Memorandum

TO: Clean Energy Solutions Inc., Virginia Energy Efficiency Council, and Virginia Department of Mines, Minerals and Energy

FROM: Alice Napoleon, Kenji Takahashi, Jennifer Kallay, and Tim Woolf

DATE: May 24, 2016

RE: Evaluation, Measurement, and Verification in Virginia

Synapse drafted this memo to respond to the questions on evaluation, measurement, and verification (EM&V) raised by the Virginia State Corporation Commission (SCC or Commission) in the March 30, 2016 order in Case PUE-2016-00022. This memo is organized into the following sections:

- Overview of Current EM&V Practices in Virginia
- Best Practices and Common Frameworks for EM&V
- Emerging EM&V Approach - EM&V 2.0
- Levelized Cost of Saved Energy

Overview of Current EM&V Practices in Virginia

For this memo, Synapse briefly researched and reviewed EM&V guidelines and practices for the largest investor-owned utilities in the Commonwealth, including Virginia Electric and Power Company d/b/a Dominion Virginia Power (DVP) and Appalachian Power Company (APCo).[1] In addition, Synapse sought information on EM&V practices of cooperative utilities and businesses who elect to "opt-out" of efficiency programming.[2] A summary of our findings is provided in the sections that follow.

Investor-Owned Utilities

DVP

Since 2010, DVP has implemented a range of demand-side management (DSM) programs.[3] For residential customers, these programs continue to provide services or other incentives for heat pump upgrades and tune ups, duct sealing, audits, appliance recycling, and air conditioning cycling. For non-

[1] Based on 2014 EIA 861 data on utility sales to ultimate customers.

[2] §56-585.1.A.5.c of the Code of Virginia.

[3] Virginia State Corporation Commission. 2015. *Report to the Commission on Electric Utility Regulation of the Virginia General Assembly*, Status Report: Implementation of the Virginia Electric Utility Regulation Act Pursuant to §56-596 B of the Code of Virginia.

residential customers, DVP's programs provide audits and financial incentives for duct sealing, lighting systems and controls, window film, and heating and cooling measures.[4] Per 2010 and 2012 Commission orders, DVP is required to provide a detailed EM&V report on its DSM programs on an annual basis.[5] DNV GL released an impact evaluation study of DVP's programs in 2015.[6] The 2015 DNV GL study reported gross and net savings,[7] gross participation, and expenditures (which were redacted in the public version), based on a variety of methods specific to each program (shown below). In the study, these actual values were compared with planned values. DNV GL conducts data quality review and deemed savings estimates on a monthly basis.[8] Oversight of the evaluation process was not addressed in the evaluation report. A summary of evaluation activities by program is provided in the table below.

Sector	Program(s)	Savings focus	Activities
Residential	Home Energy Check-Up Heat Pump Tune-Up	Energy	Billing analysis Participant satisfaction survey
Residential	Heat Pump Upgrade	Energy	Metering analysis Participant satisfaction survey
Residential	Duct Sealing	Energy	On-site blower door tests Participant satisfaction survey
Residential	AC Cycling	Demand	Analysis of event season
Non-Residential	Energy Audit Duct Sealing	Energy	On-site verification of tracking data Participant net-to-gross survey[9]
Non-Residential	Distributed Generation	Demand	Analysis of event season
All	All	Energy and demand	Review and assessment of program tracking data Updated EM&V plans

[4] Virginia Electric and Power Company. 2015. *Annual Report to the Division of Energy of the Virginia Department of Mines, Minerals and Energy*.

[5] Virginia State Corporation Commission. Order Approving Demand Side Management Programs, Case PUE-2009-00081, March 24, 2010; Order, Case PUE-2011-00093, April 30, 2012.

[6] DNV GL. 2015a. *Evaluation, Measurement, and Verification Report for Dominion Virginia Power*, Case PUE-2013-00072.

[7] Gross savings are "the change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated and unadjusted by any factors." Net savings are "the total change in load that is attributable to an energy efficiency program" which may take into account the effects of free drivers, free riders, energy efficiency standards, changes in the level of energy service, and other causes of changes in energy consumption or demand. (NEEP 2014. Model EM&V Methods: Standardized Reporting Forms for Energy Efficiency, Version 1.0.)

[8] DNV GL. 2015a, p. 3-19.

[9] A net-to-gross ratio equals net program savings divided by gross program savings (NEEP 2014). See footnote 7.

In the evaluation, DNV GL suggested that the results of its evaluation can be used for improvement of the programs, as well as in future Integrated Resource Plan (IRP) modeling.[10] The most recent IRP for DVP was filed with the Commission on April 29, 2016.[11] According to the SCC Order for Notice and Hearing, the IRP is based on the Company's current assumptions regarding load growth, demand-side management programs, and other factors.[12] Per SCC guidance, utilities are to provide overall assessment of existing and potential DSM options in their IRPs.[13]

DNV GL uses the Standard Tracking and Engineering Protocols (STEP) Manual Version 5.0.0 for estimation of deemed energy and demand reductions for tracking, monitoring, and reporting on DSM programs in Virginia and North Carolina. Under contract with Dominion, DNV GL developed the STEP Manual "using industry-standard approaches for estimating energy and demand reductions." This manual makes reference to Technical Resource Manuals (TRMs) issued by regulatory agencies in other states, primarily the Mid-Atlantic TRM version 2014 managed by the Northeast Energy Efficiency Partnerships (NEEP) for Maryland, Delaware, and the District of Columbia. In addition, the STEP manual refers to various other TRMs (from Connecticut, Maine, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, the Tennessee Valley Authority, and Vermont) and other engineering resources such as the American Society of Heating, Refrigeration & Air Conditioner Engineers (ASHRAE) and the 2012 International Energy Conservation Code.[14] The STEP manual calculates energy savings at the level of the customer meter.[15]

DNV GL also performed a potential study for DVP released in 2015, which likewise used the STEP manual for savings estimates.[16]

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[10] DNV GL. 2015a, page 1-9.

[11] Dominion. 2016. Dominion Virginia Power's and Dominion North Carolina Power's Report of Its Integrated Resource Plan, Case No. PUE-2016-00049, filed on April 29, 2016. https://www.dom.com/library/domcom/pdfs/electric-generation/2016-irp.pdf?la=en.

[12] Virginia State Corporation Commission. Order for Notice and Hearing in Case No. PUE-2016-00049. May 12, 2016. http://www.scc.virginia.gov/docketsearch/DOCS/38%25_01!.PDF.

[13] Virginia State Corporation Commission. *Integrated Resource Planning Guidelines*, p. 8. http://www.scc.virginia.gov/pue/docs/irp.pdf.

[14] DNV GL. 2015a. Appendix E: *Standard Tracking and Engineering Protocols Manual*.

[15] Ibid. p. 1-8.

[16] DNV GL. 2015b. *Dominion Energy Efficiency Potential Study: Dominion Virginia Power*. P. 78.

APCo

In the order approving APCo's current suite of energy efficiency programs, the Commission required annual filing of EM&V reports.[17] In April 2016, APCo filed reports compiled by its evaluation contractor, ADM Associates, Inc., with assistance from Johnson Consulting Group.[18]

Two of APCo's programs, the Residential Low Income Weatherization Program (RLIWP) and Peak Reduction Program (PRP), have been in operation for more than a year. For these programs, the April 2016 reports provided impact and process evaluation methodologies and results. These reports included comparisons between realized values and expected values but did not provide net savings, as it was assumed that both programs have no free ridership. The study authors used the Mid-Atlantic TRM for the food bank lighting component of the RLIWP (which provides CFL bulbs to local food banks for distribution to APCo customers for no cost), while for the weatherization component of the RLIWP they drew on the Weatherization Assistant National Energy Audit Tool software, also used by providers of the U.S. Department of Energy's Weatherization Assistance Program.[19] For estimating savings from the PRP, Pennsylvania residential air conditioning data are used.[20] The reports do not indicate whether savings are estimated at the generator or at the customer meter.

Most of APCo's programs, including the Appliance Recycling, Efficient Products, Home Performance, Manufactured Housing, and Commercial and Industrial programs, have only been in operation since early 2016. The April 2016 reports included "launch reports" with early feedback on these programs and their initial operations, as well as planned methodology for future EM&V efforts. For assessing program impacts, the authors primarily proposed to use the Mid-Atlantic TRM Version 5.0 wherever possible, to be supplemented with other resources as needed. Surveys were proposed to verify measure installation or recycling of old products, measure customer satisfaction, and assess program attribution (i.e. net-to-gross). Methodologies for estimating net-to-gross ratios were provided, suggesting that future reports will provide both net and gross savings estimates.

Per SCC guidance, utilities are to provide overall assessment of existing and potential DSM options in their IRPs.[21] The most recent IRP for APCo was filed with the Commission on April 29, 2016.[22] According to the SCC Order for Notice and Hearing, the IRP is based on the Company's current assumptions

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[17] Virginia State Corporation Commission. Final Order in Case No. PUE-2014-00039. June 24, 2015.

[18] American Electric Power. April 29, 2016 filing in Case No. PUE-2014-00039.

[19] ADM Associates, Inc. and Johnson Consulting Group. 2016. *Evaluation of Residential Low Income Weatherization Program*.

[20] ADM Associates, Inc. and Johnson Consulting Group. 2016. *Evaluation of Residential Peak reduction Program*.

[21] Virginia State Corporation Commission. *Integrated Resource Planning Guidelines*, p. 8. http://www.scc.virginia.gov/pue/docs/irp.pdf.

[22] Appalachian Power. 2016. Integrated Resource Planning Report to the Commonwealth of Virginia State Corporation Commission Case No. PUE-2016-00050, filed on April 29, 2016. http://www.scc.virginia.gov/docketsearch#caseDocs/135883.

regarding customer load requirements, demand-side management program costs and analysis, and the effect of environmental rules and guidelines, among other things.[23]

Cooperative Electric Utilities

Cooperative electric utilities have limited energy efficiency programming. Starting in 2011, several of the electric cooperatives implemented load management programs that provide incentives to customers who retain load-cycling switches on their central air conditioning systems.[24] Rappahannock Electric Cooperative also offers free energy assessments and energy-efficiency measure rebates to high-use residential members.[25] However, we were unable to find documentation of EM&V on the programs offered by the cooperative utilities.

Opt-out Electors

Per statute, a general service customer with historical peak demand in excess of 500 kW is allowed to provide a notice of non-participation in order to avoid its electric utility's energy efficiency charges ("opt-out"). Customers who have opted-out must implement energy efficiency that has produced or will produce "measured and verified results consistent with industry standards" at their own expense. The Commission may take steps to verify that these customers have achieved energy efficiency, but only if it possesses evidence that the customer knowingly misrepresented energy efficiency achievements.[26] Pursuant to the rules on opt-out, non-participating customers must provide the utility with a measurement and verification plan.[27] Furthermore, non-participants are required to provide the Division of Energy Regulation with annual reports on their energy efficiency savings, for as long as the exemption is sought.[28]

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[23] Virginia State Corporation Commission. Order for Notice and Hearing in Case No. PUE-2016-00050. May 12, 2016. http://www.scc.virginia.gov/docketsearch/DOCS/38%25p01!.PDF.

[24] Virginia State Corporation Commission. 2015. *Report to the Commission on Electric Utility Regulation of the Virginia General Assembly*, Status Report: Implementation of the Virginia Electric Utility Regulation Act Pursuant to §56-596 B of the Code of Virginia.

[25] Cadmus. 2014. *Multi-State Residential Retrofit Project Process Evaluation: Final*. P. 107.

[26] 56-585.1.A.5.c of the Code of Virginia.

[27] Such a plan must conform to "methods accepted for use by utilities and industries to measure, verify, and validate energy savings and peak demand savings. This may include the protocol established by the United States Department of Energy, Office of Federal Energy Management Programs, Measurement and Verification Guidance for Federal Energy Projects, measurement and verification standards developed by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), or engineering-based estimates of energy and demand savings associated with specific energy efficiency measures, as determined by the Commission." (§56-576 of the Code of Virginia).

[28] Chapter 316: Rules Governing Exemptions for Large General Services Customers Under §56-585.1 A 5 c of the Code of Virginia. Available at https://www.dom.com/library/domcom/pdfs/virginia-power/scc-rules-lgs-cust-a5-rider.pdf.

Best Practices and Common Frameworks for EM&V

This section discusses common approaches to EM&V, including use of deemed savings values, large scale consumption analysis, and project-specific M&V. This section also describes best practices and recommendations for developing and updating common EM&V frameworks. Common frameworks and protocols allow consistency, transparency, and stream-lined processes, and should be adopted or developed across all areas discussed below. For example, DOE's Uniform Methods Project (UMP) for project-specific M&V approaches provides useful guidelines for program administrators and M&V practitioners. This resource is detailed in the M&V Approach section below.

Uniform M&V Protocol

Deemed Savings

According to the State Energy Efficiency Action Network (SEE Action Network),[29] "[d]eemed savings values, also called stipulated savings values, are estimates of energy or demand savings for a single unit of an installed energy efficiency measure that (1) has been developed from data sources (such as prior metering studies) and analytical methods that are widely considered acceptable for the measure and purpose, and (2) is applicable to the situation being evaluated."[30] A variant of deemed savings values is deemed savings calculations where a stipulated set of engineering algorithms are used to calculate energy savings. This deemed savings approach is one of the most common approaches to evaluate energy savings for ratepayer-funded energy efficiency programs. According to a 2012 report by SEE Action, 36 states rely on some type of deemed savings in the evaluation framework.

Deemed savings and deemed savings calculations are usually documented in a TRM, which can take different formats depending on jurisdiction and range from reports and spreadsheets to online searchable databases. It can also include impact factors to be applied to calculated savings (e.g., net-to-gross ratio values), documentation of the sources of savings values and calculations, and other relevant material to support the calculation of measure and program savings.[31] The intent of a TRM is to provide stakeholders with a single, transparent source of savings values and source data for all program administrators in the jurisdiction. Thus, the document should include all measures, whether implemented by all program administrators or unique to one program administrator. While many jurisdictions use values, methods, and sources developed in other jurisdictions, it is expected that such "borrowed" deemed values be updated based on each jurisdiction's own evaluation study results. Although it is unclear how regularly and thoroughly states update their TRMs, a 2012 ACEEE report

[29] The State and Local Energy Efficiency Action Network (SEE Action) is a state- and local-led effort facilitated by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) to take energy efficiency to scale and achieve all cost-effective energy efficiency by 2020. SEE Action offers knowledge resources and technical assistance to state and local decision makers as they seek to advance energy efficiency policies and programs in their jurisdictions.

[30] SEE Action Network. 2012. *Energy Efficiency Program Impact Evaluation Guide.* Prepared by Steven R. Schiller Consulting, Inc. Available at www.seeaction.energy.gov, p. 4-7.

[31] SEE Action Network. 2012, p. 4-8.

found that most U.S. states with TRMs (28 states out of 35 states) generally modify and update deemed values over time.[32]

The deemed savings approach is a relatively easy and inexpensive way to estimate savings from energy efficiency measures.[33] If properly used, this approach "can be very useful for program planning purposes and can reduce M&V costs, create certainty, and simplify evaluation procedures."[34] However, this approach always runs the risk of producing results that are irrelevant, obsolete, or not useful. This is largely because deemed values are based on various factors (e.g., wattage savings, efficiency ratings, operating hours, measure life), assuming average consumption and typical conditions. Thus, there is a risk that some of these factors are not appropriate for the measure(s) or program(s) to which they are applied, unless these factors were recently examined in evaluation studies that are relevant to the jurisdiction. Also, even if evaluated values are used, they become outdated over time. Further, when key variables are borrowed from another state, there is a possibility that conditions underlying the variable (such as operating hours of equipment) are not adjusted to conditions in the borrowing state. An additional issue is that average savings values can vary widely from actual metered savings.[35]

To avoid these pitfalls, entities responsible for developing and updating a TRM (e.g., TRM managers and stakeholders) need to ensure (a) that deemed savings data in a TRM are based on reliable, traceable, and documented sources of information and (b) the assumptions that went into determining a value are applicable to the situation (e.g., measures, measure delivery mechanism, facility types) being evaluated.[36] A TRM is only as good as its source data, and should be coupled with an EM&V plan. EM&V plans should correspond to and complement the TRM, addressing any gaps identified through the TRM development process. States need to ensure that a TRM be a flexible and living document that is updated periodically (e.g., annually) based on best available information and reviews by stakeholders and energy efficiency experts. For this to happen, it is important to develop a formal process to update the TRM and to establish the roles of different parties.

An example of the TRM update process from NEEP's Mid-Atlantic TRM is presented below. The figure shows at least one round of feedback from the program administrators, independent reviewers, and other stakeholders. To address any disagreement on proposed changes, it is also beneficial to establish a Technical Advisory Group (TAG) to provide a more formal venue for resolution of technical disputes prior to submission to the regulators.[37]

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[32] ACEEE. 2012. *A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs*.

[33] ACEEE. 2015. *How Information and Communications Technologies Will Change the Evaluation, Measurement, and Verification of Energy Efficiency Programs*, P. 9.

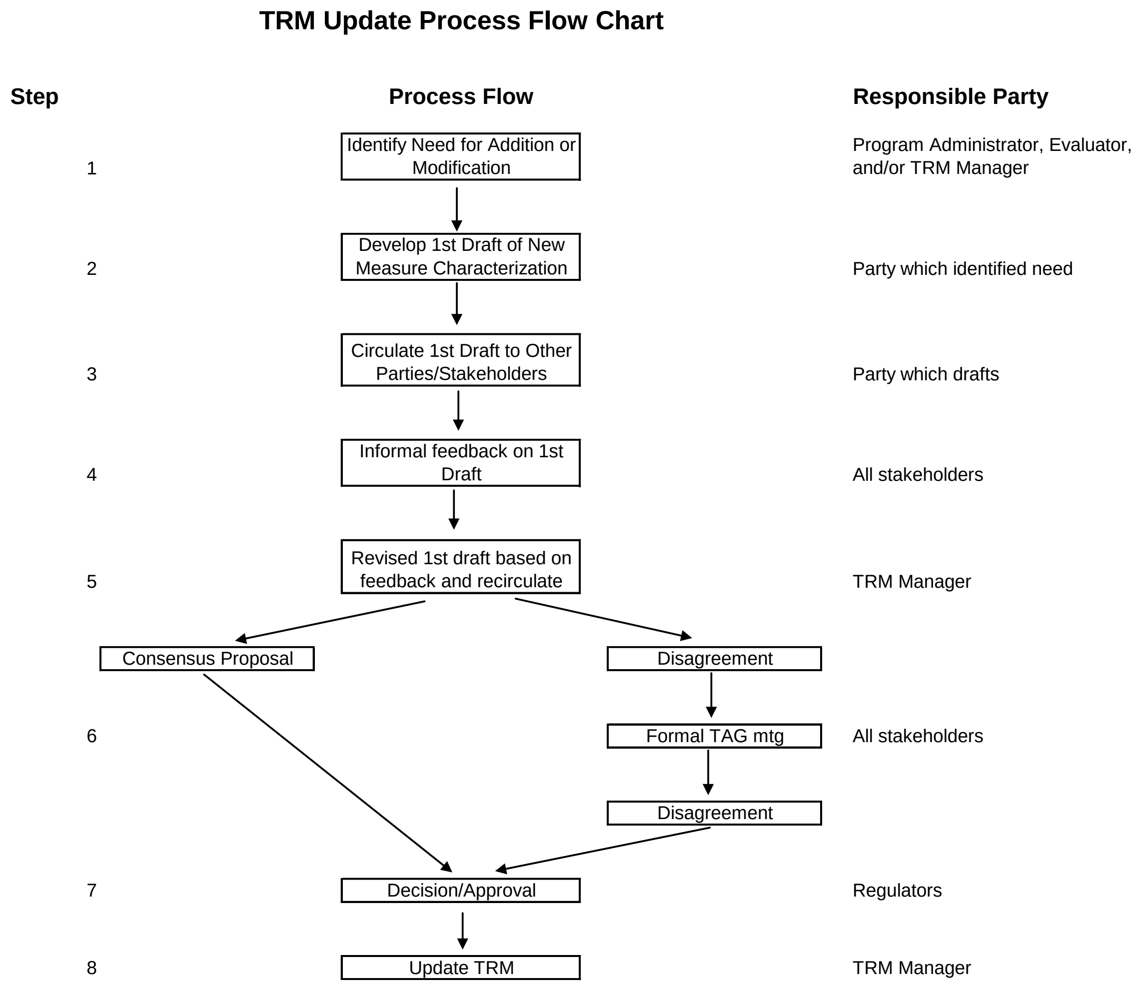
[34] SEE Action Network. 2012, p. 4-9.

[35] EnergySavvy. 2015a. *Transforming Energy Efficiency through Modern Measurement*.

[36] SEE Action Network. 2012, p. 4-8.

[37] NEEP 2016. *Mid-Atlantic Technical Reference Manual*, Appendix B.

Figure 1. Technical Reference Manual update process



Source: NEEP 2016 Mid-Atlantic Technical Reference Manual

Another key to an effective TRM update is establishing an independent entity that is responsible for managing the TRM update process. The TRM manager should identify the need for modifications to the TRM, propose updates, lead the stakeholder feedback process, and assist in the development of final recommendations to the regulators. Alternatively, if the TRM is managed by program administrators, an independent entity should have the role of (a) reviewing and (b) either agreeing with proposed additions or challenging such changes—with the regulators having final say regarding any disputes.[38]

Arkansas provides a good example of a well-managed TRM process with its highly effective stakeholder group/process called the Parties Working Collaboratively (PWC), established in 2006. One of the primary tasks of this PWC is to update a TRM with a jointly funded independent entity called the Independent

[38] NEEP 2016. Appendix B, p. 497.

Evaluation Monitor (IEM).[39] Arkansas also has a TRM update process very similar to the Mid-Atlantic TRM. Since the development of the first TRM in 2011, Arkansas has updated its TRM every year by following the established TRM process. For more discussion of energy efficiency collaboratives see page 13.

Our review of deemed savings/TRM approaches in Virginia (presented in the first section of this memo) revealed that Virginia is using a patch-work approach, in which every utility uses slightly different methods and sources. There is also no independent entity or expert that oversees utilities' evaluation study design and results. Further, there are no common evaluation protocols, e.g. for deemed savings. While it is likely that evaluation vendors such as DNV GL are doing decent evaluation work, and two of the utilities are using the same resource for some deemed values—the Mid-Atlantic TRM—there is no stakeholder process to vet any of these work products and determine whether the selected approaches and assumptions are appropriate for the Commonwealth of Virginia and the specific programs and measures being considered.

Large-Scale Consumption Data Analysis

Large-scale consumption data analyses are conducted for programs that have many participants sharing common characteristics, such as single-family detached homes in a particular community with residents of similar economic demographics.[40] This approach is often used for evaluating behavior programs with peer comparison feedback mechanisms. This type of analysis can take two different approaches: (1) a randomized controlled trials approach or (2) a quasi-experimental approach where the control group is not randomly assigned. The most common quasi-experimental method is a pre-post method in which energy consumption of the treatment group after enrollment in the program is compared with the same sites' historical energy consumption before program enrollment.[41] SEE Action recommends the randomized controlled trials approach over the quasi-experimental approach because randomized controlled trials will result in robust, unbiased estimates of program energy savings; however, SEE Action suggests using the quasi-experimental approach when the randomized controlled trials approach is not feasible.[42]

M&V Approach

The project-specific Measurement and Verification (M&V) approach is used for various types of programs. These programs involve relatively complex retrofits or new construction projects that are subject to more variation in savings than the type of projects or measures suitable for deemed savings or large-scale consumption analyses. It is generally applied to only a sample of projects in a program or

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[39] Johnson, K. and M. Klucher. 2014. "All Together Now! How Collaboration Works in Arkansas," proceedings of the 2014 International Energy Policy & Programme Evaluation Conference in Berlin.

[40] SEE Action Network. 2012, p. 4-13

[41] SEE Action Network. 2012, p. 4-10

[42] SEE Action Network. 2012, p. 7-24

when project-level savings are needed.[43] This approach uses one or more methods that can involve measurement, engineering calculations, billing regression analyses, and/or computer simulation modeling. These different methods are described in the International Performance Measurement and Verification Protocols (IPMVP). The verification part of the M&V typically accompanies field activities dedicated to collecting site information, including equipment counts, observations of field conditions, building occupant or operator interviews, measurements of parameters, and metering and monitoring.[44]

While the M&V approach largely relies on the IPMVP, actual applications of the IPMVP are likely to differ by jurisdiction, utility, or evaluation practitioner. Coupled with the trend of increasing investment in energy efficiency and greater reliance on energy efficiency as a means of meeting future energy resource requirements, there is a growing demand for publicly available, national M&V protocols that describe how energy savings are determined and reported.[45] In response, the U.S. Department of Energy (DOE) initiated the Uniform Methods Project (UMP), a collaborative effort to develop national M&V protocols for commonly implemented program measures.

The goal of the UMP is to help reduce the uncertainty associated with determining energy efficiency savings, and offer guidance for implementing the techniques and interpreting results. More specifically, DOE has the following goals for UMP:

- Offer guidelines that help strengthen the credibility of energy efficiency program savings calculations
- Provide clear, accessible, step-by-step protocols to determine savings for the most common energy efficiency measures
- Support consistency and transparency in how savings are calculated
- Reduce the development and management costs of EM&V for energy efficiency programs offered by public utility commissions, utilities, and program administrators
- Allow for comparison of savings across similar efficiency programs and measures in different jurisdictions
- Increase the acceptance of reported energy savings by financial and regulatory communities[46]

[43] SEE Action Network. 2012, p. 4-12

[44] Ibid.

[45] Haeri, H. 2015. *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*. Prepared for the National Renewable Energy Laboratory (NREL), p. 3.

[46] Haeri, H. 2015, p. 3.

To achieve these goals, the UMP documents aim to establish easy-to-follow protocols based on commonly accepted engineering and statistical methods (e.g., IPMVP) for determining gross savings for a core set of commonly deployed energy efficiency measures. The protocols also include:

A description of measure and application conditions

An algorithm for estimating savings

An example of a typical program offering and alternative delivery strategies

Considerations for the measurement and verification process, including an IPMVP option

Data requirements for verification and recommended data collection methods

Recommended program evaluation elements

Alternatives for lower-cost EM&V approaches

Currently, UMP protocols are available for several residential and commercial projects or programs.[47]

Recommendations

Virginia should develop a statewide TRM. To this end, the Commission should:

- Develop a process to develop and update a statewide TRM that all utilities in Virginia can use, and pair it with an EM&V plan;
- Develop and regularly update a statewide TRM using a thorough stakeholder process;
- Establish an independent entity that will manage the TRM update process; and
- Consider coordination with the Mid-Atlantic TRM efforts.

For programs that call for large-scale consumption analysis and project-specific M&V, the Commission should provide guidelines consistent with the best practices described in the 2012 SEE Action Network report *Energy Efficiency Program Impact Evaluation Guide.* Where applicable, the Commission should adopt DOE's UMP protocols.

These recommendations apply to electric utilities, as well as to cooperatives. Further, the SCC should consider whether adherence to common EM&V protocols should be a condition of exemption from energy efficiency charges under § 56-585.1A.5.C of the Code of Virginia.

[47] U.S. DOE. "Uniform Methods Project: Determining Energy Efficiency Savings for Specific Measures." Available at http://energy.gov/eere/about-us/ump-protocols.

Evaluation planning and process

Evaluation oversight

Transparency, independence, and proper oversight by regulators are necessary for selecting evaluation vendors, and for reviewing and applying study results. This will ensure that study results are unbiased and robust. Responsibility for the selection and management of evaluation contractors can be placed with regulators alone, or it can be shared between regulators and program administrators. As an example of the joint management approach, a group of expert consultants working for the Massachusetts Energy Efficiency Advisory Council (EEAC) work corroboratively with program administrators to hire contractors, plan and implement the evaluations, and determine how results are applied to energy savings, incentive payments, and future program assumptions.[48] As discussed above, the need for independent oversight also applies to the updating process of a TRM.

Timing of Evaluation Studies

Program evaluation timeframes are often determined by the funding and contracting schedules for a program portfolio cycle (e.g., 1–3 years). The best time to plan for evaluations is in the program design stage, the reason being that the program budget, schedule, and resources can properly take into account evaluation requirements and opportunities. In addition, when evaluation is an integral part of the program portfolio process, evaluation can enhance the portfolio's success through a timely assessment of actual program savings impacts. This type of integral assessment can also provide a useful comparison to gauge the success of the program's approach to achieving savings and reinforce the pivotal role that evaluation plays in energy efficiency planning. Finally, early consideration of the evaluation process—prior to program implementation—helps ensure that the necessary data will start to be collected once implementation begins.[49]

According to the SEE Action Network, there are various crucial evaluation activities that should start prior to, and continue during, program implementation. These activities are presented in Figure 2 below along with the four program implementation activities: (1) program goal setting, (2) program design, (3) program launch, and (4) evaluation activity. Evaluation activities required prior to program launch include setting evaluation goals, budgets, schedule and reporting expectations, and preparing preliminary evaluation plans.

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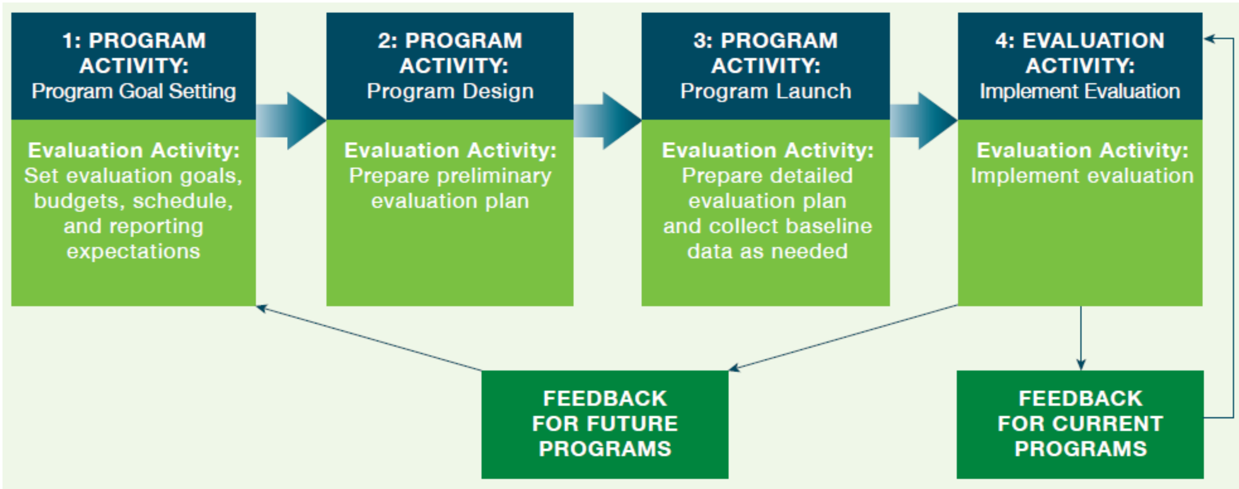
[48] Energy Futures Group, Cx Associates, and Wirtshafter Associates. 2016. Review of Efficiency Maine Trust's 2017 – 2019 Third Triennial Plan, p. 55

[49] SEE Action Network. 2012, Figure 8.1, p. 8–1.

Figure 2. Program implementation cycle with high-level evaluation activities



Source: Reproduced from State and Local Energy Efficiency Action Network. 2012. Energy Efficiency Program Impact Evaluation Guide, Figure 8.1, prepared by Steven R. Schiller.

SEE Action recommends that evaluation activities be carried out and results be produced in a timely manner as follows:

> Evaluations should be produced within a portfolio cycle or very soon after the completion of a cycle. This is so evaluation results can document the operations and effects of the programs in a timely manner and provide feedback for ongoing program improvement, provide information to support energy efficiency portfolio assessments (including market assessments and potential studies), and help support the planning of future portfolio cycles, load forecasts, and energy resource plans.[50]

Although the SCC's requirement that DVP and APCo file annual EM&V reports probably indicates that some EM&V planning is happening at the early stages of program design and implementation, it is unclear what is actually being done, and when. Virginia should require its electric utilities to document this process, and encourage cooperatives to provide such documentation as well.

Collaborative Process on EM&V Framework and TRM

Collaboratives and other stakeholder groups (such as advisory councils and boards) have proven effective for gathering stakeholder input and feedback, and for implementing successful energy efficiency programs. Some collaboratives are tasked with developing evaluation-related guidance and supporting materials, including development of a TRM or specific EM&V protocols.[51] In doing so, the

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[50] SEE Action Network. 2012, p. 8-1.

[51] SEE Action Network. 2015. *Energy Efficiency Collaboratives: Driving Ratepayer-Funded Efficiency through Regulatory Policies Working Group*. Available at https://www4.eere.energy.gov/seeaction/publication/energy-efficiency-collaboratives.

collaboratives serve to provide consistency among jurisdiction-wide efficiency EM&V by bringing all program administrators and interested parties together at one table. There are a few overarching principles to observe when establishing a collaborative.[52]

- **Clear objective.** The objective should clarify the duration of the collaborative (i.e., short or long term) and scope (e.g., evaluation planning, development of M&V protocols).
- **Ground rules.** Processes should be clear and transparent. Members should work towards consensus but there should also be a clearly defined process to resolve disputes. Meetings and meeting materials should be freely accessible to the public. Technical reference manuals and other technical EM&V material should be written as to be transparent and understandable by a broad audience.
- **Evaluation of efforts.** A periodic assessment of the collaborative helps to validate its continuation, refine its mission and operating practices, and assess its progress toward objectives.
- **Strong, experienced facilitator**. An experienced, independent facilitator can ensure all attendees have a chance to express their views.
- **Influence with commission.** A collaborative is most useful if the commission gives weight to the findings and conclusions of the collaborative.
- **Membership.** Participants should:
    - represent a range of stakeholders (energy office and utility commission staff, program administrators, EM&V technical consultants, consumer groups/advocates and environmental stakeholders),
    - have expertise in EM&V issues and methodologies,
    - be consistently engaged over a period of time,
    - be representative of a group of customers (rather than just one entity), and
    - have the ability to intervene in the proceeding if consensus is not reached.[53]

Several states have used collaboratives to develop statewide EM&V materials, including Arkansas, Illinois and California. Also, South Carolina Electric & Gas Company (SCE&G) has a board to advise them on EM&V matters.[54]

When it started in 2006, the first tasks assigned the collaborative in Arkansas, referred to as the Parties Working Collaboratively (PWC), were related to EM&V. To date, the collaborative has developed

[52] SEE Action Network. 2015.

[53] Based on a discussion at a Rhode Island Energy Efficiency Collaborative meeting on January 14, 2016. The Collaborative is a subcommittee of the Energy Efficiency and Resource Management Council (EERMC).

[54] SEE Action Network. 2015.

Technical Reference Manuals, EM&V Protocols, and net-to-gross savings adjustments. Since 2013, the PWC role has expanded beyond EM&V issues to provide on broader energy policy issues.

The PWC is composed of 20 different organization and entities, including the seven utilities, Commission staff, the Attorney General and its expert consultants, the State Energy Office, EM&V contractors, program implementers, expert consultants, the industrial customer group, commercial customer representatives, community action agencies with its expert consultants, low-income advocates, and colleges and technical schools. The collaborative is facilitated by an Independent Evaluation Monitor. The PWC debates and resolve issues in working group-style meetings that occur outside of a formal commission proceeding. In this more casual setting, stakeholders can exchange information and debate freely with one another, be more transparent about their positions, and let their positions evolve over the course of the working group process. The group is encouraged to reach consensus, and when it does a group settlement or position paper can replace briefs filed by each party in a docket. An important aspect of the PWC is that consensus is not required. There is a process for dispute resolution in which minority parties may petition the Commission directly to appeal any majority decision.[55]

The Illinois Energy Efficiency Stakeholder Advisory Group (SAG) has met monthly since it was formed in 2008. The SAG is tasked with helping program administrators modify and improve energy efficiency programs to achieve their energy efficiency and demand response goals. SAG EM&V responsibilities include developing the TRM and TRM Policy Document and resolving any other EM&V issues.

South Carolina Electric & Gas Company (SCE&G) has a utility-specific advisory group established by Commission order. Among other things, the group is tasked with reviewing and improving SCE&G's EM&V plans.

Evaluation Process Recommendations

The Commission should establish procedures for independent oversight of evaluation and require its electric utilities to document the evaluation process. Further, the SCC should develop guidance on the timing of evaluation studies. An inclusive collaborative process should be established following the principles laid out above. Membership should include a range of stakeholders, including representation by the Virginia Energy Efficiency Council; the SCC; the Department of Mines, Minerals and Energy; program administrators, including investor-owned utilities and cooperatives; and EM&V technical consultants. Invitations should be extended to the Attorney General's Office, environmental stakeholders in the energy efficiency proceedings (e.g., Chesapeake Climate Action Network and Appalachian Voices) and consumer groups (e.g. the Virginia Committee for Fair Utility Rates).

Reporting of EM&V Study Results

Consistent EM&V reporting has a multitude of benefits. It allows for more meaningful comparisons with other utility energy efficiency programs within and across jurisdictions, in order to identify best practices and improve program performance. It increases transparency and supports more informed participation

[55] Johnson, K. and M. Klucher. 2014.

and feedback by stakeholders in resource planning decisions. It allows results to be aggregated in order to inform state, regional, and national policy impacts, system planning, and forecasting. It can help support the claim of savings for air quality plans.[56] Further, it can help to streamline EM&V efforts.

A common framework for reporting EM&V methods, assumptions, and results can help Virginia realize these benefits. A number of reporting guidelines are currently available or are under development. As an example, the NEEP standardized reporting forms were developed by the Cadmus Group in consultation with the representatives of the states of Connecticut, Delaware, Massachusetts, Maryland, New Hampshire, New York, Rhode Island, and Vermont, as well as DOE and the U.S. Environmental Protection Agency (EPA).[57] While some modifications to the current version NEEP EM&V reporting forms are needed to fully align them with EPA's proposed EM&V reporting requirements, new versions of the forms are anticipated in 2016.[58] The NEEP forms have the advantage of being supported by a number of Virginia's neighboring states. Furthermore, the NEEP forms will likely be incorporated into or consistent with the National Energy Efficiency Registry.

We recommend that the Virginia SCC adopt a transparent reporting framework, such as the new version of the NEEP reporting forms, and require EM&V contractors to use them.

Emerging EM&V Approach - EM&V 2.0

Review of Literature

New information and communications technologies (ICT) are changing the way energy efficiency program administrators implement their programs and conduct EM&V on their efficiency measures, projects, and programs. Examples of relevant ICT include, but are not limited to, smart meters, smart thermostats and devices, and non-intrusive load metering (NILM) devices.[59] These technologies extract granular energy consumption data in different ways in a timely manner, and allow new data analytics software to store, track, and analyze the data in near real time using cloud-based software. This capability allows program administrators to implement automated M&V, which takes advantage of automated data processing to produce building energy profiles, estimate savings potential, or estimate whole-building energy savings in near real time.[60] This new approach for evaluating measures, projects, and programs based on emerging ICT is called EM&V 2.0.

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[56] Wallace, P. *The Value of Consistent, Transparent Energy Efficiency Reporting Across the Country: Current and Future Uses*. Northeast Energy Efficiency Partnerships. (Undated) Available at http://www.neep.org/sites/default/files/resources/SEE%20Action%20REED-Methods%20Presentation.pdf.

[57] Available at http://www.neep.org/initiatives/emv-forum/model-emv-methods-standardized-reporting-forms

[58] Wallace (Undated).

[59] Details of these ICTs are described in: DNV GL 2015, *The Changing EM&V Paradigm*; and, ACEEE 2015, *How Information and Communications Technologies Will Change the Evaluation, Measurement, and Verification of Energy Efficiency Programs*.

[60] DNV GL. 2015c. The Changing EM&V Paradigm – A Review of Key Trends and New Industry Developments, and Their Implications on Current and Future EM&V Practices, p. 34.

The way EM&V 2.0 estimates savings has similarity to traditional billing analysis. Billing analysis uses an adjusted baseline, modeled using actual metered consumption data in the pre-program period, to estimate what future building energy use would be absent the energy efficiency measure. The advantage of EM&V 2.0 over traditional methods such as billing analysis is that EM&V 2.0 estimates data in real time without needing a site visit. Thus, it can more easily develop baseline consumption and estimate savings in numerous buildings in near real time.

There are a number of potential benefits for EM&V 2.0 approaches:

Potential cost reduction: EM&V 2.0 can potentially cut costs associated with M&V practices in several different ways:

(a) Traditional M&V approaches involve site visits to verify installations and measure consumption or other operational parameters. EM&V 2.0 can reduce the need for these onsite visits and measurement by implementers and evaluators.[61] EM&V 2.0 is more difficult for complex buildings and industrial facilities, and for certain projects that are likely to have new baselines (e.g., new construction, natural replacement, and early replacement).[62] While EM&V 2.0 is not likely to eliminate the need for onsite measurement and analysis for complex premises—such as a large industrial facility with unique processes and operating patterns—combining smart meter data with additional information from a customer's energy management system will enable much more sophisticated modeling of heterogeneous building baselines and widen the field of prospects for business sector energy efficiency.[63]

(b) EM&V 2.0 can be scaled quickly and easily. It can also evaluate more projects and more programs with marginal incremental cost.[64] Further, the value of additional data is not likely to decrease with EM&V 2.0 as the more timely data available for analysis, the more accurate the analysis is likely to be.[65]

Improvements to TRM: EM&V 2.0 tools can collect more accurate and granular energy data in a timely manner. The results of EM&V 2.0 can be used to refine, calibrate, and assess the accuracy of deemed savings values in a TRM.[66]

Net to gross calculations: Given the large volume of data that could be obtained through automated M&V, evaluators can develop statistical models to detect naturally occurring trends that affect energy

[61] ACEEE. 2015. p. vi, p. 27.

[62] DNV GL. 2015c, p. 34, p. 37.

[63] ACEEE. 2015, p, 26.

[64] ACEEE. 2015, p. 29.

[65] ACEEE. 2015, p. 28; EnergySavvy 2015a, p. 8.

[66] EnergySavvy. 2015b. Comments of EnergySavvy to the EPA on the EM&V Provisions in the Proposed Model Trading Rule and Draft EM&V Guidance for the Clean Power Plan.

consumption both in the treated group and in an untreated group (or a comparison group). They can then estimate net energy savings adjusted for the naturally occurring trends.[67]

Market assessment and program delivery: Virtual audits, remote audits, and virtual assessment—subsets of automated M&V/EM&V2.0 functionality—can identify and engage potential customers as they assess investments in energy conservation measures or are pursuing maintenance and operational changes to improve energy efficiency. These remote assessments of potential customers allow program administrators to use customer-specific data in targeted marketing and customer engagement campaigns. Examples of this application would be to engage the largest potential energy savers or potential savers in highly specific geographical areas (geo-targeting) to reduce loads on constrained distribution grids. Con Edison has a geo-targeting program that adopted the latter approach.[68]

Process evaluation: EM&V 2.0 provides deep, granular insights that empower utilities to optimize the program through the year and address issues prior to the start of the next program year.[69] For example, if measured savings are not as expected, utilities and implementers can try to identify why measures are not performing as predicted. They can then attempt to fix them on the fly or come up with further measures to meet the target.[70] Some examples of factors influencing project performance include an individual measure, specific contractor, zip code, or building type.[71]

Program planning: As EM&V 2.0 can provide a prediction of the expected end-of-year savings data, utilities can know whether their programs are on track to meet annual goals.[72] Further, this ongoing learning of energy savings performance and targeted market assessment discussed above will allow utilities to improve their program designs for the new program year.

While EM&V 2.0 could provide these benefits discussed above, it also faces a number of potential limitations or challenges. Two of these challenges are discussed above: (a) EM&V 2.0 is difficult to apply to certain projects with new baselines that are different from the existing baseline; and (b) it is more difficult to apply to complex buildings with heterogeneous energy profiles. Some of the additional limitations and challenges include: (c) additional costs for collecting, storing, and validating a much

[67] EnergySavvy. 2015a, p. 8; ACEEE 2015, p. 28.

[68] DNV GL. 2015c, p. 39.

[69] EnergySavvy. 2015a. p. 10.

[70] ACEEE. 2015, p. 27.

[71] EnergySavvy. 2015a. p. 10.

[72] EnergySavvy. 2015a. p. 9.

larger amount of energy consumption data;[73] (d) transparency and standardization of automated M&V protocols;[74] (e) data ownership, access, privacy, and security.[75]

To date, many utilities and program administrators have launched pilot programs to test the data analytics of EM&V 2.0 services with a focus on identifying and engaging program participants, and providing rapid and continuous feedback to customers on the changes in energy consumption.[76] One interesting example is the "On Ramp Pilot" project conducted by the Maryland Energy Administration (MEA) on behalf of PEPCO. This pilot used Retroficiency's data analytics software called "Virtual Energy Assessment" (VEA) which uses meter data to disaggregate end uses to identify candidate buildings and systems for efficiency improvements. The pilot focused only on energy savings measures related to operational improvements and provided both remote and on-site assessments to three Montgomery Country Maryland schools.[77,78]

The pilot began analyzing energy data using VEA for eight schools and identified three schools with the best no-cost operational improvement opportunities. The selected schools were further assessed through phone conversations with building management and on-site audits in order to identify specific operational recommendations. An example of savings opportunities is that after one-off night events, school operations were not always quickly set back to their optimal control setting for typical usages. After the schools implemented some of the recommendations, Retroficiency began estimating realized savings with its "Efficiency Track" automated M&V software. This software uses proprietary algorithms based on IPMVP Option C to automatically generate a weather- and occupant-normalized consumption baseline, and estimate savings by comparing the metered consumption against the baseline. Interestingly, measured savings were 23 percent, 15 percent, and 1 percent respectively for the three schools, despite the fact that the buildings implemented the same measures. One of the potential reasons for this difference is a construction event for one building during the measurement period that may have increased energy consumption. This pilot is a good example of where automated M&V/EM&V 2.0 is effective in finding problems, and also underscores the need for standardized methods for documenting and accounting for observed events, such as baseline adjustments when using interval data.[79]

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[73] DNV GL. 2015c, p. 63; ACEEE 2015, p. 32.

[74] DNV GL. 2015c, p. 60; ACEEE 2015, p. 33.

[75] ACEEE. 2015, p. 36.

[76] ACEEE. 2015, p. 27. DNV GL 2015c, p. 58.

[77] Operational improvements present a substantial opportunity to save energy in the commercial sector; but MEA considered attaining savings in this area to be difficult, partly due to a lack of standardized programmatic EMV protocol.

[78] DNV GL. 2015c, p. 66-67.

[79] DNV GL. 2015c, p. 66-67.

Recommendations

Virginia utilities should work together to develop EM&V 2.0 pilot projects for the residential and commercial sector to assess various potential benefits discussed above for EM&V, market assessment, program delivery, process evaluation, and program planning. Virginia should also collaborate with surrounding states and regional organizations such as the Southeast Energy Efficiency Alliance and the Northeast Energy Efficiency Partnership to exchange knowledge and experience on EM&V 2.0 projects and programs.

Levelized Cost of Saved Energy

Definition and Application

Energy efficiency program costs can be presented in a useful standardized metric called the levelized cost of saved energy (LCOSE). LCOSE is "the cost of acquiring energy savings that accrue over the economic lifetime of the energy efficiency effort program/sector/portfolio, amortized over that lifetime and discounted back to the year in which the costs are paid and the actions are taken."[80,81]

There are several ways in which the LCOSE can be applied:

- It can be used to compare the levelized cost of energy efficiency resources with the levelized cost of supply-side resources.
- It can be used to compare energy efficiency programs within a program administrator's portfolio.
- It can be used to compare energy efficiency programs and portfolios across program administrators, and across states and regions.

While the LCOSE is a useful metric to compare efficiency resources with each other and with supply-sided resources, it should not be used to screen efficiency resources, i.e., to determine which resources are cost-effective. Energy efficiency cost-effectiveness should be evaluated using net present values of the stream of annual costs and benefits, and should conform to best practices for energy efficiency screening.[82]

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[80] LBNL. 2014. *The Program Administrator Cost of Saved Energy for Utility Customer-Funded Energy Efficiency Programs*. Available at https://emp.lbl.gov/sites/all/files/lbnl-6595e.pdf.

[81] This calculation should not be confused with two other cost calculations often made by program administrators: the cost of lifetime saved energy ($/lifetime kWh saved) and cost of first-year saved energy ($/annual kWh saved). While these calculations can also be useful, they do not enable apples-to-apples comparisons of programs implemented in different years as the costs are not discounted back to the same year dollars. Also, the cost of first-year saved energy does not enable apples-to-apples comparisons of programs with different measure lifetimes as the levelized costs are spread evenly across the period over which savings are accruing (LBNL 2014).

[82] See, for example: *The Resource Value Framework: Reforming Energy Efficiency Cost-Effectiveness Screening*, National Efficiency Screening Project, August 2014.

The LCOSE can be calculated for natural gas or electric energy efficiency programs. In this section, we discuss the calculation for electric energy efficiency programs.

Inputs

The key inputs for calculating the LCOSE include: (1) an assumed real or nominal discount rate,[83] (2) the total program administrator costs, (3) the annual energy saved, and (4) the lifetime energy saved. Definitions for each of these key inputs follow.

> Discount rate: an interest rate applied to a stream of future costs to convert those values to a common period, typically the current or previous year.[84]
>
> Total program administrator cost: all of the costs to the program administrator to design, market, administer, and evaluate an energy efficiency portfolio, sector, program, or program category,[85] as well as any technical support, incentives, or rebates offered to program participants, retailers, distributors, and contractors.
>
> Annual energy saved: the reduction in energy consumption due to actions taken by participants in an energy efficiency program in a given program year. These energy savings are annualized to represent a full year of savings, regardless of when the measure was implemented within the program year. Annual energy saved includes only incremental savings, representing new savings realized over that year (as opposed to cumulative savings, which include savings realized from the installation of an energy efficiency measure in a previous program year). The savings can be presented on a gross or net, claimed (pre-evaluation) or evaluated basis, as program administrator reporting is not consistent. [86]
>
> Lifetime energy saved: the reduction in energy consumption due to actions taken by participants in an energy efficiency program over the expected lifetime of the measure.

Total program administrator costs, annual energy saved, and lifetime energy saved are obtained from program administrators, often via energy efficiency plans and reports. There is a vast pool of literature on appropriate discount rates for policies that involve resource investment. The U.S. Bureau of

[83] It is important to apply a nominal discount rate when the values are in current or nominal dollars and a real discount rate when the values are in constant dollars, as the discount rate can have a significant impact on the levelized cost of saved energy. The real discount rate can be approximated by subtracting expected inflation from the nominal discount rate.

[84] SEE Action Network. 2012.

[85] Some program administrators do not allocate costs for marketing, education, and evaluation to programs.

[86] SEE Action Network. 2012.

Economic Analysis's Implicit Price Deflator is a useful source for converting nominal values to real values.

Calculation

A 2014 report by the Lawrence Berkeley National Laboratory provides the formula for the LCOSE, shown below.[87] We view this report as one of the best resources for information on how to best calculate the cost of saved energy.

> LCOSE = (Program administrator cost x Capital recovery factor) / (Annual energy saved)
>
> Where:
>
> Capital recovery factor = [Discount rate x (1 + Discount rate) ^ Weighted average measure life]/[(1 + Discount rate) ^ Weighted average measure life – 1]
>
> Weighted average measure life = Lifetime energy saved[88]/Annual energy saved

Discussion and Recommendations

Arriving at a levelized cost requires much standardization of some key variables such as discount rate and energy savings types (e.g., gross vs. net, line loss included or not) to ensure that comparisons are valid. Whenever possible, all program administrators within a single state should use common definitions and practices to enable comparisons of energy efficiency programs. Program comparisons can enable a better understanding of the range of costs of certain program categories and the drivers of cost differences, identify best practices that deliver robust services at a relatively low cost, and inform program design improvements. [89]

The following are some common standardization problems, as well as recommendations for standards that states should use for the data inputs into the levelized cost of saved energy calculation. The standards should be consistent across program administrators, and over time. Thus, it is important that the Commission provide guidance on how this metric should be presented.

- Consistent definitions of savings.
    - Annual and lifetime energy savings can be gross, rather than net, and claimed, rather than evaluated. While net, evaluated savings are more accurate, gross, claimed savings are more frequently and consistently reported by program administrators. Program administrators should work towards a more consistent

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[87] LBNL. 2014.

[88] Lifetime energy savings are not consistently provided in program administrator plans and reports. If this input is not provided, a weighted average measure life can be estimated using a measure life from like programs in other jurisdictions.

[89] Further, PJM Interconnection, ISO-New England, and New York ISO require consistent, rigorous reporting of the values used as inputs to the LCOSE in order to account for demand-side resources, including energy efficiency, in load forecasting.

definition, and reporting, of net savings. When greater consistency is achieved, net savings should be used instead of gross savings.

  - Annual and lifetime energy savings should represent savings at the end-use or site instead of at the busbar or power plant level (i.e., accounting for transmission and distribution losses), as this is what most program administrators report.

- Consistent definitions of costs.
  - Program administrator costs should explicitly include all of the costs required to implement the programs, as defined above. When calculating the LCOSE for individual energy efficiency programs, the program administrator costs should not include any utility performance incentives. However, when calculating the LCOSE for an entire portfolio of energy efficiency resources, any utility shareholder incentives should be included in the program administrator costs.

- Consistent units. To be consistent with data previously collected and reported by the Lawrence Berkeley National Laboratory (LBNL 2014), the levelized cost of saved energy should be reported in dollars per kWh of energy saved.

- Consistent discount rates. All program administrators should use the same discount rate or the same guidance for developing an assumed discount rate. As mentioned above, the discount rate can have a substantial impact on the calculated levelized cost of saved energy. It is also noteworthy that the discount rate is the only input that is assumed and not calculated directly from program administrator data. As a result, the approach for developing an assumed discount rate is of particular importance. A 2014 NEEP report entitled *Cost-Effectiveness Screening Principles and Guidelines: For Alignment with Policy Goals, Non-Energy Impacts, Discount Rates and Environmental Compliance Costs*, is a good reference for guidance on discount rate assumption. [90]

The following are some improvements to reporting transparency that Virginia can put into practice immediately.

- Report the calculation of LCOSE, all inputs used in calculating the LCOSE for each program and sector, and the source of inputs in reporting.

- Report program cost and savings data using common definitions and terminology for key inputs into the calculation of the levelized cost of saved energy. Please see LBNL's 2013 report.[91] This memo provides common definitions and terminology for these key

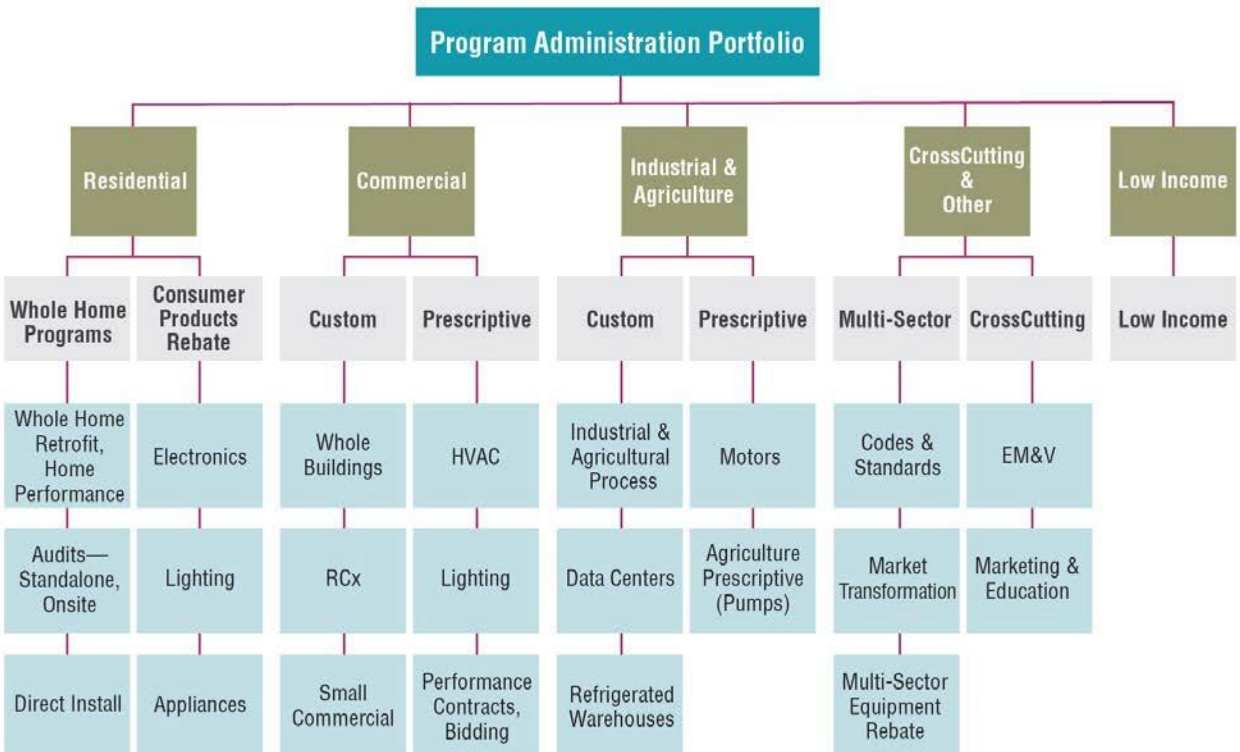
[90] NEEP. 2014. Cost-Effectiveness Screening Principles and Guidelines: For Alignment with Policy Goals, Non-Energy Impacts, Discount Rates and Environmental Compliance Costs. Available at http://www.synapse-energy.com/sites/default/files/Cost-Effectiveness%20Screening%20Principles%20and%20Guidelines%2014-059.pdf.

[91] Hoffman, I.M., M.A. Billingsley, S.R. Schiller, C.A. Goldman and E. Stuart. 2013. Energy Efficiency Program Typology and Data Metrics: Enabling Multi-State Analyses Through the Use of Common Terminology. LBNL-6370E. Available at: https://emp.lbl.gov/sites/all/files/lbnl-6370e.pdf.

inputs. LBNL also released a policy brief and reporting template to assist jurisdictions in further improving reporting consistency.[92]

- Categorize and report using common naming conventions for program sectors and categories.[93,94] This may require program administrators to add new fields to their reporting databases. Common program sectors and categories can be used to group programs and enable optimization of the LCOSE for programs in the same sector or category. One way to group program sectors and categories is presented in Figure 3 below from LBNL's 2013 report.[95]

Figure 3. Ratepayer-funded energy efficiency program grouping conventions



Source: LBNL. 2013. Energy Efficiency Program Typology and Data Metrics: Enabling Multi-State Analyses Through the Use of Common Terminology.

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[92] Rybka, G.M., I.M. Hoffman, C.A. Goldman, and L.C. Schwartz. 2015. Flexible and Consistent Reporting for Energy Efficiency Programs: Introducing a New Tool for Reporting Spending and Savings for Programs Funded by Utility Customers. LBNL-1003879. Available at: https://emp.lbl.gov/publications/flexible-and-consistent-reporting

[93] LBNL. 2014.

[94] Barbose, G. L., C.A. Goldman, I. M. Hoffman, and M. A. Billingsley. 2013. *The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025*. LBNL-5803E.

[95] Hoffman, I.M., et al. 2013.