of statistical analysis required. The VDPS evaluation team, led by

West Hill Energy and Computing, is verifying EVT's demand savings claim for the first FCM auction, including measures installed from January, 2007 through April 2010.

Between the rigorous ISO standards and the VDPS's limited experience with verifying demand reduction, the VDPS evaluation team and EVT have encountered a steep learning curve in implementing the M&V plan. This paper provides a broad overview of the FCM process, a discussion of the issues that we encountered in planning and implementing the M&V plan, the solutions adopted and the policy implications of Vermont's contribution to the FCM. The remaining sections of this paper cover the background, planning and implementation issues, policy implications and conclusions.

## Background

The FCM recognizes that capacity requirements can be met equally by either increasing supply or decreasing demand, resulting in direct competition between generation and efficiency to meet the demand for electricity. ISO-NE annually holds a competitive auction to procure necessary resources to meet its forecasted required capacity three years in advance at the lowest possible price. Both new and existing pre-qualified resources, including both traditional resources and energy efficiency, can participate in the auction. Only new resources can set the clearing price in order to ensure enough new capacity is procured, but all resources are paid the clearing price, subject to performance incentives and penalties. The first auction took place in 2008 for a delivery period commencing on June 1st 2010.

Project sponsors submit a qualification package prior to the auction where they disclose the capacity supply or reduction that they expect to provide and the market price necessary to acquire those resources. For efficiency providers, this translates into a requirement to submit a forecast of expected savings acquisitions, and a plan that corroborates that forecast, including the funding source. Further, efficiency resource providers must submit a plan for the measurement and verification (M&V) of their claim.

The M&V Plan is required to detail how efficiency project sponsors will meet standards outlined in the ISO-NE Manual for Measurement and Verification of Demand Reduction Value from Demand Resources (ISO-NE, 2008). Failure to meet the ISO requirements could result in forfeiture of auction payments or financial penalties. The manual delineates the requirements for numerous aspects of the M&V, including statistical sampling, baseline conditions, metering, reporting and data maintenance and independence in auditing. EVT and BED submitted substantially similar M&V plans, proposing the use of IPMVP Option A: Partially Measured/Stipulated Measurement for establishing the value of prescriptive energy efficiency measures. Options B, C, and D are cited for use in validating custom resources.

## Planning and Implementation Issues

The evaluation team encountered a number of issues associated with planning for and implementing the M&V plans.

- Sampling was found to be substantially more complex than a standard evaluation due to the twin requirements of meeting the rigors of ISO specifications while also accounting for the real time complexities created by the changes that inevitably occur as efficiency projects move from conception to completion.
- Establishing baselines for both retrofit and new construction (NC)/market opportunity (MOP) markets is problematic due to the logistical hurdles of defining the baseline and the lack of an effective measurement method.
- Metering and analysis also presents a challenge for small efficiency providers, as a substantial expansion of metering capabilities is required to qualify a resource for payment under the FCM.

These three specific aspects of the evaluation planning are covered in more detail below.

**Sampling**

EVT completes a total of about 800 to 1,000 custom C&I projects per year and the initial FCM auction covers more than two years of program implementation. Thus, verifying the demand reduction for this component of EVT's portfolio requires sampling. ISO-NE requires that the results meet the 80/10 confidence/precision target for the entire portfolio.

Sampling for the custom C&I projects was problematic on a number of levels. As is generally consistent with sampling strategies, the foundation of our approach was to consider the sources of uncertainty in the demand savings and how the projects can be stratified to ensure that the sample is representative and covers a wide range of projects. This entire process became a balancing act between identifying the various sources of uncertainty and trying to develop a workable stratification plan. Some of the issues that arose and their contribution to the final sampling and stratification plan are summarized in Table 1 below.

**Table 1.** Summary of Sampling Issues

| Source | Issue | Current Approach |
|---|---|---|
| **Type of Market** | 1) Baselines are defined according to whether the project is retrofit or NC/MOP.<br>2) Retrofit projects may require pre-installation metering. | 1) Stratify by type of market<br>2) Attempt real-time sampling for retrofit projects; this process is complex and may not produce the desired results |
| **Project Size** | 1) Small, medium and large projects tend to generate different types of errors and uncertainties.<br>2) FCM bid is for both summer and winter peak demand reduction, so the defining the size of the projects is not straightforward. | 1) Use the higher of the winter or summer peak reduction as the stratification variable<br>2) Stratify by size (small, medium, large) |
| **End Use** | 1) Measures within specific end uses tend to have the same sources of uncertainty and require similar metering strategies.<br>2) C&I custom projects address a wide range of end uses, and many end uses have only a few projects. | 1) Compromise by stratifying on three end use categories |
| **Seasonality** | 1) Demand reductions are claimed separately for the winter and summer performance hours.<br>2) Some measures are non-seasonal and can be verified at any time.<br>3) Other measures, particularly HVAC and refrigeration, tend to have weather-dependent savings that need to be verified. during the specific winter or summer peak period. | 1) Stratify by summer/non-seasonal v winter<br>2) Design the M&V plan to allow for sufficient time for seasonal metering<br>3) Plan for scheduling flexibility to allow short turn around when needed |

The final stratification scheme for the custom C&I component of EVT's portfolio included four variables:

- market type (retrofit projects or market opportunity (MOP)/new construction (NC) projects
- end use (HVAC, lighting and other)
- size (small, medium, large, based on the higher of the summer or winter peak reduction)
- seasonality (winter peaking and summer/non seasonal peaking)

The sampling unit was the project/end use, i.e., a specific end use for each project was selected. This approach does not call for a comprehensive review of the project as a whole. However, interactive effects between end uses need to be considered during the project review.

**Baselines**

ISO defines Baseline Conditions for demand resources as "the kW load that would have existed, in the absence of a demand reduction measure that affected such measure's load" (ISO-NE, 2007). With the exception of retrofit projects that receive ISO compliant pre-installation metering, the establishment of baseline kW values over the performance period introduces the highest degree of uncertainty in the verification of the demand reduction claims. Hourly calculation of baseline conditions is required for time- or weather-dependent loads.

Establishing baselines for both retrofit and MOP/NC projects is problematic on a number of levels. The baseline for retrofit projects is the existing conditions prior to the upgrade, which raises a host of questions about how to select projects prior to completion and obtain pre-installation metering in the required time frame. Although MOP/NC projects are typically compared to state or federal code, where applicable, or standard practice when supporting information is available, interpretation of the code for a specific situation is not necessarily straightforward. These issues are explored in more depth below.

**Baselines for Retrofit Projects.**

The baseline for retrofit projects is easily and clearly defined as the existing conditions prior to the efficiency upgrade. The ISO FCM standard adopts this definition, with the caveat that if the baseline cannot be measured, an alternative is to use state or federal energy code, or standard practice if no code applies. While it is simple enough to determine the baseline, obtaining valid measurements of the baseline operating conditions raises major logistical hurdles. In order to be able to gain access to the site in a timely manner, the projects need to be selected prior to the installation, when only preliminary information about the planned measures is available. This situation has numerous implications for the sampling, metering and program implementation, as illustrated in Figure 1.

For the initial FCM auction, the DPS evaluation team decided to establish and test a process to obtain pre-installation metered data for retrofit projects, with the exception of lighting efficiency projects which were not expected to require pre-installation metering. The program implementers provided a list of retrofit projects in the pipeline. The evaluation team then selected the projects using systematic sampling and doubling the sampling rate to allow for "dry holes," i.e., projects that do not complete. The list of selected projects was sent back to program staff to obtain the preliminary project files and the projects were assigned to evaluation engineers to develop the sampling plans.

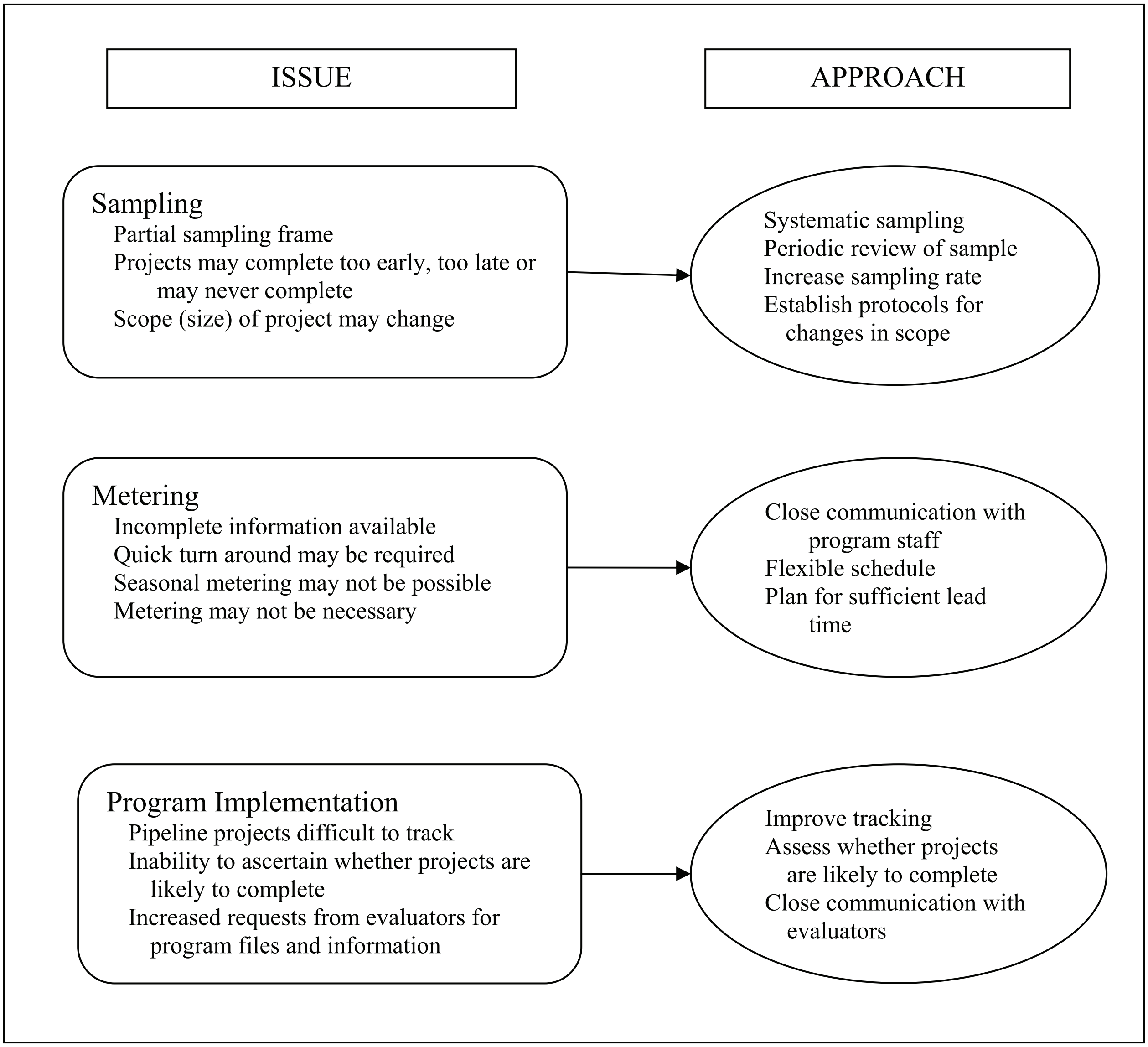


**Figure 1.** Pre-Installation Metering Issues and Current Approach

The results of this process were mixed. A total of 23 HVAC and other non-lighting efficiency projects were selected for pre-metering prior to December, 2008. Out of the 23 projects, only 5 turned out to be candidates for pre-metering, as summarized in Table 2 below.

The entire process of selecting project for pre-installation metering was costly, time-intensive and did not produce the desired results, leading us to consider other possibilities. One option is to conduct all of the sampling after project completion and use other methods for determining the baseline. For projects that actually require pre-installation metering, the solution may be to apply ISO's alternative strategy and rely on state or federal code to establish the baseline.

**Table 2.** Disposition of Pre-Metering Sample

| | # of Projects | Description |
|---|---|---|
| *Total Selected* | *23* | |
| Removed from sample | 7 | 6 did not install measures in selected end use, 1 participant was uncooperative |
| On hold | 2 | Projects not currently active, but may complete at a later date |
| Completed prior to pre-metering | 7 | Pre-metering not possible, but baseline may be established using other methods |
| No pre-metering required | 2 | Baseline can be established with post-installation metering |
| *Possibility of pre-metering* | *5* | |

**Baselines for New Construction and Market Opportunity Projects.**

For MOP and NC projects, state energy codes or federal standards generally apply, and establishing the ISO baseline should be relatively straight forward. Further investigation, however, suggests that even baselines for code-related installations can be more complicated than one might expect. Some examples are discussed below.

- The process of adopting of a new code or changing to an existing code creates a transition period where the applicability of the code is often defined by the timing of the permit application. For instance, Vermont enacted a general statewide commercial energy code for all commercial new construction in January of 2007. However, project permit dates are not obtained as part of program implementation and thus it can be difficult to make a clear determination of the correct baseline.
- In reality, "standard practice" is often in a state of flux, particularly in the custom C&I market. Vermont is a small state with a limited evaluation budget and the C&I market is highly diverse. Market characterizations are not available for many of the types of applications that arise. Under these circumstances, baselines must be based on external resources, including non-regulated government publications (e.g., DOE and FEMP requirements), product research, knowledge of the practices in other regional energy efficiency programs, and evaluation engineer experience with similar measures.
- Even when the baseline equipment has been defined, we are still in the position of trying to characterize the counterfactual, i.e., how the alternative (baseline) equipment would have performed had it been selected instead of the efficient model. Since metering has demonstrated that many of the installed measures are not performing as expected, it is unlikely that baseline conditions can be reliably calculated without potential for error, even when such calculations are informed by post installation metering data.

Evaluators should also consider the possible interaction between standard practice and net effects. ISO requires that the demand reduction be reported as gross savings that do not incorporate net effects such as free riders or spill over. However, EVT's programs have been operating since 2000 and the line between standard practice and net effects is not always clear. For example, electric injection molding machines are substantially more efficient that hydraulic machines and are an efficiency measure promoted by EVT. For market opportunity projects, the baseline is a hydraulic IM machine. It is becoming clear over time that some manufacturers have come to recognize the substantial benefits associated with the electric IM machines, suggesting that "standard practice" for at least some proportion of manufacturers is the electric IM machine. This situation raises the question whether the gross savings for this measure are the savings in comparison to the hydraulic machine and the proportion of manufacturers who would have installed the electric machines are free riders, or whether "standard practice" should somehow account for the proportion of manufacturers in the overall market who choose electric over hydraulic.

**Metering and Analysis**

The FCM claim is the first time that extensive metering has been pursued to verify Efficiency Vermont's claimed demand reduction. The combination of the stringent ISO standards, the sheer quantity of the projects to be metered and the typical issues that arise in translating metered measurements to actual savings contributed to a rather steep learning curve. The main challenges encountered by our team are meeting the ISO measurement requirements, coping with the increased volume of projects to meter, maintaining independence, addressing changes over time, developing robust and defensible methods, and establishing a realistic schedule for project completion, as explored in more detail below.

**ISO Measurement Requirements.**

The ISO standards on measurement error are quite stringent. ISO requires direct measurement of the kW with an accuracy of no less than 2%. In addition, measured proxy variables, such as temperature and flow, must result in a calculated kW with an accuracy of no less than 2%. This approach necessitates the use of specific measurement equipment and also appears to preclude some commonly used, and often irreplaceable, measurement and verification tools, including building management system trend data and the use of lower cost current loggers to measure a subset of comparable loads over time (RLW Analytics, 2008).

In some cases, it is clearly not possible to meet the 2% standard. For instance, small projects often have equipment current below the 5 AMP minimum established for a Dent Elitepro Logger coupled with 50 amp current transformers (CTs). Metering at the low end of the CT range increases the % error. Because efficiency portfolios typically include many small projects, it is essential that the tools necessary to accurately measure and log small loads be identified and incorporated into the list of compliant verification equipment.

Seasoned evaluators may question the wisdom of these strict criteria, given that other sources of error are likely to be substantially larger and less tractable than measurement error. A recent study demonstrates that measurement error of 5% or more (over double the ISO standard) has only a very small impact on the overall error (RLW, 2008).

**Volume of Metered Projects.**

A census of large projects and 80 small to medium projects are expected to be metered for the first FCM auction period. These projects often include multiple measures, and the evaluation team expects to have 24-36 DENT Elitepro data loggers deployed almost constantly during the three month summer performance period. This type of high volume metering over a three month period necessitates a high degree of quality control, a significant challenge given that meters are being implemented by three different organizations, including the two project sponsors and the VDPS.

**Maintaining Independence.**

Independence is the foundation of third party evaluation, and vigilance is required to ensure that the proper distance is maintained between implementers and evaluators. In addition, the evaluation team needs to avoid the reality or appearance that the final savings claims for specific projects could be influenced by the evaluation activities.

Our team discovered that this issue became more complex in the context of the FCM verification. Projects were selected for metering and verification prior to the finalization of EVT's claimed savings for program years 2008 and 2009, resulting in a situation in which program staff are aware of the projects under review prior to completing their savings claims. While the evaluation team and program staff are working together in good faith, it is entirely possible that simply knowing that the project is under review may affect the program's internal QC process, however inadvertently. In an attempt to address these issues, the parties agreed that the metered data collected by the evaluation team is not made available to program staff until after the savings have been finalized.

Specific situations have also arisen that tested our process. For example, when the evaluation team tried to schedule pre-installation metering at one site, the participant was highly interested and requested access to the metered data. The evaluation team did not see any way to provide the data to the participant without also allowing program implementers access to the data. While this project was eventually dropped from the sample for a variety of reasons, this type of situation could be a potential source of bias if more savvy customers effectively remove themselves from the sample by requiring that any metering results be made available to them.

**Changes Over Time.**

Although the ISO requirements clearly indicate that the demand reduction values should reflect typical operating conditions as well as provide guidance on adjusting for temporal and seasonal variations, it is silent on cyclical changes over the life of the measure, a particularly germane issue in our current economy. In the process of scheduling site visits, our evaluation team has found equipment that is not yet functioning as expected and devices that were taken off line until business picks up again. Consequently, it is not possible to measure the demand under "typical" conditions, or even to be able to define typical conditions beyond the short term. This issue is further compounded by the fact that the savings are claimed for a five-year commitment period.

Evaluators also need to consider that changes in the operation of the equipment could occur as a direct result of evaluation activities. One metered commercial project was found to have HVAC equipment that shuts down in the middle of the afternoon, although the owner claimed that it operated until 6:00 PM. It seems entirely possible that the owner learned about the actual HVAC operation schedule through the verification process and could modify the controls accordingly, thus changing the demand reduction associated with this project.

**Assumptions and Methods.**

Demand reduction cannot be directly metered. While the ISO standards are highly specific about measurement error, sampling error and metering, they provide little direction regarding the numerous engineering decisions that arise when estimating demand savings during the performance hours. The section of the manual that most directly relates to this issue instructs evaluators to control for all types of bias, including the bias associated with engineering modeling.

Estimating demand reduction is more complex than simply measuring the kW demand within 2% accuracy. With or without metered data, accurate estimation of demand reduction is dependent on engineering judgment. Even under the most stringent protocols, the metering data needs to be interpreted to estimate the demand reduction during the performance hours.

In situations where there is a high degree of uncertainty regarding savings and no clear method to reduce the uncertainty, a common practice among implementers and evaluators is to establish a conservative estimate, i.e., the savings are not likely to be below the claimed value. This approach allows implementers to claim real savings without overstating program impacts based on unverifiable parameters. However, under a strict interpretation of ISO requirements, this approach introduces a downward bias that would not meet the standard.

**Scheduling.**

Planning and scheduling the metering has turned out to require more lead time than we initially anticipated. The process of obtaining the project files, writing up the metering plan and scheduling the metering visit with the participant can easily take a month or more before the metering even starts, particularly in the summer when it is harder to reach the participants. The need to conduct seasonal metering for some projects has also added another level to the project management. While a project with an air conditioning upgrade may be assigned in December, the metering will not be scheduled until the following summer, making it more difficult to track the overall status of the project.

## Policy Implications

The Forward Capacity Market's first two auctions have attracted the interest of numerous providers of demand resources. Over 2,400 MW of new and existing demand resources cleared at the low market floor price in the first auction and approximately 2,900 MW cleared in the second. A significant portion of these demand resources was submitted by energy efficiency resource providers. Vermont's project sponsors submitted bids in the FCM auctions that were conservative estimates of efficiency portfolios planned for acquisition in the near term, and assumed a continuing level funding commitment to efficiency in the long-term. Unlike some other small providers, Vermont sponsors submitted claims for savings for both prescriptive and custom measures.

While EVT's efficiency savings are already required to undergo scrutiny under state requirements for performance, the level and rigor for verifying C&I custom projects under the methodology outlined by the ISO is unprecedented in Vermont. The level of resources necessary to undertake this verification has raised the question of whether verifying certain custom measure types to ISO standards is cost prohibitive.

However, the benefits of the additional M&V rigor undertaken for the FCM extend beyond just a new revenue stream. The process itself is likely to increase the confidence that resource planners have in efficiency as an alternative to transmission or distribution projects. Further, regional cooperation between small efficiency providers resulting from the FCM will provide consistent, updated data to use in further improving the accuracy of savings claims, while reducing the costs of verification for individual participants. Finally, the overall increased accuracy and confidence in savings claims validated by the FCM verification process also is likely to increase customer confidence in efficiency, and allow providers to more effectively target implementation of peak demand resources.

### Confidence in Claims

EVT has been implementing quality efficiency programs since 2000. During that period EVT has received national recognition in addition to steady program support from the Vermont legislature. This period has also seen the term "compact fluorescent light bulb" penetrate the nation's collective vocabulary, and a general "green revolution" promoting energy efficiency in all aspects of building design. Despite these accomplishments, resource planners continue to lack confidence that energy efficiency resources will deliver expected savings when really needed, and planners routinely discount energy efficiency estimates when determining the need for additional electric generation or transmission and distribution projects.

For example, one recently filed transmission project in Vermont has discounted funded and planned savings from energy efficiency by 30% in part "to allow for a sufficient margin for error in the energy efficiency savings estimates." The petitioner also commented that savings estimates were optimistic because "the individual measure savings are based on engineering estimates and in some cases professional judgment, although some of these estimates may be very accurate, not all have been rigorously verified through actual metering" (Vermont Public Service Board Docket 7460). In another recent case the VDPS hired a consultant to evaluate the energy efficiency peak reductions used in the petitioner's analysis. The Department consultant "de-rated" energy efficiency peak reductions by roughly 30%, partly relying on the results of a regression analysis that showed substantial and unexplained differences between reported savings and their effect on Vermont's historical peak (VPSB Docket 7373). The reluctance to accept the estimated efficiency peak reductions is understandable, even if their discount appears excessive and based more on perception than hard numbers. Verification in Vermont, prior to the 2007 program year, had focused more on ensuring annual energy savings claims were accurate, and peak claims were a secondary priority (VDPS, 2008). Further, the level of metering conducted in Vermont to verify efficiency savings claims in the past had been minimal. Regulators were working under the assumption that the marginal improvement in savings estimates obtained from metering was not worth the expense.

The FCM directed regulators' and policymakers' attention more squarely to peak resource verification, and provided a revenue stream that has facilitated extensive metering efforts to increase precision and accuracy of the verification process. Within the energy efficiency community, this additional level of rigor will improve the reliability of the savings claims for the FCM and for EVT's performance contract, and will also allow implementers and evaluations to gain a better understanding of the issues that affect the uncertainty of the estimates. For power planners, more defensible and reliable estimates should lead to greater confidence in savings claims, and provide the region's resource planners less justification to discount energy efficiency's value in resource planning endeavors.

**Regional cooperation**

A valuable byproduct of including demand reductions from efficiency in the FCM is that it has brought together efficiency providers from around the region to share information and collaborate on broad based evaluation efforts. The Northeast Energy Efficiency Partnership (NEEP) launched an Evaluation, Measurement & Verification (EM&V) Forum largely to help efficiency providers discuss, understand, and meet the M&V requirements of ISO-NE. Their initial goals are to "develop common/consistent EM&V protocols for energy efficiency and other demand-side resources."[1] The first projects for the EM&V Forum include creating a common glossary across the region, measure characterization coordination, and end use load shape studies.

Currently, there is a lack of understanding regarding the basis of measure characterizations used in different service territories. While there is justification for different characterizations of savings from the same measure in different locations (for example, penetration rates, demographics, weather), the assumptions that are used to develop measure characterizations are not widely understood outside the energy efficiency community. The NEEP M&V Forum provides the opportunity to clarify assumptions and methodologies used in developing measure characterizations, further increasing confidence in efficiency results.

[1] Northeast Energy Efficiency Partnerships. http://www.neep.org/policy_and_outreach/EMV.html

### Customer Confidence

In the past, participants have largely implemented energy efficiency measures based on the analysis provided by EVT or the customer's consultants and follow-up to verify measure performance has been minimal. EVT has moved toward metering as a strategy to help ensure customers that they are receiving return on their efficiency investments and to improve the accuracy of savings projections. To date, these efforts have largely focused on large custom retrofit measures. Metering a diverse set of small and medium projects will assist us with identifying areas in which demand impacts are particularly uncertain. To improve customer confidence in energy efficiency measures, a separate, project-specific calculation of the localized demand impacts can be performed based on the results of the FCM metering to estimate more accurately the performance of their efficiency investments.

## Conclusion

The FCM has presented us with an opportunity to increase the reliability of the verification of demand reduction and provide more defensible estimates for both the claimed savings for the FCM and for EVT's contract with the Vermont Public Service Board, and also for more general applications when planning for Vermont's future energy and transmission needs. Through the process of planning for and implementing the M&V plan for the FCM, the evaluation team has accumulated a base of knowledge regarding how to work effectively within the ISO guidelines to verify demand reduction for custom C&I projects. Some of the critical lessons learned are enumerated below.

- Sampling requires careful stratification. Our evaluation team finally settled on using the project and end use as a sampling unit, and stratifying by market type, end use, project size, and seasonality.
- Attempting to conduct real time sampling to obtain pre-installation for retrofit baselines turned out to be time-consuming, costly and ultimately ineffective. Only a handful of the selected projects could be pre-metered. Our evaluation team is considering conducting all sampling after project completion and relying on state or federal standards for the baseline for the few retrofit projects where no other approach can be applied.
- Standard practice is likely to be the baseline standard for specialized projects. A review of these types of projects with substantial savings would allow us to identify a few critical areas where market characterizations would be highly useful for establishing standard practice. The VDPS may then consider how to incorporate this activity into its broader evaluation mandate.
- Maintaining independence by drawing clear lines between implementation and evaluation is not a straightforward process due to the timing of the verification and interactions with the participants. Finalizing savings estimates prior to selection for verification will eliminate the perception that being aware of the selected projects may result in increased scrutiny on the part of the implementers, however inadvertently.
- The high volume of projects to be metered combined with the rigorous ISO standards for measurement accuracy requires intensive QC. Evaluators need to plan for long leads times to arrange for the metering and also to ensure that the metering can be conducted during the critical months for seasonal measures.

These insights have assisted us in developing a robust and flexible system for verifying EVT's demand reduction claims.

The ISO standards are highly specific and rigorous with regard to sampling and measurement error. While this approach is understandable given that these sources of error are easily quantified, they do not address two other sources of errors that are likely to introduce a substantially higher degree of uncertainty to estimating demand reduction: 1) engineering interpretation of the metering data and/or the application of engineering algorithms and 2) changes in operating conditions over time. While the measurement error is likely to be 5% or less even in the absence of strict protocols, the error associated with these other two aspects of estimating demand reduction is more likely to be in the range of 5 to 20%.

Based on our experience to date, our evaluation team would like to suggest a few areas where modifications to the ISO guidelines could be made without compromising the quality of the verified results, as proposed below.

- Relax the 2% accuracy requirement for measurement of kW demand and proxy variables since it is not feasible for some applications and can be eased without creating a substantial increase in the overall error.
- Explicitly allow conservative estimates of demand reductions where it is not feasible to obtain accurate measurements of one or more critical parameter(s).
- Recognize the error introduced by operating changes at the C&I sites, particularly in the current economic climates, and consider possible approaches to address these issues.
- Consider the nuances of estimating the gross demand reduction in the context of the interaction between market effects and baseline demand use.

The regional cooperation that has been fostered by the creation of the FCM provides a forum for the exploration and resolution of these issues.

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