Evolution of EM&V: State experience that looks to the future

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ABSTRACT

Policymakers have recently put increased focus on energy efficiency as clean, low-cost, and reliable utility system and distributed energy resources to meet both short- and long-term energy needs and climate goals. Meanwhile, emerging innovations in data analytics and data access are setting up new opportunities for energy efficiency EM&V to further evolve and improve. This increased attention and range of opportunities calls for increased excellence in EM&V.

We conducted more than two dozen interviews with national experts, focusing on current challenges, state policy, utility leadership, trends in advanced data analytics (or "M&V 2.0"), deemed savings, technical reference manual (TRM) developments, and market-level effects. Based on recommendations from those interviews, we examined recent experience and forward-looking plans in a handful of leading states (California, Massachusetts, Michigan, Connecticut, and Illinois) and developed a narrative about recent state experiences that demonstrate forward-looking leadership. Our aim was to inform policymakers and regulators as well as program implementers and the broader evaluation community.

Based on our review, we identified several examples of states that are EM&V leaders in areas such as overall framework, effort level, progress in tapping into new advanced data analytics, or core improvements, such as efforts to update deemed savings. Collectively, these examples provide practices and strategies for others states to consider as they seek to improve their own EM&V policies and practices.

Introduction

Policymakers have recently put increased focus on energy efficiency as clean, low-cost, and reliable utility system and distributed energy resources to meet both short- and long-term energy needs and climate goals. Meanwhile, emerging innovations in data analytics and data access are setting up new opportunities for energy efficiency EM&V to further evolve and improve. This increased attention and range of opportunities calls for increased excellence in EM&V. Against this backdrop, we explored the biggest EM&V challenges and some of best practices for meeting the evolving challenges.

The goal of this paper is to focus on some broad and timely questions for the evaluation community and to assess specific examples of state and utility leadership: 1) What state policy frameworks create an effective landscape for best practices and evolution of EM&V? 2) How are states and utilities responding to specific opportunities for improved M&V with data analytics and data access? What are the early successes, challenges, and obstacles? 3) To what extent can deemed savings approaches and technical resource manuals (TRMs) be further improved? 4) What are emerging practices for EM&V within a long-term, market transformation context?

In the first section of the paper, we describe the results of our expert interviews, including specific challenges, developments, and examples of state leadership. We then describe how states and utilities are improving EM&V with data analytics and data access. In the second section, we provide several specific state profiles.

Expert interviews

We interviewed about 24 individuals, representing various types of EM&V consultants and vendors, utility evaluation managers, non-governmental organizations (NGOs) and national labs with energy efficiency evaluation experience.[1] We had planned to speak with additional stakeholders, including regulators, who worked in specific states mentioned as leaders. However, due to time constraints, completing the additional interviews was not possible. Comments made by individuals are referred to in this paper, but no comment is attributed to a specific individual. We asked all interviewees to put aside any interests of their particular company or organization, and give us their objective and candid thoughts as professionals in the field. We first asked about overall EM&V challenges, developments, and specific examples of state leadership. We then delved into a couple of specific topics, including M&V 2.0[2], deemed savings, and market-based approaches. In addition to the expert interviews, we also conducted independent research of the relevant literature and reviewed examples of evaluation efforts in several states.

Challenges

Table one presents results of the first question we asked during the expert interviews: an open-ended question to gauge the biggest one or two challenges facing energy efficiency EM&V today. The responses are grouped into the ten categories.

Table 1. Expert interview responses: biggest challenges facing EM&V[3]

	Response	Number of responses
1	Keeping EM&V relevant in a changing world. We need to weigh the value of attribution studies with their costs. Efficiency is "victim of its own success," making it difficult to isolate net impact after decades of doing EE. This leads to a need to look more at market effects going forward.	✓✓✓✓
2	Using new data sources effectively (e.g., AMI; related data processing)	✓✓✓
3	Assessing the value of M&V 2.0 and navigating related changes	✓✓✓
4	Making results and language around evaluation more impactful, accessible, timely, and relevant	✓✓✓
5	Budget challenges: insufficient EM&V budgets or pressure to reduce EM&V spending	✓✓✓

[1] The following individuals participated in a first-round phone interview: Kausar Ashraf, Jordana Cammarata, Beth Delahaij, Tracy Dyke-Redmond, Tom Eckman, Ellen Franconi, Rafael Friedmann, Michael Goldman, Steve Grover, Tim Guiterman, Randy Gunn, Nick Hall, Katherine Johnson, Michael Li, Sierra Martinez, Peter Miller, Jake Oster, Gil Peach, Jane Peters, Ralph Prahl, Rick Ridge, Steven Schiller, Brian A. Smith, Elizabeth Titus, and Bryan Ward.

[2] M&V 2.0 has become the most commonly used term to convey a set of tools that can automate certain types of whole-building M&V, enabled by improved data analytics and data availability. Franconi et al. 2017 highlight two key features of M&V 2.0: (1) automated analytics that can provide ongoing, near-real time savings estimates, and (2) increased data granularity in terms of frequency, volume, or end-use detail.

[3] Twenty-four individual respondents provided answers, however some only provided one main challenge or had responses that were categorized into the same type of challenge. As a result, we tallied 25 total unique responses.

	Response	Number of responses
6	Regulatory perceptions: Lack of confidence that savings are real or concern that utilities are inflating savings.	✓✓✓
7	Political changes, specifically conservative policy trends at federal and state levels, that will impact EM&V institutions, focus and expenditures	✓✓
8	Attribution issues: time lag between participant decisions and evaluation surveys	✓✓
9	Insufficient requirements for independence, along with insufficient evaluation guidance and oversight resulting in reduced confidence in the evaluation results	✓
10	Increasing concentration of the evaluation industry, which negatively impacts quality of work	✓

It is striking to note the wide range of responses. There is clearly a diversity of concerns among the evaluation expert community.

That said it is possible to discern some common themes. We found that the ten response categories followed two general tracks: the first track related to specific challenges within EM&V practices (e.g., attribution issues, or making the results and language more impactful) while the second track related to external forces exerting pressure on EM&V and creating challenges (e.g., regulatory perceptions of energy efficiency savings or changes in political landscapes).

The most common response was the challenge of keeping efficiency EM&V relevant in a changing world. Some of these respondents described efficiency as becoming a victim of its own success, because after decades of policies and programs to promote energy efficiency, it becomes incredibly difficult to isolate net impacts. As a result, these respondents indicated that it becomes even more important looking ahead to focus on other metrics, such as market impacts, as a way to assess attribution and to move beyond the standard ways of assessing attribution.

The next two responses (2 and 3) are related, yet the way interviewees framed the challenges were distinct. First was the challenge of using vast new data sources effectively (e.g., AMI or smart thermostat data, and the associated data processing requirements). Second was assessing the value of M&V 2.0 and navigating changes that come along with its new tools. While the first was about data availability itself, the latter was about being confronted with a range of possible applications of M&V 2.0 and needing to determine how to proceed. We see the first response as a broad challenge, and the second response as navigating which tools can be used to accomplish different objectives. Each response was mentioned three times as a biggest challenge.

Next, three interviewees talked about the challenge of making results and language around evaluation more impactful, accessible, timely, and relevant. Some specifically noted the importance of improving timeliness of results, while others talked about the need to communicate high-level results to policymakers and stakeholders more clearly without using too much technocratic jargon. This extends not only to communicating EM&V results, but also to making the case to policymakers for robust evaluation and the necessary resources.

Next, three experts noted EM&V budget challenges as a primary concern, either insufficient EM&V budgets or the constant pressure to reduce EM&V spending. Past research has shown that utilities spend about 3-5%[4] of efficiency portfolio costs on EM&V. ACEEE recently examined EM&V spending for a set of 26 utilities around the country and found similar results, with EM&V representing a range of 1-6% of total efficiency budgets and an average of 3% (ACEEE data). However, it is worth noting that while the percentages are around the same range, the absolute amounts vary significantly due to the wide

[4] Based on data from the Consortium of Energy Efficiency

differences in portfolio budgets. Among these 26 utilities, overall EE budgets ranged from about $2 million to $435 million, with a median of $75 million. EM&V budgets ranged from about $75,000 to $14 million. One expert commented that with economies of scale, larger states and utilities should be able to handle a percentage at the lower end of the 1-6% range, while states just getting started should have a much higher percentage of perhaps 10%.

The next two responses (6 and 7) were examples of external forces rather than EM&V practices. The first one we categorized as regulatory perceptions, including both the perception that energy efficiency does not produce real savings, or that utilities are inflating their savings estimates. The second external pressure referred to political changes, specifically conservative policy trends. Respondents noted the significant challenges this has already posed to EM&V budgets and practices. There is the potential for further challenges under the Trump administration.

The eighth challenge is somewhat like the first in that it focused on attribution issues. However, this response had a much narrower framing, specifically focusing on the time lag between participant decisions and self-report attribution surveys.

The ninth challenge mentioned was insufficient levels of EM&V independence and oversight. In past ACEEE research, we found that most jurisdictions required independent evaluation of some type, but the particular structures and approaches to achieve this varied greatly (Kushler et al 2012). Similarly, another challenge mentioned was how to properly define the role of the evaluator, for example, what should be the definition of independence?

Finally, the tenth challenge noted was that the evaluation industry has become more concentrated into fewer larger firms, which could negatively impact the quality of work. This is because when more entry-level employees take on increasing amounts of responsibilities there is the potential for lesser quality work.

Some other challenges were mentioned, but didn't rise to be the top one or two challenges. These included workforce challenges, and the prohibitive costs of competing for high-quality data scientists, who can receive higher salaries in other industries.

State leadership

ACEEE's annual *State Energy Efficiency Scorecard* does not currently include any policy metrics related to the structure or implementation of best practice EM&V policies. Systematic assessment of state policy commitment to EM&V is a current gap in the literature. To help fill this gap, ACEEE is including some elements related to EM&V in its *2017 Utility Energy Efficiency Scorecard*[5], and is exploring new state policy metrics related to EM&V for its next State Scorecard.

For this paper, we examined some best practice state EM&V policy frameworks. We posed a question to interviewees about which states have shown leadership on energy efficiency EM&V. We tallied responses to this question and provide the results in Table 2. This was not meant to be a comprehensive examination of all state policy commitments to EM&V. We recognize a key caveat that we may have interviewed experts with more experience in certain states than others. Still, we tried to cast a wide net geographically in our interviews, and we found that this was a useful exercise and a reasonable approach to examine high-level trends in state leadership.

California and Massachusetts received the most mentions, followed by jurisdictions that received 2-4 mentions. In addition, the following jurisdictions received at least one mention: Maryland, New Mexico, Ontario, Oregon, Pennsylvania, Rhode Island, and Wisconsin. When we asked about leading states, some experts also noted that examples from states such as California and Massachusetts cannot easily be replicated in other states just getting started and without sufficient budgets. This presents the bigger challenge and the question of how more robust EM&V can be deployed in the wider market.

[5] See http://aceee.org/research-report/u1707

Table 2. Expert interview responses: state leaders on EM&V

State	Number of mentions
California	11
Massachusetts	8
Connecticut	4
Arkansas	3
Michigan	3
New York	3
Illinois	2
Washington	2
Northwest	2

M&V 2.0

A growing body of research explores the opportunity for new measurement and verification techniques through enhanced data analytics and increased data availability. For example, the Northeast Energy Efficiency Partnerships (NEEP) outlines these trends across two major areas in its report *The Changing EM&V Paradigm*: 1) advanced data analytics and program enhancements (enabled by new software); and 2) advanced data availability (enabled by new hardware) (NEEP 2015). ACEEE also began to explore this topic in 2015 (Rogers et al. 2015). This growing opportunity is generally referred to as M&V 2.0. Recently, Rocky Mountain Institute (RMI) and Lawrence Berkeley National Laboratory (LBNL) provided a helpful overview of M&V 2.0 tools, methods, and applications (Franconi et al. 2017). Also, there is an ongoing LBNL stakeholder working group focused on these topics.

When describing the opportunity for M&V 2.0, stakeholders are increasingly acknowledging the importance of distinguishing its role as not being the 'E' of EM&V (evaluation), but instead as one type of savings estimation approach for (M&V) measurement and verification applications. And within savings estimation approaches, M&V 2.0 is one tool in the toolbox. Whereas evaluation encompasses a broad set of activities to meet the objectives of EM&V[6], M&V is narrower and applied at the project level to determine gross energy savings at individual sites or projects. M&V can use one or more methods and can involve metering measurements in combination with engineering calculations, statistical analysis, and/or computer simulation modeling.

To better understand the M&V 2.0 landscape, we asked interviewees, "How are states and utilities responding to the opportunities for improved EM&V with data analytics and real-time data access?"

Most respondents noted that states and utilities are responding with interest, yet caution. Many respondents said that there is a significant opportunity with new data analytics and data sources, but that we are still at the very earliest stages. For example, some noted that we have not yet seen any jurisdiction that has relied on M&V 2.0 to estimate savings claimed by a utility or a third party. And some are wary whether vendors can deliver the promised results.

Another theme that emerged is the question of whether M&V 2.0 is truly a new technique. Some described how the industry has had similar approaches to billing analysis for years. Rather, what is new and helpful is the ability to collect and handle more data faster. However, the same challenges that have always made billing analysis complex remain today. Some respondents are skeptical of the notion that we can automate savings estimates. This is because there are so many individual decisions that any analyst

[6] The three key objectives of EM&V are broadly understood as accountability of the impacts, risk management, and continuous improvement. See http://aceee.org/sector/state-policy/toolkit/emv

must make in assessing gross or net savings, such as decisions driven by the data set you're given – including how to treat outliers and collinearity. If you take out the human component and automate, we will get an answer but it may not be the best answer.

Many respondents commented on how M&V 2.0 has often been conflated with evaluation, and that we need to continue doing a better job of drawing a clear distinction between them. Several respondents also pointed to the fact that M&V 2.0 tools are more often used and valuable on the program side, for example, for use in program monitoring. M&V 2.0 tools offer a range of capabilities valuable to program designers and implementers, from customer intelligence to end-use load disaggregation.

Over the past year, the initial reaction toward M&V 2.0 by the broader EM&V community has evolved, from skepticism and a feeling of being threatened, to new partnerships on EM&V. More utilities are learning what they can do with these tools to better understand customer energy usage, program participation, and to obtain more timely information on how to better serve customers.

Overall, we find that M&V 2.0 is a positive trend, but that states and utilities do not have enough information yet to know the full range of its impacts and opportunities.

Deemed Savings and Technical Resource Manuals (TRMs)

We asked experts about the use of deemed savings and TRMs, including what leading states are doing to solidify or improve use of deemed savings. Currently about 24 states have some sort of technical resource manual (TRM), either statewide, utility-specific, or regional (Tamble et al. 2016).

We found that the use of TRMs and deemed savings[7] is widely regarded as an important tool for saving time and reducing EM&V costs. However, experts note important caveats regarding the use of TRMs, including that they should be constructed in an independent and unbiased manner, regularly updated as better and newer information becomes available, and be transparent.

We heard some say that jurisdictions are moving toward more deemed savings in general, while others felt that states are trying to move away from deemed savings. Overall, most experts noted that deemed savings make program implementation easier and they are incredibly useful, as long as they are not overused. Along these lines, some interviewees pointed to the theme of 'Why deem it when you can measure it?' Certain programs and approaches are better suited to project-level M&V and M&V 2.0 tools. Deemed savings approaches are not going away, but perhaps we will see more segmentation going forward, with deemed approaches used for some program segments.

We also asked to what extent deemed savings approaches can be further improved with recent innovations in data analytics and data access. While nobody referred to specific cases of translating AMI data into deemed savings values, many recognized the opportunities. For example, there is a large opportunity to go beyond annual average savings estimates to get more granular savings estimates for heating and cooling seasons and to leverage load shape and end-use data.

State Profiles

We asked interviewees for examples of leading states in terms of overall EM&V frameworks, process, or results. Most respondents pointed to California and Massachusetts. We conducted follow up interviews to better understand overall EM&V frameworks and specific areas of leadership. Below we profile California, Massachusetts, and Michigan followed by briefer reviews of a couple of key activities in Connecticut and Illinois. These profiles are not intended to be comprehensive reviews, nor are they intended to each follow the same format. Rather, we examined key policies, trends, program examples and other developments that made the states notable to interviewees.

[7] Many clarified that deemed savings are only one type of parameter that can be deemed – methodologies and other values can also be deemed, adding value to efficiency program implementation.

California[8]

California received the most mentions as a longtime state leader on EM&V. However, some interviewees also mentioned changes in state policy, leaving some EM&V activities in flux and somewhat uncertain.

Changes in electricity supply in California, including generation plant closures, increased solar penetration and the duck curve phenomenon[9], have been key drivers for policy discussion around energy efficiency. There is now an increasing need for energy efficiency to replace some of the lost baseload and for lowering demand at certain times of day. The California Public Utilities Commission (CPUC) is approaching efficiency resource planning through multiple channels. One of these is phase III of the CPUC's energy efficiency rulemaking (R. 13-11-005), also known as the "rolling portfolio" proceeding, which is expected to remain open through 2017 and into mid-2018. Also, the CPUC and investor-owned utilities (IOUs) are assessing whether and how to update the evaluation framework, in part due to legislative drivers, including Assembly Bill (AB) 802 that directed the increased use of existing condition baselines as a default assumption for program implementation[10] and updated the rules to allow for measurement of energy efficiency based on savings observed at the meter (weather-normalized metered energy consumption (NMEC)). Another key driver is Senate Bill (SB) 350, which includes a goal of doubling the amount of energy efficiency savings in California by 2030, with emphasis on approaches such as market transformation and pay-for-performance.

These broader policy and market trends are driving some of the new EM&V trends in the state, and utilities are responding in part by tapping into opportunities through M&V 2.0 tools. The following specific examples of Pacific Gas & Electric (PG&E) energy efficiency programs demonstrate an increasing look at whole-premise evaluation, ongoing engagement, and multi-year commitments. Another utility example is Southern California Edison (SCE), which has been working on a Preferred Resource Pilot to examine their energy efficiency efforts on the grid and understand how the measures perform.

PG&E program examples

Residential Pay-for-Performance (P4P) Program. PG&E is launching a new P4P program by late 2017. The utility's current home upgrade program (HUP) and Advanced HUP have seen high costs and low cost effectiveness, which are an impetus for the utility returning to a pay for performance approach.[11] The goals with the new approach are to encourage contractors to go deeper with measures, giving freer rein to contractors (more than the deemed measures approach, which was limiting), and to achieve higher realization rates. This program is an outcome of the previously mentioned AB 802 legislation that broadens the range of qualified measures beyond the set of approved deemed measures to include all interventions that can be observed using NMEC—including behavioral and operational measures that were not allowed previously. IOUs were invited to submit proposals for expedited review for the High

[8] Information for this profile is based on informational interviews with utilities and evaluators, and independent research.

[9] The state used to see peak demand in the hottest afternoons of summer and now those are times of oversupply due to solar generation; peak demand has now shifted into the evening.

[10] With certain justified exceptions in cases where a baseline determined by codes and standards and/or a dual baseline would be appropriate, as determined by the Commission.

[11] For a review of pay for performance programs and business models, see NRDC. 2017. *Putting your money where your meter is: The opportunity for pay-for-performance efficiency programs to increase energy savings.* The report finds that P4P has some important opportunities for increasing energy savings, but also key limitations that will need to be better understood through piloting and experimentation.

Opportunity Projects and Programs (HOPPs). The utility submitted an Advice Letter (AL) to the CPUC for consideration, providing information about the budget, program plan and detailed EM&V plan[12].

To date, PG&E has completed a competitive bidding process for implementers; has vetted multiple companies that have submitted proposals; and has selected a couple of firms to move forward. A key element of the bids was the proposed $/kWh and $/therm payments potential aggregators would need. NMEC (weather normalized pre/post) will be used as a basis for calculating incentive payments; these are referred to as payable savings. PG&E is committing to provide multiple performance-based payments beginning one year after program intervention. Since weather normalized pre/post consumption analysis, without control or comparison groups, does not address exogenous factors, there is a risk to PG&E that the evaluation results (that will come sometime after initial payments are made to implementers) will differ from the paid savings. However, PG&E believes that providing the market with consistent and straightforward consumption analysis methods for the determination of incentive payments is essential to give future savings aggregators sufficient certainty.

The methodology for calculating payable savings is known as CalTRACK[13], a standardized set of analysis methods being developed by a technical working group that provide for the use of daily consumption data.[14] The objective is to provide transparency in how M&V savings determination is done by having open-source code that anyone can use, and when combined with pre- and post-intervention usage data, in theory, come up with similar estimates of savings. If CalTRACK can meet that objective, the goal is that EE savings could be more readily accepted by the investor community as a resource.

Commercial whole building performance demonstration project. Another example is a commercial whole building performance project, which is a performance-based approach designed to deliver at least 15% post-installation energy savings in existing commercial buildings. PG&E is targeting buildings without significant process loads and stable end uses, such as large and medium-sized commercial office buildings, supermarkets and public buildings such as schools and libraries. The first year of performance has been completed and the impact evaluation is underway. They are using multiple models to project counterfactual baselines, including two open-source International Performance Measurement & Verification Protocol (IPMVP Option C models), two proprietary Option C models, and a fifth "ensemble" model developed by PG&E data scientists that blends estimates of the Option C models. They are also using IPMVP Option D (building simulation) to ascertain when less expensive Option C-based estimates yield comparable estimates. Similar to the residential example, an overall goal is to move away from program designs restricted by the need for all measures to be vetted into deemed values. In addition, PG&E is determining how the program could be scaled.

Strategic Energy Management (SEM). In the past there has been contention between IOUs and regulators relative to attribution in the large commercial and industrial (C&I) sector. For large customers that have had long relationships working with the utility on energy efficiency projects, a standard approach to net-to-gross attribution is not appropriate. For example, in the past a very large project that receives a large incentive may not be viewed as a net effect because the evaluator regards the project as industry standard practice or as consistent with the ordinary course of doing business. However, the impact has been (at least in part) the result of years of engagement on the part of the utility. PG&E is launching a new, SEM approach in 2017 that focuses on building long-term relationships with these larger

[12] See March 25, 2016, "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program" https://www.pge.com/tariffs/tm2/pdf/GAS_3698-G.pdf

[13] http://www.caltrack.org/about.html

[14] The CalTRACK technical working group also has ratified a methodology for using monthly billing data since many utilities do not yet have AMI infrastructure in place. The use of daily data is preferred because it allows for better statistical control of the association between weather on energy use.

firms for energy management, following the leadership of the Pacific Northwest.[15] LBNL, under contract to the CPUC, drafted an evaluation plan that was subject to public review.

Technical Reference Manual and Deemed Savings

Another important development is that California is developing a new statewide, electronic TRM. The purpose of the "eTRM" is to consolidate California ex ante savings information currently contained in the Database of Energy Efficiency Resources (DEER), non-DEER work papers, and the publicly owned utility (POU) TRM into a user-friendly, well-documented, repository. In addition to increasing transparency of key parameters and sources of data, and providing a clear path to update those parameters, another goal is to save money and reduce regulatory contentiousness. The proposed structure of the "eTRM" builds off of research on best practices around the country.[16] The California Technical Forum is working out next steps on its development.

Massachusetts[17]

Several experts named Massachusetts as a leader in EM&V. They noted that Massachusetts has a strong EM&V policy framework, empirically-driven results used to update the TRM, a significant research effort, dedicated EM&V funding, and is one of the leaders in examining market effects. The state views EM&V as a critical engine for providing objective and fact-driven results to ensure reliable savings claims.

Institutional framework

The Massachusetts Energy Efficiency Advisory Council (EEAC) oversees all evaluation activity, while the utility program administrators (PAs) administer the evaluations through an Evaluation Management Committee which includes a representative from each PA and from the EEAC consultants.[18] The EEAC is the state's energy efficiency collaborative, which was established by state law, and has council members appointed by the Department of Public Utilities (DPU).[19] In 2009, the EEAC adopted a formal resolution establishing an EM&V framework, which was then submitted to the DPU. The EEAC has a dedicated EM&V consulting team, whose objective is to enhance and ensure the objectivity, accuracy, timeliness, and usefulness of utility EM&V activities on behalf of the Council. The team must oversee all aspects of the EM&V process, including evaluation planning, contractor procurement, study implementation, reporting and outreach, and application of study results. [20]

Before 2009, EM&V was done at utility level. Under the new resolution, EM&V was made primarily a statewide function and formal decision-making authority was given to the Council or its agents. Aside from potential studies and pilots developed by utilities, most studies are statewide. There are multiple contracting teams that collectively produce about 40-50 studies per year.

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[15] For example, see http://neea.org/resource-center/prior-neea-annual-reports/2013/success-stories/strategic-energy-management

[16] See Beitel, A. et al "Technical Reference Manuals Best Practices from Across the Nation to Inform the Creation of the California Electronic Technical Reference Manual (eTRM)," published in Proceedings of ACEEE 2016 Summer Study.

[17] Information for this profile comes from interviews with utilities and evaluators in Massachusetts, and past ACEEE research http://database.aceee.org/state/massachusetts.

[18] Massachusetts EM&V studies completed over the last several years can be found here: http://ma-eeac.org/studies/

[19] Massachusetts is one of only a few states that have an "enhanced" energy efficiency collaborative, characterized by a significant operating budget, statutory permanence, and a broad array of specific tasks and responsibilities (State and Local Energy Efficiency Action Network 2015).

[20] For additional information on the 2009 resolution, see http://ma-eeac.org/wordpress/wp-content/uploads/Consultant-Team-Year-2014-Approved-Workplan1.pdf

The 2009 resolution has a provision that the EEAC and its agents could overrule decisions by individual PAs. However, the goal was to never need to use that authority, and to instead establish a collaborative framework. The EEAC and PAs set out trying to reach negotiated solutions to every issue and never in eight years have had to use that authority. Still, the underlying authority provides leverage. The resolution enabled this collaborative framework, which is a delicate balancing act, but ultimately yields trust and respect. This collaboration and overall framework have been important elements of success. It leads to an atmosphere of stability and deals with conflict of interest by having an outside party with authority to oversee the process.

TRM

In Massachusetts, the TRM is viewed as a mechanism for applying all impact evaluation study results. For each impact study, stakeholders assess how it will impact the TRM. While PAs administer and maintain the TRM, the EEAC and other stakeholders act as the reviewers. There is a clear process for updating it annually, and it is in the process of being moved online to serve as a technical resource library (TRL). The objective is to make the information more transparent and accessible.

Market effects

Massachusetts is also considered a leader on assessing market effects of energy efficiency. In some cases, the state has used empirically-driven net-to-gross ratios as a way to incorporate market effects. However, the market effects approach has been challenging for a state operating within a resource acquisition approach. Some of the challenges include collecting necessary data, such as program sales data and counterfactual data for comparison. Another challenge is that stakeholders usually do not think about doing a market effects study until the program is well-established. However, by then it is difficult to measure market effects. In this situation, it is necessary to examine market effects retrospectively and then make expert judgments to assess prospective market effects. A preferred approach is to establish evaluation studies prior to the implementation of programs that are expected to lead to market transformation. This prospective approach would identify programs with plausible market transformation theory, and conduct long-term, theory-driven evaluations from the outset of the programs.

Somewhat related to market effects, the state has been examining a top-down analysis of the aggregate effects of all programs on usage using a regression modelling approach. Initial top-down models are focused on isolating the net impacts of energy efficiency programs on electricity consumption in the residential sector. This type of approach, while complex, could ultimately be useful in calibrating the results of evaluation studies focused on individual programs, which may not fully reflect the program's contribution to market transformation.

Michigan

A few respondents mentioned Michigan as a noteworthy example of a pragmatic approach regarding EM&V in general and, in particular, for its approach to deemed savings. Michigan has focused its resources on increasing the accuracy and consistency of deemed savings values rather than net savings issues such as free-ridership and savings attribution. The state's mechanism, comparable to a technical reference manual, is called the Michigan Energy Measures Database (MEMD). It is updated and enhanced through an annual collaborative process with input from utilities, Michigan Public Service Commission (PSC) staff, the MEMD contractor, and other members of the Michigan Joint Energy Optimization Collaborative such as energy efficiency experts, equipment installers, and other public interest stakeholders.

An important feature of Michigan's EM&V approach is the use of a deemed net-to-gross ratio. This reduces uncertainty for utilities by eliminating the risk of a retroactive application of a different NTG

ratio from that assumed in program planning, and avoids the controversy and argumentation over attribution issues that has sometimes occurred in other jurisdictions. This feature adds to the reasons that utilities and other stakeholders pay significant attention to the accuracy and consistency of deemed savings measure values in the MEMD.

There are several advantages to this system. It is statewide, which provides consistency of measure savings values across utilities, programs, and contractors. It is updated annually through a collaborative that includes both utility and non-utility members, which builds consensus and buy-in among stakeholders. The savings values themselves are enhanced through calibration research on an ongoing basis. Originally when the system was established, many values were initially borrowed from other states and adapted to Michigan. Over time, more primary research, including evaluations as well as building modeling simulations, was done to refine and improve the accuracy of the database.

Another advantage is that the MEMD update process costs less than $100,000 per year, a relatively small part of overall spending on EM&V in Michigan, which is several million dollars per year.

Pilot programs are an important aspect of the MEMD update process. Michigan utilities can take up to 5% of their efficiency budget to spend on pilot programs. They then get credit for an equivalent percentage of their annual energy savings goal. Having such a strong incentive for utilities to run pilot programs creates a pipeline of measures that have been field-tested and may ultimately be added to the deemed savings database.

One aspect that could be considered a weakness of the MEMD is that it is based on average savings values for each measure as calibrated in a variety of building commercial and residential building types. That is, it is inherently a prescriptive set of statewide average values, rather than custom or by utility. While deemed savings values are applied using appropriate weather factors for different parts of the state (Northern Michigan has a much different climate), there is still some loss of precision.

The MEMD administrator has been working with the Commission and utilities to refine deemed values over time to take advantage of smart meter data and analytic capabilities for better data gathering and better billing analysis. More data and more sub-segments to sample yields higher quality savings numbers. In the past, to do this level of analysis would have required building sub-metering.

In addition to pointing out the state's approach to deemed savings, others highlighted efforts by DTE, which has been exploring and testing M&V 2.0 tools for the past few years (Kupser et al. 2016). Beginning in 2014, DTE conducted pilot tests comparing the effectiveness of custom econometric analysis and third-party software tools. M&V 2.0 results can be useful to utilities by providing real time information on program performance, improving customer targeting and program management, and resource planning. DTE used their Residential Heating, Ventilation, and Air Conditioning (HVAC) Program and a behavior program branded as DTE Insight (formally called Smart Phone Behavior Application, with and without real-time data add-on) for the study.

Although M&V 2.0 is not yet well established compared to traditional measurement and verification methods, DTE is continuing to do research on their air conditioning and behavior-based programs to learn what problems it can solve and what questions to ask. For example, how can emerging approaches and software tools be used to improve the accuracy of deemed savings values in the statewide database, or to test savings realization rates?

Connecticut

Many experts pointed to Connecticut as another leader, notably for embarking on a new 3-year pilot on commercial building M&V 2.0. The Connecticut Department of Energy and Environmental Protection (DEEP) is facilitating the pilot project in partnership with LBNL, Eversource, United Illuminating (UI), NEEP and the Department of Energy (DOE). DOE is providing financial support. The goal is to assess the value of M&V 2.0 approaches for understanding energy savings and as an evaluation tool, starting with commercial buildings. An additional goal is to analyze the savings estimates derived from the tool

compared to results from traditional engineering analyses. With data from the utilities, the project team is now trying to select buildings and measures to test the LBNL modeling tool. As of spring 2017, they are in the early stages of identifying specific projects.

Illinois

Illinois also received several mentions. The state has been holding a collaborative with various stakeholders to come together to write a new set of protocols around NTG ratios. Contractors had been coming up with different NTG ratios for the same programs due in part to different methods. This prompted the Illinois Commerce Commission (ICC) to form this group over last year and a half. In early 2017, the ICC hosted a workshop on M&V 2.0. Illinois has emerged as a good state to watch in their EM&V practices.

Conclusions

Looking to the future, the evaluation industry anticipates a changing landscape as energy efficiency as a utility resource gains increased attention, and the need for reliable, accurate and timely EM&V will be greater than ever. In addition, standard approaches to attribution will need to evolve, and there is an increasing need to examine market effects. Finally, there is the challenge of learning how to best take advantage of the increased data availability that AMI provides, and how to incorporate new and emerging analytical tools through M&V 2.0. State policy provides an important set of guidance that drives effective EM&V frameworks and practices, and it is helpful to look at leading and emerging states that are tackling these challenges and addressing them through policy. In addition to policy drivers, a transparent and collaborative approach will help stakeholders navigate the changing EM&V landscape.

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