

Advanced measurement & verification (M&V) for energy efficiency projects shows great promise as a means to provide near real-time feedback on project savings and support new program approaches. While promising, there are many challenges to overcome in developing new M&V methodologies. For several years Lawrence Berkeley National Laboratory (LBNL) has been conducting research to support partner efforts to implement these M&V practices (also known as “M&V 2.0”). The latest phase of M&V 2.0 research included the 2017 launch of two pilots.

## What is M&V 2.0?

M&V 2.0 (sometimes called automated M&V or advanced M&V), is characterized by (1) Increased data availability, primarily in terms of finer time scales or higher volume and (2) enabling the processing of large volumes of data at high speed via automated analytics, to give near real-time savings estimates. These approaches are intended to be conducted more quickly, more accurately, and potentially at lower cost than non-automated methods<sup>1</sup>

## Pilots Purpose

Published research demonstrates the technical feasibility of M&V 2.0, typically using historical energy usage data. However, a key benefit of M&V 2.0 is the ability to monitor project energy savings on a continuous basis as savings are accumulating. Conducting pilots in real-time, with ‘live’ projects, will provide practical insights on implementing M&V 2.0 within a utility program setting. In addition to technical findings the pilots will provide insight for professional application of these techniques, and identify remaining needs for M&V 2.0 to fulfill its promise. The pilots will also help to understand the relative benefits of M&V 2.0 methods across different program types.

## Pilot Tasks

Ongoing pilots in partnership with United Illuminating, Eversource, and Seattle City Light are employing similar approaches, including the following steps:

- **Develop M&V Plan:** Define M&V process, documentation and acceptability criteria.
- **Baseline screening:** Develop baseline models for a high volume of sites, to confirm suitability of the selected M&V tool, and to identify a target population with stable baseline characteristics.
- **Select pilot participants:** Preference given to programs/projects with high savings (>5% whole building savings) and complex measures.
- **Ongoing M&V:** Tracking savings as they accumulate, and looking for non-routine events that may need to be accounted for.
- **Savings Claim:** Establish gross annual savings, and make adjustments for non-routine events as needed. Compare with conventional M&V methods.

The pilot final reports will document the savings claims, lessons learned from implementing M&V 2.0, comparison with conventional M&V methods, and insights on the level of effort required to implement M&V 2.0 methods.

## Pilot Partners

### Connecticut

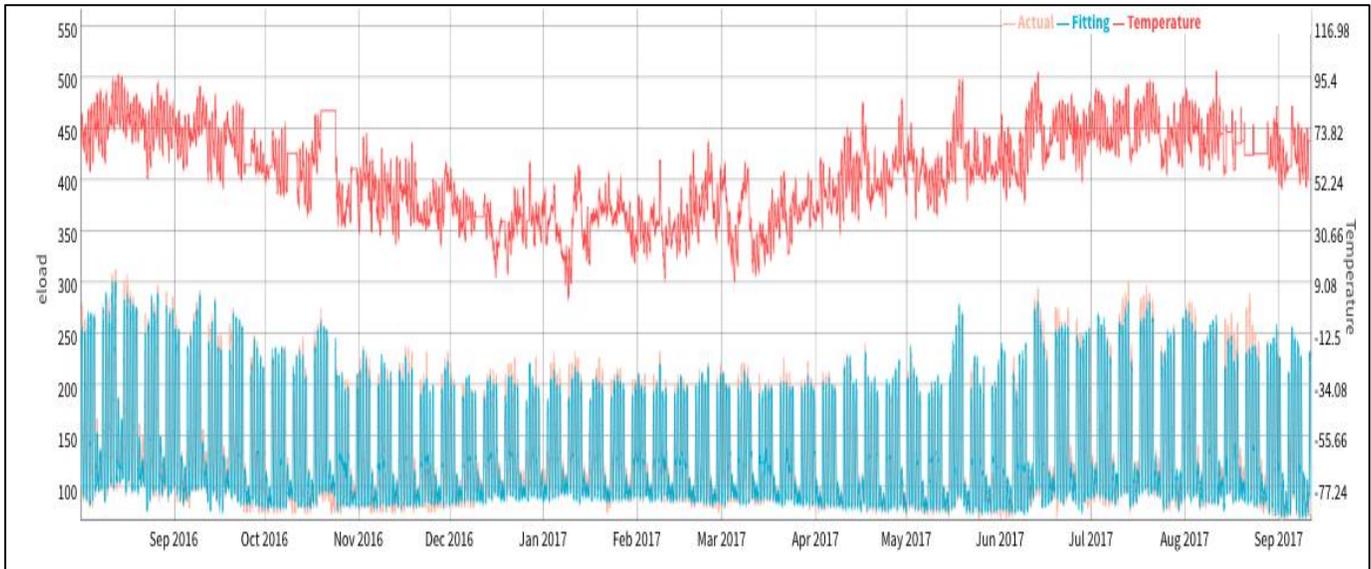
- CT. Dept. of Energy & Env. Protection
- United Illuminating
- Eversource

### Seattle

- Bonneville Power Administration
- Seattle City Light

U.S. Department of Energy

<sup>1</sup> Franconi, E., Gee, M., Goldberg, M., Granderson, J., Guiterman, T., Li, M., and Smith, B.A.. *The Status and Promise of Advanced M&V: An Overview of “M&V 2.0” Methods, Tools, and Applications*. Rocky Mountain Institute, and Lawrence Berkeley National Laboratory, 2017, #LBNL-1007125.



**Advanced M&V baseline model for a United Illuminating customer. Chart shows modeled baseline (blue) compared to actual hourly consumption data (orange). Model meets pilot criteria for model fitness.**

## Pilot Status: Seattle

Pilot participants are currently being targeted for the Seattle City Light pilot. An upcoming pay-for-performance program would be ideally suited for an M&V 2.0 approach, as M&V 2.0 ties directly to true impacts at the meter as opposed to engineering estimates. Other programs are being considered, such as a building tune-up program and complex retrofits, where an M&V 2.0 approach may be easier than complex spreadsheet calculations. The pilot is targeting two to three dozen participant sites.

The initial round of baseline screening is complete for the Seattle City Light pilot. Baseline models were created using 12 months of hourly electric consumption data for over 400 large commercial buildings, and 85% of the models met acceptability thresholds for “model fitness” (a measure of accuracy). The high pass rate indicates the chosen model form/tool is adequate for the Seattle climate zone and buildings, and identifies a large pool of buildings which appear well-suited to the M&V 2.0 methodology.

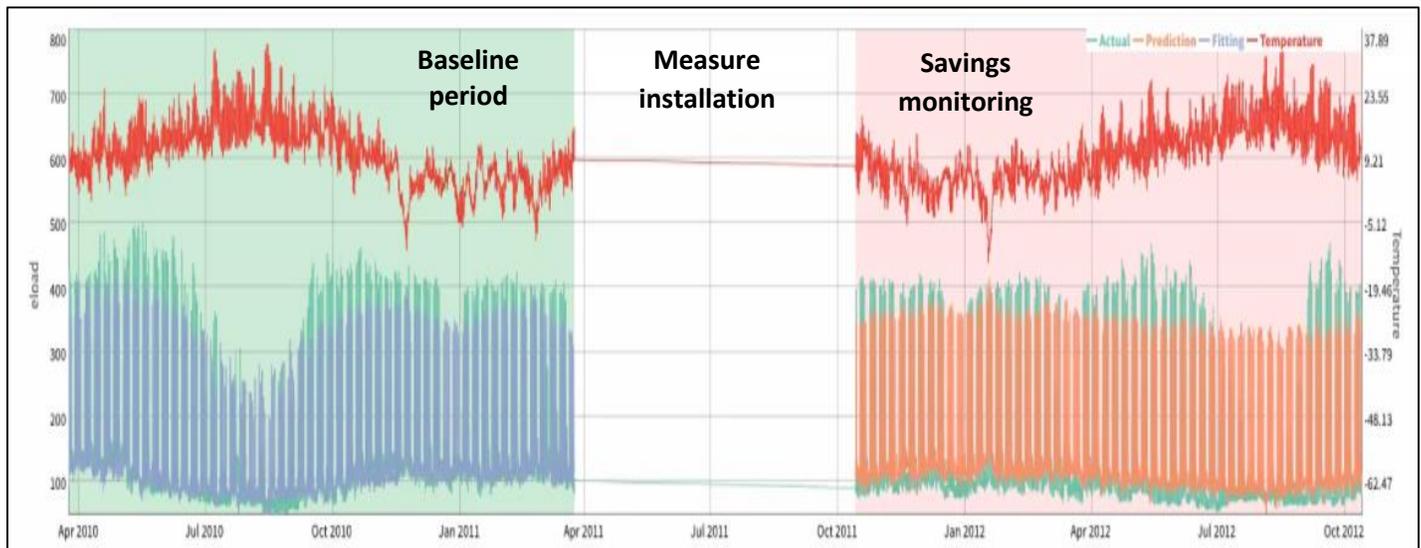
## Pilot Status: Connecticut

A diversity of project types is being considered for the Connecticut pilot, to include retrocommissioning and lighting/HVAC retrofit projects (Energy Opportunities and Small Business Energy Advantage Programs). United Illuminating (UI) and Eversource are particularly interested in using M&V 2.0 to quickly gain visibility into project savings, as typical program evaluations may not

provide results until more than a year after projects are completed. Using hourly consumption data and M&V 2.0 methods a utility can get an early indication of project savings – within months - and make program adjustments to resolve any issues that arise.

## Pilot Highlights to Date

- Baseline models created for 550 buildings; 85% of Seattle buildings from Seattle pilot, and 72% of Connecticut buildings, met model fitness criteria
- Programs targeted:
  - Seattle:** Pay-for-Performance Program; Building Tune-Up; Retrocommissioning
  - Connecticut:** Retrocommissioning; Energy Opportunities; Small Business Energy Advantage
- Phase 1 (screening and participant selection) due for completion by end 2017
- Phase 2 (savings monitoring) phase to be complete by end 2018



**Example time series chart showing baseline and post period for a project. During the post-Implementation period actual hourly data (green) is compared to model predictions (orange) to determine savings**

UI and Eversource are in the process of gathering energy data for baseline screening, and project information for candidate pilot sites. 14 sites have been selected to date, and screening continues for 141 commercial properties in UI territory.

### Next Steps and Expected Outcomes

The initial phase of the M&V 2.0 pilots is expected to be complete by the end of 2017, resulting in up to 50 pilot participants being selected for study (14 confirmed to date). Throughout 2018, pilot participants' interval data will be monitored to track savings from implemented measures. Pilots are expected to complete by the end of 2018.

Taking M&V 2.0 from a research exercise to an established M&V methodology is a multi-phase effort involving many industry stakeholders overcoming a series of technical and market barriers. The ongoing pilots are targeting several tangible outcomes that benefit program implementers and practitioners:

- Providing 'practitioner workflows' that enable consistent application of M&V 2.0 methods for an ongoing program.

- Establishing data on the level of effort required to implement M&V 2.0 methods.
- Providing guidance on approaches to continuous monitoring to maximize savings and identify non-routine events.
- Further refinement of M&V 2.0 accuracy and results documentation requirements.
- Highlighting practical tips on M&V 2.0 application and identifying limitations and/or situations where M&V 2.0 may not be applicable.

Overarching objectives of the pilots are to better understand where M&V 2.0 works, where it doesn't, and to document examples of the benefits and challenges of implementing within a utility program context. The pilots also provide a valuable opportunity to drive conversations on how M&V 2.0 overlaps and interacts with traditional EM&V practices.

Pilot results will be shared via webinars and publications, along with resources, tools, and guidance to further assist utilities and practitioners in adopting M&V 2.0.

## Lawrence Berkeley National Laboratory's M&V 2.0 Research

The recent phase of LBNL's automated M&V research started in 2014 and has encompassed development of test methods for M&V tools, technical evaluations of advanced M&V tools and methods, guidance on accuracy and documentation requirements, and application of M&V 2.0 techniques to historical project data. More information on these efforts can be found at <http://eis.lbl.gov/auto-mv.html>