Efficiency Vermont Takes Action to Apply M&V 2.0

Traditionally, savings measurement and verification (M&V) costs can range from 1% to 5% of total project costs. Currently, more than $7 billion is spent on utility demand side management programs each year, representing tens to hundreds of millions of dollars in expenditures on savings estimation. "M&V 2.0" methods promise to reduce these costs significantly.

M&V 2.0 Overview

M&V 2.0 Defined

M&V 2.0 refers to energy savings estimation that uses high-granularity or high-volume data, e.g., from smart meters and smart devices or from large numbers of buildings, in combination with automated computation and analytical tools. These meter- and software-based approaches are the subject of surging industry interest, particularly in the context of energy efficiency program delivery, implementation, and evaluation.

Potential Benefits of M&V 2.0 for Program Implementation

M&V 2.0 methods offer a number of potential benefits related to streamlining the savings estimation process, and tracking measure performance through continuous feedback.

Efficiency Vermont's Vision for Use of M&V 2.0

As an implementer of efficiency programs, Efficiency Vermont must reliably document the magnitude of energy savings achieved by their projects. By potentially reducing costs, M&V 2.0 could allow Efficiency Vermont's programs to support more complex small and mid-size projects. This could open many opportunities to achieve savings through new technologies, without waiting for expensive field trials to generate deemed savings estimates. In addition, by demonstrating the specific savings that each customer realizes, rather than relying on typical savings and engineering models, they can shift the customer's focus to achieving savings rather than simply qualifying for incentives. Structuring agreements around delivering measured savings also allows them to share the risk with contractors responsible for executing the project, through performance incentives. These opportunities suggest that M&V 2.0 can do more than simply reducing administrative costs for Efficiency Vermont; it can facilitate new models for working with customers to help them save energy.

Today's analytical tools provide the ability to track savings as they accrue throughout the performance period; this visibility can enable early identification and correction of measures that may be underperforming, as well as long-term persistence in savings. By leveraging automated data acquisition and savings calculations, M&V 2.0 also promises to reduce the time and cost necessary to quantify program or project-level savings. The reduced time and cost of tracking and quantifying savings could in turn allow energy efficiency implementers to scale program delivery and increase overall throughput.

Working toward the Vision

Recently, Efficiency Vermont began to explore the performance of M&V 2.0 for future use in their commercial programs with potential extension to residential applications. Specifically, they are working to develop an M&V 2.0 platform based on open-source algorithms. These algorithms are used to automatically model an existing-use whole-building energy baseline; compute metrics to determine the model's goodness of fit to the metered data; run the baseline model against pre- and post-measure data to determine avoided energy use (savings); and quantify the uncertainty in the savings result that is associated with errors in the baseline model.

Efficiency Vermont worked with researchers at Lawrence Berkeley National Laboratory (LBNL) to test these open-source algorithms against a small set of historic program data comprising between nine and twelve months of pre- and post-measure interval meter data, and outside air temperature. The automated routines were executed, and model fitness and savings uncertainty were evaluated. Parallel analyses were conducted by the Efficiency Vermont team and the LBNL team to ensure repeatability of results and correctness of code implementation.

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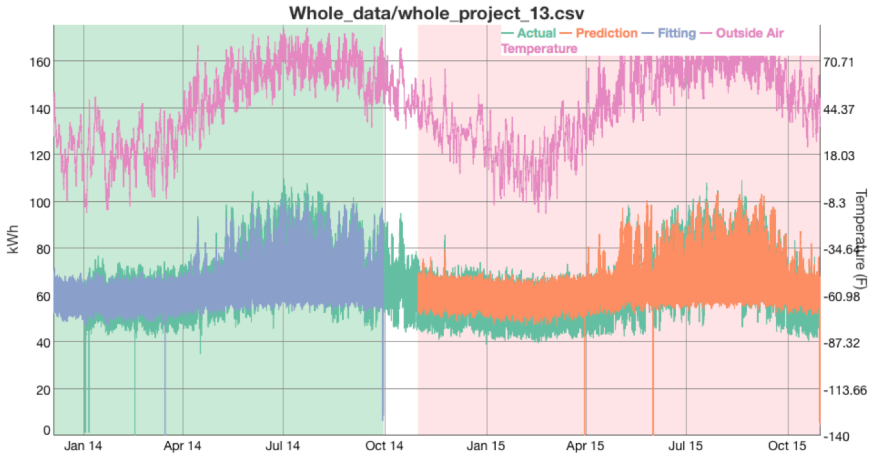
Exploratory Findings

Of the small set of buildings and projects that were analyzed with M&V 2.0 methods, savings were found to range from approximately 4% to 14%. Good model fit was observed for half of the commercial buildings, using a limited set of explanatory variables including time of day, day of week, and outside air temperature. The normalized mean bias error for these buildings and CV(RMSE) were found to meet ASHRAE Guideline 14 recommendations of less than 0.5% and less than 25%, respectively. In addition, for the majority of cases the savings were estimated with a level of uncertainty that met or surpassed the ASHRAE recommendations, i.e., fractional savings uncertainty less than 50% of the estimated savings at a 68% confidence level. Analyzed as an aggregated portfolio, savings were quantified with a fractional uncertainty of less than 10%, at 95% confidence.



Metered data (green), outside air temperature (pink), fit baseline model (purple), and model projection (orange) for one of the buildings in the exploratory study.

For the commercial buildings for which the M&V 2.0 model did *not* pass the goodness of fit requirements, a deeper investigation of the data revealed that this was in some cases due to incorrect documentation of the measure implementation date, and in other cases due to seasonal trends not captured by the baseline model.

Ongoing Development

Following this successful exploratory effort, Efficiency Vermont plans to take steps to re-factor the M&V 2.0 algorithms for faster run time, and will build out the M&V 2.0 platform for internal use and testing in pilots focused on retro-commissioning programs. The algorithms will also be run on data from a large number of accounts across their portfolios to target these efforts to customers for whom the baseline model provides a good enough fit to ensure reliable results. Future pilots will test new methods of program delivery that can more easily support emerging connected technology and drive market transformation by demonstrating the cost-effectiveness of efficiency projects.

Project Summary

With a desire to develop an M&V 2.0 platform for program delivery, Efficiency Vermont worked with researchers at Lawrence Berkeley National Laboratory (LBNL) to test the performance of M&V 2.0 open-source algorithms against a small set of historic program data. Parallel analyses were conducted by the Efficiency Vermont team and the LBNL team to ensure repeatability of results and correctness of code implementation.

Exploratory Findings

Of the small set of buildings and projects that were analyzed, good model fit was observed for half of commercial buildings, and for the majority of cases, savings uncertainty met or surpassed the recommendations in ASHRAE Guideline 14. Where the M&V 2.0 model did not pass the goodness of fit requirements, a deeper investigation revealed it was in some cases due to incorrect documentation of the measure implementation date, and in other cases due to seasonal trends not captured by the baseline model.

Ongoing Development

In their ongoing efforts, Efficiency Vermont plans to:

- Build out their M&V 2.0 platform for internal use and testing
- Run algorithms on a large set of commercial buildings to determine M&V 2.0 suitability
- Pilot M&V 2.0 platform in retro-commissioning programs

Use M&V 2.0 in Your Efforts

Visit http://eis.lbl.gov/ for more information. Contact us if you are interested in obtaining M&V 2.0 code or piloting commercial M&V 2.0 tools in your efficiency programs: jgranderson@lbl.gov or sgfernandes@lbl.gov.