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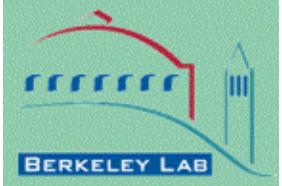

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National Energy Efficiency Evaluation, Measurement and Verification (EM&V) Standard: Scoping Study of Issues and Implementation Requirements

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Contents

Executive Summary

This report is a scoping study that identifies issues associated with developing a national evaluation, measurement and verification (EM&V) standard for end-use, non-transportation, energy efficiency activities. The objectives of this study are to identify the scope of such a standard and define EM&V requirements and issues that will need to be addressed. To explore these issues, we provide:

- a set of definitions applicable to an EM&V standard;
- a literature review of existing guidelines, standards, and 'initiatives' relating to EM&V standards as well as a review of "bottom-up" versus "top-down" evaluation approaches;
- a summary of EM&V related provisions of recent Federal legislative proposals that include national efficiency resource requirements;[1] and
- an annotated list of issues that are likely to be central to, and need to be considered as part of developing a national EM&V standard for energy efficiency.

There are three primary reasons for developing a national efficiency EM&V standard. First, some state utility and air regulators and practitioners believe that a national standard would streamline EM&V implementation, reduce costs and complexity, and improve comparability of results across jurisdictions; although there are benefits associated with each jurisdiction setting its own EM&V requirements based on their specific portfolio and evaluation budgets and objectives. Second, if energy efficiency is determined by the US Environmental Protection Agency to be a Best Available Control Technology (BACT) for avoiding criteria pollutant and/or greenhouse gas emissions, then a national EM&V standard may be required for documenting the emission reductions resulting from efficiency actions. Third, an EM&V standard might be required if future Federal legislation is enacted that includes a national energy resource standard (e.g., an energy efficiency resource standard, a renewable electricity standard or a clean energy standard) that allows end-use energy efficiency to qualify as an eligible resource for purposes of complying with the standard. This report uses language proposed in several recent Federal energy bills to provide a framework to guide an examination of the issues that would need to be resolved in developing a national EM&V standard for energy efficiency.

Developing a national EM&V standard is likely to be a lengthy process; this study focuses on the critical first step of identifying the issues that must be addressed in a future standard. Perhaps the most fundamental of these issues is "how good is good enough." This has always been the fundamental issue of EM&V for energy efficiency and is a result of the counter-factual nature of efficiency. Counter-factual in that savings are not measured, but estimated to varying degrees of accuracy by comparing energy consumption after a project (program) is implemented with what is assumed to have been the consumption of energy in the absence of the project (program). Therefore, the issue of "how good is good enough" is a short version of asking how certain does

[1] The Markey-Waxman bill (American Clean Energy and Security Act of 2009) and Bingaman bill (American Clean Energy Leadership Act of 2009) and their EM&V provisions were selected solely for analytical purposes. Neither the authors of this report, nor the U.S. Department of Energy that sponsored this study, imply any type of endorsement of either of these two 2009 bills, or any past or pending related Federal legislation in this report.

one have to be of the energy savings estimate that results from EM&V activities and is that level of certainty properly balanced against the amount of effort (e.g., resources, time, money) that is utilized to obtain that level of certainty? The implication is that not only should energy efficiency investments be cost-effective, but EM&V investments should consider risk management principles and thus also balance the costs and value of information derived from EM&V (i.e., EM&V should also be cost-effective).

In a number of Federal energy bills proposed over the last several years, energy efficiency has been included as an eligible technology that could meet the requirements of a "clean", "diverse", or "renewable" energy standard.[2] Thus, in addressing the issue of "how good is good enough," one will probably also have to address the question of "as compared to what." Since all energy resources have uncertainties associated with their development, performance and cost, policymakers may conclude that there is a need to establish a level of confidence and risk regarding the performance of energy efficiency resources not just in absolute terms but relative to other resources. For example, given that resources such as wind or nuclear power generation plants directly measure their output, will there be expectations that efficiency resources must also be directly measured? Or will energy efficiency, due to its inherent characteristics, which in almost all cases does not allow direct measurement of "savings", be treated differently as is current standard practice?

"As compared to what" can also refer to the baseline against which efficiency actions are compared for determining energy savings and whether attribution (causes of the efficiency based savings) should be considered? For example, should gross savings be documented (i.e., the savings from efficiency actions irrespective of their cause) or should attempts be made to document net savings (i.e., those savings directly attributable to an energy resource standard)? In this report the authors indicate the advantages of a standard focusing on gross savings and using industry standard EM&V practices, which acknowledge the inability to measure efficiency savings directly.

In this report, the authors identify four high-level issues that need to be considered and addressed as part of developing a new national EM&V standard for energy efficiency resources:

- What level of detail will be provided in the EM&V standard and how much flexibility will be left to professional discretion?
- Will requirements be performance-based (i.e. a requirement for a level of certainty) or prescriptive (i.e. requiring certain EM&V approaches for any given efficiency activity)?
- Who is responsible for documenting EM&V savings from energy efficiency resources that have been met as part of a national clean energy resource standard - a state agency, administrators of ratepayer-funded energy efficiency programs (e.g., utilities), or independent, third-party EM&V professionals?

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[2] In his January 25, 2011 State of the Union address, President Obama called for a new goal of "by 2035, 80 percent of America's electricity will come from clean energy sources."

- What entities will be the users (audiences) for the results (information) that the EM&V standard generates beyond a Federal entity responsible for enforcing an energy resource standard (e.g., will regional electricity system operators use the results for system planning and/or will environmental regulators use the results for testing compliance with emission reduction requirements)?

To address these four high-level issues, we identify and discuss nine issue topic categories that if addressed and resolved should generate answers for these high-level issues. We expect that the entity designated in any future Federal energy legislation to develop a national EM&V standard for energy efficiency will be tasked with answering major issues and addressing the various issue topic categories. This could occur as part of an administrative rulemaking process to implement legislative provisions of an energy efficiency resource standard or a renewable electricity or clean energy standard.

The nine topic categories are:

1. Legislative Structure for Efficiency Resource Standard
2. Scope and Metrics of a Standard, including net versus gross savings requirements
3. Baselines
4. EM&V Approaches
5. Certainty of Savings Determination
6. Who Conducts the Evaluation Activities
7. Reporting and Schedules
8. Dispute Resolution
9. Regulatory Audiences and Requirements for Standards/Protocols

It should be noted that these issues all address only one primary objective of EM&V – documenting the effects (specifically energy and/or demand savings) resulting from efficiency activities to determine if savings goals have been met. The issues do not address documenting non-energy co-benefits of efficiency activities (e.g., emission reductions) or the other primary objectives of EM&V activities: understanding why those effects occurred, identifying ways to improve current activities (i.e., process evaluations), and providing feedback on energy efficiency programmatic activities (e.g., consider discontinuing ineffective activities). The importance of these other objectives of EM&V cannot be understated for meeting long-term energy efficiency goals. However, the authors assume that these objectives of EM&V will not be explicitly included in the EM&V requirements for energy efficiency resources as part of an energy resource standard and thus are not addressed in this report.

In recent years, the energy efficiency industry and Federal, regional and state entities have undertaken a number of efforts to enhance the quality and consistency of EM&V efforts. For example, a number of industry, regional, and international entities have established collaborative forums with the intent of increasing the consistency of EM&V approaches and reporting (see Appendix B). These entities could accelerate the process of developing a national EM&V standard for energy efficiency resources by providing input on issues identified in this study. Thus, our intent is for this report to be a useful resource for Federal agencies, which may be given responsibility to develop a national EM&V standard, as well as for the energy efficiency industry. For the efficiency industry, this report should assist them in framing their input to current and future discussions on the development of federal EM&V guidelines and protocols as part of any national energy resource standard that includes energy efficiency as an eligible resource.

1. Introduction

1.1 Energy Efficiency[3] Investment and EM&V in the United States

Energy efficiency policy in the U.S. has largely been driven by building codes, appliance and equipment efficiency standards and programs paid for by utility customers. Energy efficiency budgets for programs funded by U.S. utility customers have increased significantly in recent years (e.g., $5.3B in 2010 compared to $1.6B in 2005) [Consortium for Energy Efficiency 2010]. A recent Lawrence Berkeley National Laboratory study projected that energy efficiency programs funded by utility customers could increase to $7.5-12B in 2020 based on an analysis of existing state policies and legislation (e.g., Energy Efficiency Resource Standards) and utility resource plans (Barbose et al 2009).[4] The U.S. also has a robust private sector, energy services company (ESCO) industry; ESCOs estimated that energy efficiency projects and measures account for about $3B of their $4.1B in annual revenues in 2008 (Satchwell et al 2010). Finally, the American Recovery and Reinvestment Act (ARRA) provided a massive influx of funding for local and state energy efficiency programs (~$16 Billion) to be spent over ~3-4 years (Goldman et al 2010).

Energy efficiency projects funded under ARRA, programs funded by utility customers, and ESCO projects have varying level of evaluation, measurement and verification (EM&V) activity and requirements. In the private sector, the focus is on project-by-project analyses, or measurement and verification (M&V). The International Performance Measurement and Verification Protocol (IPMVP 2010) and various documents from the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE 2002) and the Federal Energy Management Program (FEMP 2008) Measurement & Verification Guidelines define the state of the art for project-level M&V.

In terms of program or portfolio evaluation, or the combination of program evaluation and project measurement and verification (EM&V), the state of the art has been defined by activities associated with efficiency programs funded by utility customers (i.e., ratepayer-funded programs). A range of EM&V approaches and techniques are used to estimate electricity and gas savings for these programs. Most evaluations have originated from the need for state regulators to assess the success of programs funded by utility customers. Regulators support evaluation activities because of their interest in documenting total savings, assessing the cost-effectiveness of efficiency compared to generation alternatives and assessing the relative contribution of program administrators in achieving savings and impacts versus common practice, end-user self motivation, or codes and standards.[5]

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[3] This report addresses end-use, non-transportation efficiency activities, such as building and industrial process efficiency retrofits.

[4] Note that the comprehensiveness and maturity of energy efficiency programs funded by utility customers varies significantly among states.

[5] This issue of varying objectives for the use of information produced by EM&V studies is discussed in section 4.

Over the last two decades, the professional efficiency evaluation community has undertaken a number of efforts to develop common practices and standard terms for efficiency project M&V and evaluation of the impacts of energy efficiency programs (see Appendix B).[6] About a dozen states have established EM&V requirements and/or guidance documents for efficiency programs utilizing funds from regulated utility ratepayers.[7] In addition, at least a half dozen more states are in the process of developing their own protocols and/or guidance documents for documenting the savings from ratepayer-funded efficiency programs (Messenger et al 2010). Numerous regional and national EM&V efforts are underway that facilitate sharing of EM&V resources and support increased consistency in industry practices. Examples include the Northwest Regional Technical Forum[8], the Regional Evaluation, Measurement and Verification Forum (in the Northeast and Mid-Atlantic states)[9], State Energy Efficiency Action Network[10], the Consortium for Energy Efficiency[11], the North American Energy Standards Board,[12] and several regional transmission organizations (e.g., New England Independent System Operator[13] and PJM Regional Transmission Organization).

However, currently, savings results from ratepayer-funded energy efficiency programs in different states are typically not directly comparable (Messenger et al 2010). In practice this is because of varying EM&V guidelines and protocols, differences in definitions of savings, and in the level of rigor applied in savings determination.[14] State and federal policymakers, regulatory agencies and stakeholders are increasingly interested in comparing the performance, results and experience implementing energy efficiency programs, which would be facilitated by more standardized EM&V protocols, guidelines and approaches. Some policymakers and practitioners have called for the development of a "National Energy Efficiency EM&V Standard."

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[6] See National Action Plan for Energy Efficiency 2007. "Model Energy Efficiency Program Impact Evaluation Guide," prepared by S Schiller.

[7] For example, see California Public Utility Commission's Energy Efficiency Evaluation Protocols www.calmac.org/publications/EvaluatorsProtocols_Final_AdoptedviaRuling_06-19-2006ES.pdf

[8] http://www.nwcouncil.org/energy/rtf/

[9] http://www.neep.org/emv-forum

[10] http://www1.eere.energy.gov/office_eere/see_action.html

[11] http://www.cee1.org/

[12] http://www.naesb.org/

[13] http://www.iso-ne.com/

[14] For some observers, this lack of a common set of EM&V requirements can imply that some states and program administrators are having to "reinvent the wheel" or are not applying "best practices" when determining savings achieved by energy efficiency programs. However, the lack of consistency might actually be driven by different EM&V objectives and what might be best practices under one state's circumstances might not be appropriate for another state.

At present, such a standard has not been developed for several reasons. First, there has not been a driving need for consistent EM&V of energy efficiency across states. The fact that savings estimates are not truly comparable across states has been unfortunate, but is not necessarily a critical issue for state regulatory agencies charged with overseeing the administration of energy efficiency programs and ensuring that programs funded by utility customers are prudently spent in their own state. Second, state regulatory agencies, regional transmission organizations, and program administrators will often have different definition of baselines, one of the fundamental components of determining energy or demand savings.[15]

Third, different state regulatory bodies use results differently, and/or assign a different level of importance to energy efficiency resources. For example, one state may have historically not offered energy efficiency programs funded by utility customers, may have very limited goals for energy efficiency, and may have minimal existing energy codes. Another state might have established aggressive, long-term energy savings targets in legislation, offered large-scale energy efficiency programs for more than a decade, and developed a performance-based incentives scheme for program administrators linked to program impacts. Given these differences, the first state might have very little need for rigorous EM&V and fairly 'permissive' baselines; while the second state might require very rigorous (and more expensive) EM&V with 'conservative' baselines that reflect state building energy codes and current practices and adoption of high-efficiency measures and strategies in their building stock. Thus, for each state the value of having their own unique EM&V approach might very well outweigh the value of ability to directly compare results among different jurisdictions. In summary, it has just not been necessary for state regulatory commissions and administrators of energy efficiency programs funded by utility customers to define a saved unit of energy in exactly the same way. Each state can and many do develop EM&V requirements that are appropriate for their own situations.

These differences in 'needs' for less or more rigorous EM&V also translates into significantly varying levels of investment in EM&V. Anecdotally, it appears that many public utility and local and state government efficiency programs, as well as private sector projects, have very little, if any, investment in ex-post EM&V activities and rely heavily on ex-ante savings estimates with some level of inspections to verify installations. A recent LBNL study (Messenger, et. al. 2010) indicated that EM&V activities in energy efficiency programs funded by utility customers ranged from <1% to over 5% of program budgets. Thus, assuming a moderate level of effort is required to comply with a national EM&V standard, it is likely that some states will have to increase their funding levels for EM&V activities.

[15] Baselines are the 'business as usual' conditions against which project energy consumption after a retrofit is compared to determine energy and/or peak demand savings. Determining the baseline implicitly requires one to define the counter-factual situation (e.g., what would the energy usage pattern have been in the absence of the energy efficiency project). A range of options are available for defining baselines. Examples of approaches used to establish baselines include (1) the use of control groups, (2) assuming the equipment/systems at the participating facility would have complied with building energy codes or simply common practice for new construction projects, or (3) existing equipment for projects that involve early replacements. The point is that what would have occurred in the absence of the efficiency activity (i.e., the baseline) can vary based on EM&V approaches as well as the project assumptions and applicability conditions.

1.2 Energy Efficiency Resource Standard and EM&V

Over the last several years, organizations that promote and support energy efficiency have proposed a national energy efficiency resource standard (EERS) or that energy efficiency should be included as an eligible resource if a national renewable electricity standard or clean energy standard is enacted. Support for this policy is based in part on state experiences with EERS. As of 2010, eighteen states have enacted some form of an EERS, while four other states have proposals pending (ACEEE 2010). At the state level, an EERS can be defined as a mechanism established by law or rulemaking that encourages more efficient use of electricity (and/or natural gas) by requiring utilities to save a specified amount of energy on an annual or cumulative basis – a savings target. These savings targets (expressed as percentage of baseline sales) often increase over time (ACEEE 2009). Most states have adopted a separate EERS and RPS, while other states (e.g., NV, NC) combine the mechanisms by allowing energy efficiency to meet a portion of the RPS requirement.

Savings from end-use energy efficiency projects are included in all states that have adopted an EERS. In some states, distribution system efficiency improvements, combined heat and power (CHP) systems and other high-efficiency distributed generation systems are also included. Penalties for non-compliance vary by state. Electricity and/or gas savings requirements for utilities may include flexibility to achieve the standard through a market-based trading system of energy savings certificates.

If an EERS or a renewable electricity or clean energy standard that includes energy efficiency resources were enacted, it is likely that there would be requirements for consistent reporting and documentation of realized results and compliance with the legislation and/or implementing regulations. Each state (or utility) would likely be required to report results from their energy efficiency activities consistent with a national EM&V standard. Two 2009 bills addressed options for documenting compliance by energy efficiency resources as part of a federal energy resource standard: HR2454 (Waxman-Markey) and S1462 (Bingaman). HR 2454 included energy efficiency resources under a "Combined Efficiency and Renewable Electricity Standard." S 1462 incorporated a "Federal Renewable Electricity Standard" that included energy efficiency as an eligible resource to satisfy a portion of this standard's requirements. For analytical purposes, both 2009 bills provide useful examples of EM&V provisions that could be included in future energy legislation.[16]

It should be noted that another Federal "action" that could create the need for consistent EM&V requirements across all states is a US EPA determination that end-use energy efficiency is a Best Available Control Technology (BACT) for avoiding criteria pollutant and/or greenhouse gas emissions. In such a situation, regulated sources such as utility power plants would need to demonstrate their implementation of this BACT (i.e. efficiency programs) and that it is effective

[16] In June 2010, a diversified energy standard was included in the Practical Energy and Climate Plan (S.3464) introduced by Senators Richard Lugar (R-IN), Lindsay Graham (R-SC), and Lisa Murkowski (R-AK). In September 2010, Senator Lindsay Graham (R-SC) introduced the Clean Energy Standard Act (S. 20).

(i.e. there are documented savings). However, such a BACT determination and the EM&V implications are not a focus of this report.

1.3 Report Roadmap

This scoping study is organized as follows. Section 2 includes definitions of key EM&V terms as background information. In section 3 (and Appendix A), the authors summarize relevant provisions of 2009 proposed Federal energy legislation (using HR 2454 and S 1462 as examples) to provide context for our discussion of possible EM&V requirements. In section 4, we examine the scope of a national EM&V standard and identify and discuss issues that must be addressed in such a standard. In section 5, we discuss several implications of these EM&V issues. Appendix B provides brief summaries of selected evaluation, measurement & verification (EM&V) guidelines, protocols, and resources that have been developed or are under development by industry, nonprofit, governmental, national and international organizations. We have tried to select protocols and standards that are representative of industry practice but acknowledge that our coverage may not be comprehensive. Appendix C provides a draft outline for the structure of an Evaluation, Measurement & Verification National Standard.

2. Definitions: Key Energy Efficiency and EM&V Terms

In this section, we provide definitions for key terms in the energy efficiency evaluation, measurement and verification field to provide a common starting place for readers for key terms used in this report. For some of the definitions we also provide commentary on the definitions with respect to their application to a national EM&V standard.

- *EERS – Energy Efficiency Resource Standard or Target*: An Energy Efficiency Resource Standard (EERS) or energy efficiency target are mechanisms to encourage more efficient use of electricity and perhaps natural gas and other fuels that are typically established for electric (and/or gas) utilities in stationary, non-transportation, applications (e.g., buildings) through state (or Federal) legislation and/or rulemakings of regulatory commissions.

- *Evaluation* - The performance of studies and activities aimed at determining the effects of an energy efficiency program or portfolio.
  Comment: "Evaluation" is often used broadly to include market analysis for program or portfolio design, inputs for overall resource planning or procurement, etc.

- *Measurement and Verification (M&V)* – Data collection, monitoring, and analysis associated with the calculation of gross energy and demand savings from individual sites or projects.
  Comment: M&V can be a subset of program evaluation.

- *Evaluation, Measurement and Verification (EM&V)* - The term "evaluation, measurement, and verification" is frequently seen in efficiency evaluation literature. EM&V is a catchall acronym for determining both program and project impacts.

- *Bottom Up Evaluation*[17] - A bottom-up evaluation method generally means that estimates of aggregate energy savings for a program are obtained by summing savings that have been determined at a more granular level (e.g., at the level of individual measures). For example, energy savings obtained through the implementation of a specific energy efficiency improvement measure are determined and then added to energy savings results from other specific energy efficiency improvement measures to determine "total" savings from an individual program or portfolio of programs within a specified geographic area (e.g. utility service territory or state).

  Comment: Required data can be obtained by direct measurements, analysis of energy bills, expert calculations or estimates (ex ante or ex post; with or without on-site inspection), or a variety of other approaches. The major advantage of bottom-up evaluation methods (as compared to top-down methods) is the fact that they allow a direct determination of the energy savings that are due to specific efficiency measures,

[17] This definition and text (for bottom up and top down) are modified from definition used by the European Union for their energy efficiency initiative - http://www.evaluate-energy-savings.eu/emeees/en/home/index.php

projects or programs. Assuming a properly defined baseline (which is a major assumption), this approach can thus achieve greater accuracy and has additional advantages, as it enables the development of benchmarks, direct indication of energy savings sources, and better program control. Potential drawbacks of bottom-up evaluation are the potentially high costs of data collection and cumulative and typically difficult to quantify random (e.g., sampling) and systematic (e.g., measurement) errors that can cause a poor indication of actual, "total" energy savings.

- *Top Down Evaluation:* Top-down evaluation refers to methods that rely on energy consumption data or per unit energy consumption indicators (e.g., energy consumption per unit of output or per person) defined by sector, utility service territory, state, regional, or country as the starting point for energy savings determination.

  Comment: Top-down approaches start from aggregate data such as state-level statistics for energy consumption and then attempt to correlate any realized energy savings with energy efficiency actions. The major advantages of top-down evaluation methods (as compared to bottom-up methods) are potential lower evaluation costs and the potential direct indication of sector, state, national, etc. reductions in energy consumption. The primary potential drawbacks of top-down evaluation are the difficulty in attributing energy savings to specific energy efficiency policies and/or particular programs and actions and relying on potentially unreliable energy performance indicators. Top-down efficiency evaluation methods are significantly less developed than bottom-up methods.

- *EM&V Standard and EM&V Protocol:* An EM&V Standard is a set of conditions and requirements, established by a government entity, which must be satisfied by processes, procedures, conventions, or test methods. An EM&V Protocol is a document, which may be adopted by a government entity that describes how EM&V activities should be performed; EM&V Protocols may vary in their level of detail and specificity and extent to which they adopt prescriptive approaches (e.g. specifying how each EM&V activity must be performed vs. a collection of guidelines indicating various options).

  Comment: The definitions for standards and protocols are placeholders and are provided because these terms are often used interchangeably, with ambiguous meanings (along with the terms EM&V Frameworks and EM&V Guides) in different states. Thus, these are not formal or legal definitions, but amalgamations of various common use definitions. See section 4 for comments on "regulatory requirements for standards or protocols."

- *Technical Reference Manual (TRM):* A TRM is a term of art that describes a document or database of standardized assumptions and ex-ante values for determining the savings from well-defined energy efficiency measures installed and operated under defined conditions.

  Comment: TRMs are not formal standards or protocols, but tools that are used to assist with EM&V activities. TRMs are best known as a source of stipulated, or deemed, savings values and are utilized in a number of states (e.g., CA, MN, NJ, NY, PA, OH, VT).

- *EM&V Frameworks, Portfolio Plans, Program Plans, and Site Specific M&V Plans:* Policy-specific program evaluation requirements can be defined in four hierarchical planning documents:

    - EM&V Framework – A framework is a primary document that lays out EM&V principles, metrics, allowable approaches, net versus gross savings issues, reporting requirements, schedules, who does what, etc. An EM&V framework document tends to be "fixed" but can be updated periodically and often sets the expectations for the content and format of other EM&V documents and annual portfolio and statewide evaluation reports prepared by state agencies, utilities and/or independent evaluators charged with assessing impacts and results of energy efficiency programs.
    - Annual Portfolio (or State) EM&V Plan - An annual plan that indicates the major evaluation activities that will be conducted during the evaluation cycle (typically one or two years), including budget and allocation between programs/measures/market sectors, as applicable.
    - Evaluation Activity-Specific Detailed Research Plans - Research plans are created for the major EM&V activities or studies planned in a given cycle prior to the time each effort is launched.
    - Site Specific M&V Plans - Site-specific plans may be required for custom project sites that are analyzed and inspected.

Figure 1 outlines the hierarchy of these documents and indicates their typical time frame (or horizon) and applicability level (e.g. state or utility program administrator, program or portfolio of programs, or individual projects).

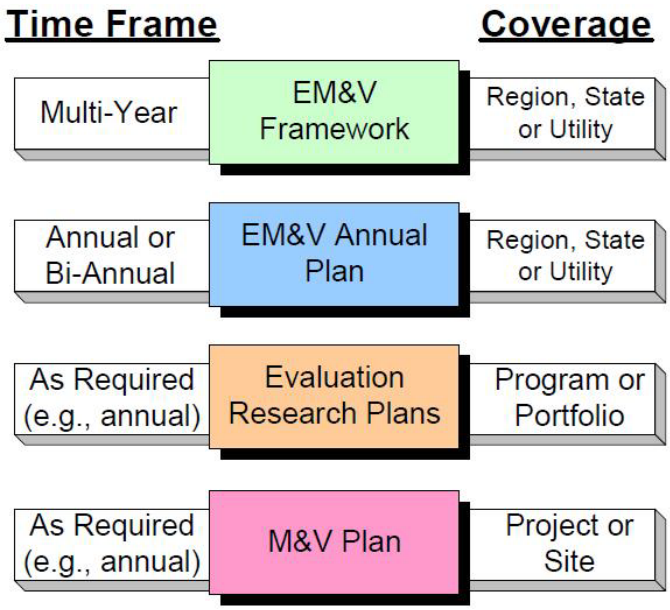

Figure 1: Hierarchy of EM&V Planning Documents

3. Evaluation, measurement and verification of energy efficiency resources in proposed Federal energy legislation

In this section, we summarize the energy efficiency resource standard provisions from several energy bills that have been seriously considered in Congress, including requirements for evaluating and verifying savings targets. The status and future prospects for Federal energy legislation are quite uncertain in the near term. Our objective is to provide readers with background on the EM&V requirements in recently proposed Federal legislation in order to provide a context for our discussion of issues that will need to be considered when developing a national EM&V protocol or standard for energy efficiency. These overviews and descriptions of the EM&V concepts in the legislation are not intended to be comprehensive or legal interpretations but rather to illustrate concepts or language on EM&V that may be included in future clean energy legislation.

3.1 Overview of Recent Federal Energy Legislative Proposals

The American Clean Energy and Security Act of 2009 (i.e., HR 2454 or the Waxman-Markey bill) was passed by the House of Representatives in June 2009. According to its sponsors, the objectives of the legislation were to create clean energy jobs, achieve energy independence, reduce global warming pollution, and transition to a clean energy economy. The Waxman-Markey bill included a provision for a combined efficiency and renewable electricity standard. Thus, it provides a useful starting point for discussing EM&V requirements for energy efficiency resources that could be used to comply with a national energy resource standard (e.g., an EERS or a renewable electricity or clean energy standard that allows end use efficiency to qualify as an eligible resource).

S1462 (Bingaman bill) is the American Clean Energy Leadership Act of 2009 (ACELA). ACELA cleared the Senate Energy and Natural Resources Committee in 2009. Subtitle C of the bill would have created a national renewable electricity standard, or a provision that would require that 15 percent of electricity be produced by renewable sources by 2021. Entities that must comply with the standard could have met a portion of their obligation in any calendar year with energy efficiency (26.67%). ACELA also created a national energy efficiency credit market. Attachment A to this document provides text excerpts from HR2454 (Waxman-Markey) and S1462 (ACELA) that are relevant to a national energy efficiency EM&V standard.

A plan for a diversified energy standard was introduced by Senators Richard Lugar (R-IN), Lindsay Graham (R-SC), and Lisa Murkowski (R-AK) in 2010. The Lugar Practical Energy and Climate Plan seeks to reduce greenhouse gas emissions by reducing oil imports, improving and creating new efficiency standards, and establishing a clean energy standard. It does not include a price on carbon. Similarly, Senator Lindsey Graham (R-SC) introduced the Clean Energy Standard Act of 2010 in September 2010. Neither of these legislative proposals was reviewed as

part of this scoping study, however a summary and comparison with the ACELA and Waxman-Markey bills can be found on the Pew Center on Global Climate Change website.[18]

In his 2011 State of the Union address, President Obama proposed a goal of generating 80 percent of the Nation's electricity from clean energy sources by 2035. A clean energy standard fact sheet released in the following days by the White House calls for renewable energy, nuclear power, efficient natural gas, and coal with carbon capture and sequestration to count toward the President's 80 percent goal. With respect to efficiency, the Fact Sheet proposed that the clean energy standard be paired with energy efficiency programs that will lower consumers' energy bills, such as stronger appliance efficiency standards, tax credits for energy efficiency upgrades, and the proposed Home Star program.[19] The Fact Sheet did not include energy efficiency within the clean energy standard itself. However, as discussed above, there would still be other reasons for developing a national EM&V protocol.

3.2 EM&V Concepts noted in the ACELA and Waxman-Markey Legislation

Summary concepts from the proposed legislation, with respect to preparing an EM&V standard, are noted below.

- Compliance with the legislation can be met with efficiency or renewable energy;
- The compliance requirements are for electricity savings (no mention of natural gas or fuel oil);
- The focus seems to be on retail electricity providers being responsible for obligations;
- Specific acceptable (or eligible) measures are left to regulations, although categories of measures are defined, for example:
  - Distribution losses may be included and thus a standard might need to indicate how such savings are calculated
  - Allowable savings include heat recovery (recycled energy) and combined heat and power (and fuel cells); thus a standard might also need to indicate how these savings are calculated
  - Market transformation savings are also implied as meeting efficiency resource requirements and thus the savings from such efforts should be considered in calculation methods[20]
- The proposed legislation text calls for standards and protocols; these could be different documents;
- Annual targets are indentified as well as annual reporting – requiring a standard to address annual savings (and cumulative savings);
- Certain EM&V requirements/options are called out in the proposed legislation:

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[18] http://www.pewclimate.org/federal/congress/111/lugar-practical-energy-climate-plan

[19] White House State of the Union CES Factsheet, Office of the Press Secretary, January 25, 2011.

[20] The potential inclusion of market transformation (MT) savings in an EERS raises several broad EM&V issues. MT program effects tend to require a long-term EM&V perspective and the occurrence of MT is usually attributable to many causes. Particularly for smaller states, estimating market transformation effects is likely to cross state borders to encompass regions. Thus, documenting savings from MT efforts can take years and it can be difficult to assign credit to one state or utility.

    - Savings need to be calculated for each year of measure life
    - Basic baselines (measure specific and for all electricity consumption) are defined
    - Deemed savings and useful life values should be developed
    - Savings are to be adjusted for independent variables
- Third-party verification is required, with accreditation, but the definition of what is a third-party will be defined by regulation;
- States (and utilities) may propose alternative EM&V approaches, other than what are called for in implementing regulations or the EM&V standard; thus a mechanism for considering alternative approaches should be defined;
- Attribution to utility efforts should be considered (to ensure savings are due to efforts of the retail energy supplier); thus net to gross definitions and analyses may need to be included in a standard;
- Codes and standards savings seem to be excluded from allowable savings. In ACELA it is clear that savings from national, state or local building, equipment, or appliance efficiency standards are excluded. Waxman-Markey excludes savings from compliance with mandatory appliance and equipment efficiency standards or building codes, but it is not stated if this is Federal, state and/or local standards/codes. Thus, impacts of codes probably need to be considered in the baselines and/or methods for how to calculate savings from codes/standards.
- Development of EM&V standards and other regulatory responsibilities in Waxman-Markey appears to be delegated to the FERC (Commission[21]), whereas in ACELA it is delegated to the Department of Energy (Secretary).

In Chapter 4, these design and scope concepts from the legislation as well as the authors' experience with other protocol/standards efforts are used to identify questions that need to be addressed before an EM&V standard can be developed.

3.3 Special Note on Energy Efficiency Certificates

ACELA creates an approach for showing EERS compliance - a crediting program, presumably some form of energy efficiency or 'white" certificate programs for efficiency that allows one entity to show compliance by buying efficiency savings offsets from another entity.[22] The concept of efficiency certificates is based on the model of tradable renewable energy certificates (TRECs) that is associated with renewable portfolio standards. However, the concept of efficiency certificates is more complicated than TRECs because efficiency is not a generation resource and because of the complexity of EM&V for energy efficiency resources.

If a Federal energy resource standard included a trading component for compliance, the EM&V standard would very likely require more detailed requirements and perhaps different approaches

[21] In Waxman-Markey bill, responsibilities are delegated to the "Commission" (i.e., the Federal Energy Regulatory Commission); in the ACELA bill, the administrative authority is the Secretary of Energy.

[22] This entity does not necessarily need to have an EERS target or it could be an entity that has an EERS target but has extra savings that exceed the target.

than what would be required for just showing utility-wide or statewide compliance as defined in Waxman-Markey. The reasons for this are:

- With a white certificate program the savings (credit) from a project is "sold" to an entity seeking compliance with the energy resource standard. Therefore, the savings from each individual project needs to be determined (versus a sample for program evaluation) for the life of the credit and a certifying entity needs to confirm not only the savings but that the project meets the criteria (e.g. baselines, measure type) of the resource standard. There also needs to be confirmation that the savings are attributed to the seller of the credit and not double-counted (this means that a tracking system needs to be put in place); and that there is no "leakage[23]". This is all incremental (in effort and cost) to systems without trading that do not require every project to have documented savings, certificate certifiers, and offset tracking systems. The tracking system would likely be much more complex than TREC tracking programs (e.g., WREGIS[24]) since thousands (millions?) of energy efficiency projects will not necessarily have contracts or metered output data. However, if program versus project savings are traded, this incremental cost and effort for EM&V and tracking is somewhat reduced.
- These issues could possibly be negated if trading is done at a "state" or "utility" level. For example, if a state exceeds its efficiency resource requirements for a given year and then sells excess "white credits" to state(s) that have not met their goals. In these situations the EM&V requirements would not seem to be affected. However, there might very well be energy resource standard design and equity issues associated with this approach since part of the objective of at least the efficiency component is that all energy users benefit from efficiency investments. Thus, if one state is spending money on another state's efficiency efforts (even if they are less expensive or more cost-effective), the former state's residents are not benefitting directly from their own investments.
- In the case of climate change caps and a cap and trade system, the energy efficiency certificate can be redundant to the certified emission reductions that are traded (double-counting). This is particularly complex if the caps are placed on electricity generators, as is almost universally implemented and proposed. This is because end-use electricity efficiency savings are indirect emission reductions – an end-use savings of electricity results in emission reduction at the generator not at the project site irrespective of the cause of the reduction (e.g., customer investment versus utility investment).

The above points are not intended to be a comprehensive review of efficiency trading programs and their pros and cons, only an indication that an efficiency trading program, if included as a part of an energy resource standard, would probably add complexity to the design of the standard as well as its implementation and EM&V (see Bertoldi et al 2010 and Loper et al 2008 for a more in-depth discussion of energy efficiency certificates).

[23] Leakage occurs if the savings at a project site causes increased energy usage at another location, for example if reduction in energy consumption in one factory results in an increase in energy usage at another factory

[24] The Western Renewable Energy Generation Information System (WREGIS) is an independent, renewable energy tracking system for the region covered by the Western Electricity Coordinating Council http://www.wregis.org/

4. Developing a national EM&V standard/protocol: Issues to Address

In this section, we discuss issues that would need to be addressed by the entity designated in future Federal energy legislation to develop a national EM&V standard/protocol as part of a program to implement an energy resource standard (e.g., an EERS, a renewable electricity standard or a clean energy standard) that allows end use efficiency to qualify as an eligible resource. We develop our issue list based on our review of EM&V language and concepts included in the Waxman-Markey and ACELA proposed legislation (see section 3) as well as the author's experience with developing state and regional EM&V guidance/protocol/standard documents. The topics are:

- Structure and Context of the Energy Resource Standard
- Scope and Metrics of a Standard, including net to gross requirements
- Baselines
- EM&V Approaches
- Certainty of Savings Determination
- Who Conducts the Evaluation Activities
- Reporting and Schedules
- Dispute Resolution
- Regulatory Requirements for Standards/Protocols
- Other

The topics are presented in the form of questions with some discussion of the issue, although, in some cases only questions are posed, as they are considered self-explanatory.

4.1 Legislative structure and context for including energy efficiency resources in an Energy Resource Standard

The structure and context of future Federal energy legislation that establishes a national energy resource standard may affect the treatment of energy efficiency resources and EM&V for energy efficiency. Future federal energy legislation could include provisions that establish:

- Stand-alone EERS;
- Combination energy resource standard, such as the 2010 proposed Lugar or Graham Clean Energy Standard that allows several resources (e.g., solar, wind, energy efficiency, nuclear, combined heat and power) to be used to meet resource requirements;
- Combination energy resource standard, such as the Clean Energy Standard outlined in the February 25, 2011 White House Clean Energy Standard Fact Sheet, that allows several resources to be used to meet resource requirements, but not energy efficiency which is instead promoted though a series of separate complementary policies; or
- A climate bill with or without cap and trade elements that allows consideration of efficiency-related offsets.

For the purposes of this report only, we assume that energy efficiency resources will be eligible for use in complying with some type of national energy resource standard. This provides the context for our primary objective in this study, which is to define requirements for an EM&V

standard that meets the needs of documenting efficiency as part of a national energy resource standard.

Question L1: Assuming the energy resource standard will include multiple resources, what are the potential implications for EM&V requirements?

The scope of an EM&V standard for energy efficiency resources does not hinge on whether those resources are used to comply with a stand-alone EERS, or with a renewable electricity or clean energy standard that treats energy efficiency as an eligible resource, because in any instance where energy efficiency can be used for compliance, units of demand and/or energy saved have to be calculated.

However, if energy efficiency can qualify as an eligible resource under a renewable electricity or clean energy standard, development of an EM&V standard would be significantly impacted by a requirement that EM&V approaches and documentation for efficiency must be equivalent or comparable to documentation methods for generation resources. Under such a requirement, , only direct measurements of energy output or "measured" savings would be allowed to count towards compliance with an energy resource standard. We do not believe this expectation is valid because of the distinctive characteristics and features of energy efficiency and its relative risks and benefits as compared to other resources. Output from a power plant can be directly measured whereas savings from energy efficiency cannot be measured in the same fashion; this is perhaps the principal risk of energy efficiency.[25]

We think it is preferable to consider the benefits and risks of energy efficiency and generation resources as part of a resource planning process. Thus, in our view, EM&V requirements that would have the effect of disqualifying efficiency resources upfront would be a short-sighted approach to a proper risk management strategy. There are several options for addressing this issue:

- Legislation could include language that specifically recognizes that EM&V protocols for energy efficiency have to be appropriate for resource characteristics and features. We favor this approach;
- Legislation could include language that defines acceptable EM&V approaches for "measuring savings." For example, one option would be to define "measured" savings for energy efficiency resources to include comparison of pre-project (program) and post-project (program) energy consumption for treatment and control groups;[26] or
- If the inability of efficiency to have directly measured results becomes a large concern, then legislation could include language that defines EM&V protocols for energy

[25] One can define a meter standard with great precision to accurately indicate the output of supply-side resources. One cannot do the same for energy efficiency because of the counter-factual baseline issue and the vast range of efficiency measures and measure applications that do not allow for a single, or even several, measurement protocols to cover all possible efficiency applications.

[26] Real time comparison group EM&V involves comparing the energy use of a subject population that has participated in an efficiency program with a group of non-participants (control group) that are "identical" in all aspects except for the application of the efficiency measures. It is consistent with a "net savings" metric.

efficiency with some provisions for adjusting (or possibly discounting) the savings values to meet the resource standard depending on the rigor of the EM&V approach.

Question L2: Will the resource standard include a trading mechanism and what are the implications for EM&V and tracking?

Another structural design issue is whether or not to include trading of efficiency savings credits in the design of a resource standard.[27] Opinions vary among policy analysts about the viability and wisdom of a trading program for energy efficiency (Loper et al 2008; Bertoldi et al 2010). However, with respect to EM&V standards, such a crediting program would possibly create a need for more granular indications of savings (per project?) and very clear attribution rules. The level of required granularity would seem to depend on whether the trading is between individual users or utilities. If trading occurs between utilities, do they need to document each project in their portfolio? If only very large customers can trade, then that is different than having to verify every single house or small retail store. While EM&V will be required even without a trading program, knowing exactly where each unit of savings is coming from is likely to be less important without a trading program (see section 4.3).

Question L3: Will the requirement/opportunity for energy efficiency be combined into a cap and trade offsets program?

Including energy efficiency in an emissions cap and trade program as offsets can take two forms – offsets from outside the capped sectors or offsets within the capped sectors. The latter is very complex and can lead to very detailed M&V requirements and a significant potential for double counting.[28] Offsets from outside the capped sector are less complex to define and are currently used in the UNFCCC Clean Development Mechanism (CDM) program.[29] However, the rules and structure of EM&V activities in the CDM program is complex, especially with respect to additionality. In the near term, the likelihood of a cap and trade program for greenhouse gases is low in the US. That said, if cap and trade legislation were passed at some time in the future, it is

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[27] For example, a key difference between the treatment of resource standards in ACELA and Waxman-Markey bills is whether an efficiency credit trading system is allowed.

[28] One of the counter-intuitive aspects of an allowance cap is that while emissions cannot exceed the cap they also are unlikely to fall below the cap. The reason for this is that a source that emits less than the allowances that it has available in a given compliance period can sell those allowances to another source, which can use them rather than reduce its emissions. Under many trading schemes, sources may also "bank" unused allowances to use in a future year. Thus, the overall regulated sector will always emit approximately at the cap level. The fact that capped emissions tend to remain at the cap level for the entire pool of covered sources, in each compliance period, is relevant to the effects of energy efficiency. For example, energy efficiency reduces the output of electricity generators or the burning of natural gas in boilers, and thus reduces emissions. In the *absence* of a cap and trade program, energy consumption reductions due to efficiency in one location do not lead, in themselves, to increased emissions in another location. However, under a cap and trade program, reductions in capped-source (e.g., large generators or boilers) emissions due to end-use efficiency will make extra allowances available to others. Those "efficiency windfall" allowances can be sold in the market and used elsewhere or banked for use in a later year. Thus, if allowances are freed up by increased efficiency, total emissions for the sector in the overall compliance period will remain roughly equal to the cap level. Thus, energy efficiency in capped systems does not necessarily reduce emissions.

[29] http://cdm.unfccc.int/index.html

likely that it would include the utility sector. Thus, the issue becomes whether the national EM&V standard under consideration in the final scoping study should consider non-US electricity sector efficiency actions (e.g., natural gas or fuel oil projects or projects in other countries).

4.2 Scope and Metrics

A key issue for a national energy resource standard that allows efficiency resources to be eligible as a compliance strategy is the scope of measures that would be covered by the standard and the indicative metrics. The metrics define what needs to be documented (determined and reported) in an EM&V protocol. The value of the metrics and risk of getting the metrics' values wrong defines the level of effort that would be implied or mandated in the standard.

Question S1: What forms of energy efficiency would be covered in a national energy resource standard and thus must be covered in the EM&V standard?

The expectation is that energy efficiency resources that are eligible to participate in an energy resource standard will address end-use, non-transportation efficiency. A national EM&V protocol verifying energy efficiency resource savings would focus on savings in homes, businesses, and industry. For these consumers, the possible forms of energy would include at least electricity and possibly natural gas, propane, and fuel oil.

Question S2: What types of energy efficiency actions should be covered and defined as eligible energy efficiency activities under the standard?

Examples include:

- End-use customer energy efficiency measures
    - Commercial
    - Residential
    - Industrial
    - Governmental
- Specialty measures defined for certain constituencies (e.g., waste-heat recovery and combined heat and power)
- Training programs
- Market and public education programs
- Research, development and/or demonstration programs/emerging technology programs
- Market transformation programs[30]

[30] Although all of the above actions can be considered as intended to transform markets, here market transformation activities are distinguished as programs specifically include activities and programs that broadly address barriers to the functioning of the market for multiple actors (e.g., working with upstream market players versus end users).

Thus far, proposed Federal energy legislation is either silent on this issue or includes broad provisions that allow a wide range of actions. The implication is that the EM&V standard would also need to cover a wide range of measures and applications.

Question S3: Is the primary metric energy savings and/or demand savings?

The intent of this question is to focus attention on whether energy consumption or demand reduction, or perhaps some combination that includes both targets is the fundamental goal. The implication for an EM&V standard is that different approaches are required for calculating demand versus energy savings. For each metric, a formal definition would also be required that includes temporal aspects. For example, in terms of demand savings is it annual average peak demand reduction, peak period average demand reduction, coincident peak demand reduction, etc?

These definitions would also require a decision on whether only first year savings are considered or savings from installed measures/projects that reflect their estimated economic lifetime are added cumulatively for each year that the standard is in force. The granularity of savings also needs to be specified both in terms of whether only total savings are required to be reported (e.g., per State or utility service territory) or whether savings needs to reported for various time periods (e.g. annual, seasonal, monthly, daily). Examples include:

- Annual energy savings (in kWh) are calculated and reported for each year of each measure's effective useful life.
- Annually accumulated electricity savings from installed measures/projects, up through their expected or documented lifetime, are to be reported at end of each calendar year. Cumulative savings targets are developed relative to a defined applicable percentage of base quantity. For example, base quantity could be defined as the average electricity sales delivered by distributor to retail customers during the previous 2 years.

Question S4: Are there non-energy, co-benefit metrics that should be determined?

Federal and state efficiency programs tend to have multiple goals beyond just energy and/or demand savings and thus a Federal energy resource standard might also have additional goals which are implicit, but not necessarily explicitly called out in the targets. If so, it may be decided that the EM&V standard, or perhaps more likely a companion guidance document, should address how to determine success with respect to meeting these 'implicit', non-energy, co-benefit goals. This would be similar to completed evaluations of the Department of Energy's State Energy Programs and the planned evaluations of efficiency programs funded by the American Recovery and Reinvestment Act of 2009.[31]

[31] http://weatherization.ornl.gov/evaluation_sep.shtml and http://www1.eere.energy.gov/recovery/

Examples of non-energy, co-benefit goals are:

- For market transformation programs – market shares of new products, stocking practices, etc.
- For energy efficiency measures – number of homes treated, number of measures installed, etc.
- Job creation
- Emission reductions
- For training programs – number of people trained.

Question S5: Should end use energy savings include transmission and distribution (T&D) losses between generation and use?

If T&D savings are included as either an eligible demand-side strategy or indirectly as an "add-on" to end-use energy savings, should utility specific, regional or national average values be used or values calculated on a per project basis? Typically, T&D savings, when included, are simply estimated using a "guesstimate" average value. More accurate values would require more data and a methodology for applying T&D loss values to end-use energy savings.

Question S6: Should end use energy savings be calculated using site energy use or source (e.g. power plant input) energy?

If source energy savings are the metric, should regional or national average values be used or values calculated on a per source basis? As with T&D losses, common practice is to report site energy use reductions with occasionally an estimate of the source energy savings using "typical" values.

Question S7: Should net and/or gross savings be calculated and reported; if net savings are to be reported, what is included in the definition of net savings?

Gross savings are the change in energy consumption and/or demand that results directly from program-related actions taken by participants in an energy efficiency program, regardless of why they participated. Net savings are the total change in load that is attributable to an energy efficiency program, which may include 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. Specification of net or gross savings is a major issue as the differences can be very significant; in particular because estimating net savings is more difficult and subject to significant uncertainty around determining the motivations of individuals and organizations.

In practice, decisions regarding use of gross and/or net savings to estimate the impacts of energy efficiency resources are likely to be driven by many factors beyond EM&V requirements. For example, for system planners and environmental regulators, gross energy savings from efficiency programs and projects are of primary interest. In contrast, many consumer advocates are concerned about net savings because of their view that administrators of utility customer-funded programs should only be allowed to take credit for actions induced by the programs and thus are interested in how effectively program funds are being utilized. Irrespective of the pros and cons

of net versus gross savings, if net savings are the metric, the following EM&V issues must be addressed in an EM&V standard:

- If net savings are included, it must be decided what factors are used to determine net savings (e.g., free riders and spillover) as well as a rigorous definition of each factor.
- Net savings determinations are often based on determining the motivation of program participants and non-participants. Since the reliability of determinations of motivation/basis for human behavior are often quite low in energy efficiency studies, it is particularly important to define what methods are acceptable, and sufficiently reliable, for net savings determinations.
- If net savings are determined for purposes of attribution, is it determined per program, energy efficiency portfolio, utility service territory, or state?

Question S8: Given that evaluation activities typically include a lessons learned component, should generating information to support best practices be a requirement of a national standard or excluded?

There are two key objectives of evaluations:

- To document and measure the effects of a program and determine whether it met its goals with respect to being a reliable energy resource.
- To help understand why those effects occurred and identify ways to improve or discontinue current programs, and select future programs.

Energy efficiency evaluations should develop retrospective estimates of energy savings attributable to a program in a manner that is defensible; defensible to the standard established (e.g., good enough for regulators overseeing the use of public funds, good enough for resource planning, good enough for a demand response program operated by a regional transmission organization). Evaluation studies should also go beyond documenting savings to actually improving programs and providing a basis for future savings estimates.

Ideally the evaluation process should be integral to what is typically a cyclic planning-implementation-evaluation process. Therefore, while it is quite unlikely that a national standard would cover providing feedback to current and future program managers as an objective, it is reasonable to expect companion guidance documents would encourage such feedback (e.g., those that can be developed for analyzing non-energy co-benefits). For example, it might be suggested that evaluation planning should be part of the program planning process so that the evaluation effort can support program implementation and provide evaluation results in a timely manner that support existing and future programs.

4.3 Baselines

Question B1: What are the baselines against which savings are judged?

Standard baseline categories are Project-Specific Baselines, Performance Standard Baselines and Dynamic Baselines. The issue is sometimes presented as “is the baseline existing equipment/systems or what would be required by common practice, best practice, or a building

energy code or equipment/appliance standard?" In assessing the appropriate baseline, it is helpful to identify and group projects in categories of new construction, early replacement (of equipment or appliances), and end of life replacement projects.

Common approaches are:

- New construction and end of life replacement: baseline is either common practice, best practice, or a building energy code/standard.
- Early replacement: baseline is typically the existing equipment/appliances/systems that are in place and operating at time of retrofit.
- In some cases, a dynamic baseline is defined so that the baseline energy consumption changes over the life of a measure (e.g., at end of the useful life of early replaced equipment the baseline changes from existing equipment to code complying equipment). This approach has a strong technical basis but is more costly to determine savings in part because it can be challenging to determine the remaining lifetime of existing equipment in various situations.[32]

Question B2: Will national or regional baselines be defined or will differences between states in terms of common practice and/or building energy codes and standards be taken into consideration when establishing baselines?

If each state is allowed to establish its own baseline in estimating savings, then there could potentially be fifty sets of baseline requirements. This could lead to a number of complexities. For example, qualified measures in State A may not qualify in State B because those measures are common practice or are at or below a code requirement in State B. Moreover, the level of savings attributed to the same measure, installed under the same conditions (e.g., end-use, weather, usage pattern) would differ from state to state as the baselines differ in those states.

On the other hand, if a national baseline was established, would it be set at the level of the most 'efficient' states with perhaps high energy costs or at the lowest common dominator? If the former approach is used (i.e., national baseline set at levels that reflect practices in most efficient states), then many states may not get credit for improving the energy efficiency of their building stock from existing levels up to the national baseline. If the latter approach is used (i.e. national baseline set at efficiency levels that reflect practices in least efficient states), then many states might get credit for doing what is already common practice in their state. [33]

There is a both an equity issue as well as the technical issue of how exactly baselines are defined from state to state. A possible compromise that should be considered is the development of regional baselines.

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[32]Many homeowners and building owners utilize equipment and appliances far beyond their expected economic lifetime, often preferring to repair aging equipment rather than incurring significant capital costs of equipment replacement.

[33] The Proposed Federal energy legislation reviewed takes varying approaches as to whether states (or utilities) can take credit for savings from building energy codes and standards (see section 3).

4.4 EM&V Approaches

Question A1: Will a range of evaluation approaches be allowed or only a recommended approach? For determining net and/or gross savings? For determining other metrics?

Will a very prescriptive set of requirements be specified for various types of energy efficiency programmatic activities, or will each jurisdiction be allowed to pick from a range of approaches, as is common practice? If multiple approaches are selected, is that per best practices or to meet an overall level of savings estimation certainty/reliability or some other criteria?[34]

Existing guidance documents (e.g. California protocols and National Action Plan Impact Evaluation Guide) indicate a range of approaches as acceptable for calculating gross and net savings. Will acceptable EM&V approaches be defined for all types of measures or will each type/class of measure have a set of allowable approaches? Will there be guidance or prescriptive selection criteria for using particular approaches/methods?

Historically, a range of evaluation approaches has been allowed in state EM&V guidance documents and protocols because there are many types of efficiency activities and thus it is not possible to define requirements for every type of measure in every situation.

Question A2: Will top down and/or bottom up approaches be allowed/required?
See descriptions of top down and bottom up evaluation approaches in section 2.

Question A3: If an existing evaluation effort is underway, can it be used; and if so under what conditions?

Some utilities and states have developed existing, and long-standing, evaluation activities and protocols or have EM&V protocols that are under development. Regional Transmission Organizations (e.g., ISO New England) have also established guidance for how to document load impacts of energy efficiency measures during specified peak periods. Can these EM&V protocols be used, even if they do not match or are inconsistent with a national EM&V standard? Will these states end up having to prepare "two sets of books" – for example, one for documenting energy savings used to comply with a national energy resource standard and another for state regulatory agencies (e.g., reporting impacts of a portfolio of energy efficiency programs or for determining performance incentives for energy efficiency program administrators)?

Question A4: How will project and program implementation be verified and what will be the role of verification in the EM&V process?

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[34] Note that the application of "best practices" concepts in EM&V needs to be applied with caution as differing evaluation objectives and budget levels may significantly influence characterization of "best practices" under varying circumstances.

Measure or project verification is a component of almost all evaluation efforts and is aimed at confirming the installation of energy efficient measures at customer sites and checking associated documentation through review of reports, surveys and/or onsite inspections – with or without commissioning. Verification typically does not include primary research (e.g., billing analysis, metering) for the purpose of determining the energy use/savings of installed measures. Verification activities are conducted outside of and in addition to normal, routine quality assurance reviews undertaken by the program administrator as part of implementing programs. Verification can be the most important aspect of an independent evaluation effort for those measures in which deemed savings or deemed calculated values are used to estimate and determine savings.

In this report, thus far, we assume that a national EM&V standard would involve independent, ex-post determination of demand and/or energy savings for activities seeking to qualify under an energy resource standard. If this is the case then the EM&V activities would most likely include both project verification and evaluation (determination) of demand and/or energy savings.

However, another option which is simpler and is used for many private sector projects would be that the EM&V standard might simply involve a process for approving ex-ante (pre-project or program implementation) savings estimates combined with verifying installation of the indicated projects. Thus, in this approach, the savings are "confirmed" once it is verified that the actual projects and/or programs were implemented.

4.5 Certainty of Savings Determination

Question C1: How will accuracy or results be defined?

Historically, EM&V budgets for energy efficiency are first set and a level of effort is applied that fits within that budget. Some parameters may be set such as sampling precision/confidence, but other factors associated with systematic error are not. The fundamental issue of EM&V: "how good is good enough" will need to be addressed in a national EM&V standard, probably through a combination of subjective and objective requirements.

As mentioned earlier, there can be many uses and audiences for efficiency EM&V data; examples of potential users of the data are resource planners, air quality regulators, public utility commissions, and in-state program administrators. Ideally, a national EM&V standard can be established so that the results from evaluations can be used by most if not all the audiences so that multiple evaluations are not needed. Thus, one approach would be that a number of "reliability" or "certainty" goals can be defined, perhaps based on the needs of different audiences. These can be then input to a sensitivity analysis to compare EM&V costs, and certainty of results, for different example mixes of measures/programs/portfolios. The end result might then be a set of accuracy requirements that meet multiple needs.

Question C2: Will there be defined principles for savings determination?

Examples from the WRI GHG Protocol for Project Accounting[35] are: relevance, completeness, consistency, transparency, and accuracy. Should estimates be required to be conservative, that is calculated in a manner that tends towards under-estimating savings?

Question C3: Should a M&V 'lite' be allowed for small utilities, states and/or programs?

Many utilities rely solely on ex-ante estimates for small programs or certain efficiency measures. Will this be allowed and if so under what conditions? Will smaller programs have more flexibility in using deemed savings values? Will EM&V requirements differ for smaller utilities (below a specified size threshold) that presumably have fewer staff or technical resources or for whom EM&V requirements would account for a significant fraction of overall EE program costs?

Question C4: Will deemed savings values be allowed and if so what will be the sources of deemed savings values; to what extent will deemed savings values vary by state or region; and how will they be updated?

This could potentially be a challenging issue to address. A number of deemed savings databases (technical reference manuals, TRMs) currently exist in the U.S. (see Appendix B). It is safe to assume that at least some (if not many) of the values for the same measures are different across state technical reference manuals. These differences might be perfectly valid for technical reasons (e.g., differences in baseline assumptions, measure lifetimes, weather or demographics). However, some values might be different simply because different estimation methods and/or levels of rigor were used to calculate the values.

Thus, it will not be a simple matter to just use "existing" TRMs or to create a new national database. In order to do so, issues raised elsewhere in this section must be resolved (e.g., baseline issues). The State Energy Efficiency Action Network EM&V Work Group will be preparing a scoping study that assesses the need for additional regional, and/or national, databases; this scoping study may provide insights on differences between existing databases and a process for preparing a national TRM.

Question C5: Are savings reported based on ex-ante values or on ex-post? How are ex-post values used to update ex-ante values?

Estimates of savings from efficiency measures are typically made both prior to program implementation (i.e., *ex ante*) and after program implementation (i.e., *ex post*). *Ex post* estimates of cost and savings are generally considered a more accurate representation of actual cost and savings, particularly after they have been reviewed and analyzed by an independent, third-party evaluator, in which case they can be called *evaluated, ex post* estimates. Realization rates are a term used to indicate the difference between ex ante and ex post results, ex ante and ex post evaluated results, or between ex post and ex post evaluated results.

[35] http://www.wri.org/publication/greenhouse-gas-protocol-ghg-protocol-project-accounting

This raises issues such as:

- Should ex-ante stipulated savings claims be based on values from an approved technical reference manual (TRM), be adjusted retroactively based on ex post studies, or only applied on a going forward basis?
- If net savings are the metric used to count savings for energy efficiency resources and realization rates are used to indicate compliance for energy efficiency resources as part of a national energy resource standard, do the ex post evaluations utilize ex ante, ex post, or ex post evaluated values for net to gross ratios?

For example, for the first issue described above:

- Using TRM values developed in 2009 indicate that the savings from measures installed in a utility program in 2010 are 10,000 MWh.
- However, an ex-post evaluation indicates that the values in the TRM were overly optimistic and that the actual savings are 9,500 MWh.
- If all the measures were installed, does the state or utility get credit for 10,000 MWh of savings or only 9,500 MWh?

A typical, but not the only possible, approach is:

- Cost and savings estimates in the TRM should be based on the best available information at the time these estimates and/or calculations are made.
- Therefore, if *ex post* cost and savings estimates for efficiency measures and programs vary from *ex ante* estimates of cost and savings, *ex post* estimates should be the preferred values and adopted for use in future program savings claims.
- However, as a rule, deemed or deemed calculated savings claimed for prior measures or programs should not be adjusted retroactively for investments made in the current year. Effective useful life values however may be adjusted.
- Savings from custom projects or programs, where savings are determined ex-post using agreed to protocols, should use these *ex post* values as the credited savings.

4.6 Who Conducts Evaluation Activities

Question W1: How is independent evaluation defined? Which entities will hire and manage the evaluators?

Evaluators should ideally be impartial in their work and not have their compensation tied to the magnitude of their impact evaluation results. However, in many states, energy efficiency program administrators often fulfill many EM&V roles (for cost savings or other reasons). Thus, as part of developing a national EM&V protocol, it is likely that concepts such as “independent evaluation” and/or “third-party evaluation” will need to be defined. It is possible that acceptable institutional models and arrangements for what organizations or types of organizations conduct various types of EM&V activities may also have to be discussed. Examples of institutional models for EM&V roles and responsibilities include:

- EE Program Administrator (utility or state) manages and conducts EM&V with internal staff;

- EE Program Administrator manages and conducts EM&V utilizing third-party consultants;
- Regulatory oversight agency (e.g. state public utility commission), or surrogate entity that has been established by the state regulator (e.g. Advisory Board) oversees and manages EM&V with third-party consultants; or
- EE Program Administrator conducts EM&V with review and audit conducted by regulatory oversight agency.

If the energy resource standard is a renewable electricity or clean energy standard, those involved and interested in the results will expand well beyond energy efficiency stakeholders to create more options for who conducts the EM&V (e.g., evaluators that do not specialize in efficiency, but who cover the spectrum of all renewable electricity and/or clean energy resources). Moreover, there may be the potential for more conflicts as those associated with generation resources that potentially compete with energy efficiency would have a stake in the efficiency EM&V approaches and results.

Question W2: What are the types of EM&V activities that should be managed or conducted by EE program administrators, state regulatory commissions, state agencies, third-party evaluators, and DOE/FERC?

Examples of EM&V activities include:

- Utility, Statewide or regional market studies
- Planning and Management
- Process Evaluations
- Program Tracking Databases
- Primary Data Collection and Impact Analyses
- Audit - Data Collection and Impact Analyses (optional)
- Reporting
- Best Practices and Communication
- Conflict resolution

The EM&V standard will probably need to indicate what entities, or type of entities, conduct each of these activities.

Question W3: If an EE program administrator is allowed to conduct EM&V activities, what oversight is required?

This question can be broadened to an overall question of whether evaluation contractors can also perform program implementation and vice-versa, or should there be a strict prohibition against this potential conflict. In addition, if there is such a prohibition, does it apply to a contractor not doing evaluation and implementation in the same state, or any state, or for the same utility's programs or any utility?

Question W4: Will there be a Certification process for evaluators?

If so, who would run such as certification process? Will it create delays; can there be a grandfathering clause?

4.7 Reporting and Schedules

One of the key elements of an EM&V standard are the requirements for what needs to be reported (e.g., the savings metrics, the research plans, raw data, calculations, inspection reports, list of evaluators), how often and when, by whom and to whom, and in what format. Some of the questions these requirements raise are:

Question RS1: What are the reporting requirements, including schedules for reporting?

Implicit in this question is how much lag will be allowed between the end of a "crediting period" (e.g. a calendar year) and when the reports are required. EM&V requires analyses and it is not unusual for EM&V reports to require six months and longer for completion after a crediting period has ended.

Question RS2: Will standard reporting formats be required?

Examples of standard reporting formats are the EIA Form 861 Schedule 6[36] and the EM&V Forum's Common Statewide Energy Efficiency Reporting Guidelines.[37]

4.8 Dispute Resolution

Question D1: How are disputes between EE program administrators and state regulatory oversight agencies or DOE/FERC resolved with respect to EM&V implementation and results?

One element that connects dispute resolution and EM&V is whether the potential penalties for non-compliance are higher than or lower than the costs for conducting the EM&V. If penalties end up being very light, enforcement of EM&V requirements will be more difficult than if they are stringent (expensive).

4.9 Regulatory Requirements for Standards or Protocols

Question RR1: Are there formal definitions of standards (or protocols) for FERC or DOE?
Question RR2: Do FERC or DOE have formal procedures for developing standards?

An understanding is required of the procedures that might exist for preparing formal standards documents, what they must contain, and public processes for developing them and receiving comment.

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[36] http://www.eia.doe.gov/cneaf/electricity/forms/eia861/eia861instr.pdf
[37] http://neep.org/emv-forum/forum-products-and-guidelines

4.10 Other

Question O1: Are there alternative approaches, such as not certifying the approaches but certifying the practitioners that are allowed to do evaluation reporting for an energy resource standard?

A reality of EM&V is that it is as much an art as a science. Industry protocols and guidelines provide suggested EM&V approaches, but these are usually presented as a range of options. In practice, evaluation practitioners decide what approaches to use for a particular energy efficiency activity based on their own experience and perceptions of budget, needs for certainty, data availability, schedules, program characteristics and other factors. In effect, it is practitioner experience that guides many EM&V decisions as much as or more so than actual protocols. Thus, one option is to provide very general guidance and reporting requirements in an EM&V standard, but require the use of experienced, certified, EM&V practitioners who agree to follow certain ethical and industry practices.

Question O2: How will the EM&V standard be kept up to date with consideration of new legislative or regulatory requirement, new EM&V innovations, and changes in efficiency measures and options?

5. Implications for Development of a National Efficiency EM&V Standard

5.1 Summary of Issues

Energy efficiency is likely to play an increasing role in meeting future energy resource needs in the U.S. A new Federal energy resource standard (e.g., an EERS, a renewable electricity standard or a clean energy standard) that includes efficiency as a compliance option is an example of a policy driver that could further increase the role of energy efficiency. Two high-level questions are fundamental to measuring and verifying the load impacts that result from energy efficiency programs and projects– "*how good is good enough", and "compared to what*". These issues arise because of the unique characteristics of energy efficiency resources: it is not possible to construct a definitive baseline counter-factual (i.e., what would the energy consumer have done in the absence of a program intervention) and because savings are not measured, but estimated to varying degrees of certainty.

In this scoping study, in order to assess the implications of these two high-level questions, we identified and discussed a detailed list of issues (see section 4) that must be considered when developing a national EM&V standard for energy efficiency. These issues can be summarized into four broad categories:

1. What level of detail will be provided in the EM&V standard and how much flexibility will be left to professional discretion? And, if a significant amount of the definition of appropriate EM&V is left to professional discretion, should there be a certification process for such professionals?
2. Will EM&V requirements be performance-based (i.e. a requirement for a level of certainty) or prescriptive (i.e. requiring certain EM&V approaches for any given efficiency activity)? If a certain level of certainty (i.e. rigor is required), than how will that level be quantified when many aspects of uncertainty (e.g., systematic errors) are hard to quantify or if high levels of certainty preclude program administrators from being able to cost-effectively document their program results and impacts?
3. Who is responsible for conducting EM&V activities and documenting savings from energy efficiency resources that are used to comply with a national energy resource standard - a state agency, administrators of ratepayer-funded energy efficiency programs, (e.g., utilities), or independent, third-party EM&V professionals? Decisions on the appropriate organizational entity may limit the types of efficiency activities that are practical to document. For example, if utilities are responsible for EM&V, what about codes and standards which are generally the responsibility of states (and also very cost-effective efficiency actions).
4. What entities will be the users (audiences) for the results (information) that the EM&V standard generates beyond a Federal entity responsible for enforcing an energy resource standard? For example, will regional electricity system operators use the results for system planning and/or will environmental regulators use the results for determining compliance with emission reduction requirements?

Conceptual approaches that draw upon risk management techniques provide a useful framework for addressing EM&V issues identified in this report. Unfortunately, for energy efficiency, risk management is hampered by the large number of difficult to quantify aspects of efficiency and EM&V; although the tools for addressing this are improving (Mathews et al 2005). Other resources have uncertainty and risks as well (e.g., performance risks, cost of construction, and risk and uncertainties associated with future fuel costs). However, perhaps the single most identifiable risk of efficiency is the inability to directly measure savings, which creates uncertainty.

Tolerance for uncertainty is driven by how much risk is associated with getting the wrong answer. For example, with energy efficiency, the risks include crediting too much savings or too little savings to the actions that have been taken to comply with an energy resource standard. This can lead to expending too many resources on ineffective actions or the opposite, or simply not obtaining the desired outcome (i.e., less energy consumption). However, there is another counter-balancing risk, which is that if policymakers eliminate energy efficiency as an eligible resource because of this measurement risk, this implicitly means that only supply-side resources that have different, and perhaps greater, risks associated with their performance and/or lifecycle costs will be considered as eligible resources. Thus, the primary risk to be managed with efficiency EM&V might be approaches that over-specify certainty of what cannot be measured, which results in unnecessarily excluding or limiting energy efficiency as a compliance strategy. Perhaps this is summed up best by the quote attributed to Albert Einstein: "Everything that can be counted does not necessarily count; everything that counts cannot necessarily be counted."

5.2 Next Steps

A national EM&V standard for energy efficiency to meet the requirements of Federal energy legislation would likely be developed by a designated Federal agency responsible for implementing or administering portions of that legislation. However, the energy efficiency industry can accelerate the process by providing input now on these issues. Forums for providing this effort already exist and there is a large volume of literature on this topic.[38] In Appendix C, we provide an outline of a potential EM&V standard that can help organize discussion of the topics. We also recommend that stakeholders involved in the design, implementation, administration, and evaluation of efficiency activities (including customers) be consulted on EM&V requirements for energy efficiency resources. As a first step, facilitated workshops involving a select group of EM&V practitioners and program administrators may be useful as a way of developing "straw person" options and suggested approaches on issues highlighted in this scoping study on the design of a national EM&V standard or protocol. The straw person options and approaches could then be considered by a broader group of stakeholders.[39]

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[38] See Appendix B for list of EM&V forums and examples of the literature as well as a description of the relatively new field of top-down evaluation of efficiency activities.

[39] As part of this effort, EM&V practitioners may consider addressing the risk management issues described in this scoping study.

References

ACEEE 2010. “State Energy Efficiency Resource Standard (EERS) Activity 2010.” http://www.aceee.org/fact-sheet/state-energy-efficiency-resource-standard-eers-fact-sheet-u

ACEEE 2009. “Energy Efficiency Resource Standards 2009: A State Model.”

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) 2002. "Guideline 14-2002 - Measurement of Energy and Demand Savings." http://www.ashrae.org/

Barbose, G., C. Goldman, and J. Schlegel 2009. "The Shifting Landscape of Ratepayer-Funded Energy Efficiency in the U.S." *The Electricity Journal*, LBNL-2258E, October. http://eande.lbl.gov/EA/EMP/reports/lbnl-2258e.pdf

Bertoldi, P., S. Rezessy, E. Lees, P. Baudry, A. Jeandel, N. Labanca 2010. “Energy supplier obligations and white certificate schemes: Comparative analysis of experiences in the European Union.” *Energy Policy 38 1455–1469.*

Bingaman, J. 2009. "S. 1462, American Clean Energy Leadership Act". http://energy.senate.gov/public/_files/s1462pcs1.pdf

Bonneville Power Administration Office of Energy Resources Commercial Programs 2010. "Research Supporting an Update of BPA's Measurement and Verification Protocols, Final Report, April 2010." http://www.nwcouncil.org/rtf/studies/rfp/simplifiedM&V/M&V_Protocol_Review_040210.pdf; http://www.bpa.gov/Energy/N/Projects/cr_discount/pdf/site_specific_verification.pdf

California Commissioning Collaborative 2008. "Guidelines for Verifying Existing Building Commissioning Project Savings - Using Interval Data Energy Models: IPMVP Options B and C, Rev 1, 2008 (EBCx-M&V Guideline)." http://resources.cacx.org/library/holdings/VoS%20Guide%20111308_final.pdf

California Public Utilities Commission 2004. "The California Evaluation Framework 2004." http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/EM+and+V or http://www.calmac.org/publications/California_Evaluation_Framework_June_2004.pdf

California Public Utilities Commission 2006. "California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals". http://www.calmac.org/publications/EvaluatorsProtocols_Final_AdoptedviaRuling_06-19-2006ES.pdf

California Public Utilities Commission 2008. "Load Impact Estimation for Demand Response: Protocols and Regulatory Guidance (M&V), 2008." www.calmac.org/events/FinalDecision_AttachementA.pdf

California Public Utilities Commission 1999. "Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs. Prepared by

the California Demand Side Advisory Committee (CADMAC). (EM&V)," March. http://www.calmac.org/cadmac-protocols.asp

Consortium for Energy Efficiency 2010, "State of the Efficiency Program Industry: Budgets, Expenditures, and Impacts 2009," March. http://www.cee1.org/files/2010%20State%20of%20the%20Efficiency%20Program%20Industry.pdf

Efficiency Valuation Organization (EVO) 2010. "International Performance Measurement and Verification Protocol (IPMVP): Concepts and Options for Determining Energy and Water Savings - EVO-1000000-1-2007." http://www.evo-world.org

Efficiency Valuation Organization (EVO) 2010. "International Performance Measurement and Verification Protocol (IPMVP)." San Francisco, CA. http://www.evo-world.org

Goldman, C., M. Fuller, E. Stuart, J. Peters, M. McRae, N. Albers, S. Lutzenhiser, and S. Spahic. 2010. "Energy Efficiency Services Sector: Workforce Size and Expectations for Growth," LBNL-3987E, September.

Horowitz, M. "Measuring the savings from energy efficiency policies: a step beyond program evaluation." www.springerlink.com/content/l7140878t3411j02/

Intelligent Energy Europe project 2006. "Active Implementation of the European Directive on Energy Efficiency" (AID-EE) and "Guidelines For the Monitoring, Evaluation and Design Of Energy Efficiency Policies - How Policy Theory Can Guide Monitoring & Evaluation Efforts and Support The Design of SMART Policies," October. http://www.aid-ee.org/documents/000Guidelinesforthemonitoringevaluationanddesign.PDF

International Energy Agency (IEA) 2009. "Demand Side Management Agreements Task XXI on Standardization of Energy Savings Calculations." http://www.ieadsm.org/Content.aspx?ID=15

International Partnership for Energy Efficiency Cooperation (IPEEC) Website. "A partnership of G8 countries, China, India, South Korea and the European Community established in 2008 - EM&V." http://vibe1.nrel.gov/ipeec-login?p_p_id=56_INSTANCE_lO6t&p_p_lifecycle=1&p_p_state=exclusive&p_p_col_id=column-1&p_p_col_count=1 (Note - It is a website under construction and you have to create a new account)

International Performance Measurement and Verification Protocol (IPMVP) 2010. "Concepts and Options for Determining Energy and Water Savings, Volume 1," EVO 10000-1:2010. Prepared by the Efficiency Valuation Organization. September. www.evo-world.org

ISO New England 2010. "Manual for Measurement and Verification of Demand Reduction Value from Demand Resources (M-MVDR), Rev. 2, 2010." http://www.iso-ne.com/rules_proceds/isone_mnls/index.html

Lapillonne, B., D. Bosseboeuf, S. Thomas 2009. "Top-down evaluation methods of energy savings: Summary report," Wuppertal Institute on Behalf of the Evaluation and Monitoring for the European Union Directive on Energy End-Use Efficiency and Energy Services (EMEES)

Consortium. http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_WP5_Summary_report_May_2009.pdf ; http://www.evaluate-energy-savings.eu/emeees/downloads/WP_5_EMEEES_case_studies_report_Final.pdf

Loper, Joe, J. Harris, L. Ungar, S. Capanna, and S. Devranoglu 2008. "Deal or No Deal? Pros and Cons of Trading Under an Energy Efficiency Resource Standard." *Proceedings of 2008 Summer Study on Energy Efficiency in Buildings.* Washington, DC: August.

Lugar, R., L. Graham, and L. Murkowski 2010. "S.3464 -- Practical Energy and Climate Plan Act of 2010 (Introduced in Senate - IS)." http://thomas.loc.gov/cgi-bin/query/z?c111:S.3464: and http://www.pewclimate.org/federal/congress/111/lugar-practical-energy-climate-plan

Mathews, P., J. Kromer, O. Sezgen and Steven Meyers 2005. "Actuarial Pricing Of Energy Efficiency Projects: Lessons Foul And Fair." *Energy Policy 33 1319–1328.*

Messenger, M., R. Bharvirkar, B. Golemboski, C. Goldman S. Schiller 2010. "Review of Evaluation, Measurement and Verification Approaches Used to Estimate the Load Impacts and Effectiveness of Energy Efficiency Programs," LBNL-3277E, April.

Minnesota Office of Energy Security 2008. "Measurement and Verification Protocols for Large Custom Conservation Improvement Projects - Version 1." http://www.state.mn.us/mn/externalDocs/Commerce/MV_Protocols_122809031058_LargeProjectMVProtocols.pdf

National Action Plan for Energy Efficiency 2007. Model Energy Efficiency Program Impact Evaluation Guide. prepared by Steven R. Schiller, Schiller Consulting, Inc. www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf

New Jersey's Clean Energy Program 2010. "Protocols to Measure Resource Savings." http://www.njcleanenergy.com/main/public-reports-and-library/market-analysis-protocols/energy-savings-protocols/energy-savings-pr

New York State Energy Research and Development Authority (NYSERDA) 2008. "Energy $martSM Commercial/Industrial Performance program - M&V, 2008." http://www.nyserda.org/Funding/1101t3manual.pdf ; http://www.nyserda.org/Energy_Information/evaluation.asp

North American Energy Standards Board (NAESB) 2009. "Measurement and Verification of Demand Response Programs." http://www.naesb.org/pdf4/ferc041709_dsm_filing.pdf; The retail electric market standards for V 1.2 - http://www.naesb.org/req/req_final.asp

Northeast Energy Efficiency Partnership. "Regional Evaluation, Measurement and Verification Forum." http://www.neep.org/emv-forum

Northeast Energy Efficiency Partnerships (NEEP) 2010. "Regional EM&V Forum- Methods and Savings Assumptions Guidelines." http://neep.org/emv-forum/forum-products-and-guidelines

Northwest Regional Technical Forum Website. "Northwest Regional Technical Forum (RTF) - Pacific Northwest Deemed Measure Review and Simplified Measurement and Verification Protocols Projects." http://www.nwcouncil.org/rtf/subcommittees/deemed/Default.htm, rtfAdmin@nwcouncil.org

Ontario Power Authority (OPA) 2007. "Evaluation Measurement & Verification Framework for Ontario Power Authority (OPA) Conservation and Demand Management (CDM) Programs-v.1, 2007." http://www.powerauthority.on.ca/Storage/53/4852_FINAL_Framework_Oct_15.pdf

Oregon Department of Energy 2006. "Guide to Energy Savings Performance Contracting -(Sections 9 & 10), M&V, 2006." http://www.oregon.gov/ENERGY/CONS/school/docs/ESPCGuide.pdf

Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric (SDG&E) and Southern California Edison (SCE) 2010. "2010 California Statewide Customized Offering Procedures Manual for Business - Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric (SDG&E) and Southern California Edison (SCE) (M&V), Version 1, January 2010". SCE - http://www.sce.com/customized_solutions/; SDG&E - http://www.sdge.com/documents/business/savings/bid/ESBPolicyManual.pdf ; PG&E - http://www.pge.com/mybusiness/energysavingsrebates/rebatesincentives/ief/

PJM Forward Market Operations 2010. "PJM Manual 18B: Energy Efficiency Measurement & Verification, Rev. 1, 2010." http://www.pjm.com/~/media/documents/manuals/m18b.ashx

Rosenberg, M. and L. Hoefgen 2009. "CIEE Market Effects and Market Transformation: Their Role in Energy Efficiency Program Design and Evaluation, White Paper, 2009." http://uc-ciee.org/energyeff/documents/mrkt_effts_wp.pdf

Satchwell A., C. Goldman, P. Larsen, D. Gilligan, T. Singer 2010. “A Survey of the U.S. ESCO Industry: Market Growth and Development from 2008 to 2011,” LBNL-3479E, June.

SRC International A/S 2001. "European Ex-Post Evaluation Guidebook for DSM and EE Service Programmes,” April. www.aid-ee.org/documents/00MethodologyExpostevaluation.PDF

Texas Commercial and Industrial Standard Offer Program 2005. "Measurement and Verification Retrofit Guidelines." http://www.puc.state.tx.us/rules/rulemake/30331/m&v_guidelines.pdf ; AEP: http://aepefficiency.com/cisop/participation/measurin.htm ; Oncor: http://www.takealoadofftexas.com/index.aspx?id=commercial-standard-offer# ; Centerpoint: www.centerpointcisop.com ; Entergy: http://www.entergy-texas.com/content/Energy_Efficiency/ and http://www.entergy-texas.com/energy_efficiency/res_mv.aspx; Xcel:http://www.xcelefficiency.com/TX/COM/Xcel_CommercialSOPMVGuidelines_2010.pdf

U.S. Department of Energy. Energy Efficiency and Renewable Energy (EERE) Weatherization & Intergovernmental Program Website. "American Recovery and Reinvestment Act (ARRA) Reporting and EM&V Requirements for the State Energy Program (SEP)." http://www1.eere.energy.gov/wip/recovery_act_guidance.html

U.S. Department of Energy, Energy Efficiency and Renewable Energy (EERE) 2006. "Guide for Managing General Program Studies." http://www1.eere.energy.gov/ba/pba/pdfs/evaluation_mgmt_guide_final_2006.pdf

U.S. Department of Energy, Energy Efficiency and Renewable Energy (EERE) 2007. "Impact Evaluation Framework for Technology Deployment Programs." http://www1.eere.energy.gov/ba/pba/pdfs/impact_framework_tech_deploy_2007_main.pdf

U.S. Department of Energy, Federal Energy Management Program (FEMP) 2008. " M&V Guideline for Federal Projects, V.3." http://www1.eere.energy.gov/femp/pdfs/mv_guidelines.pdf

U.S. Environmental Protection Agency1990 and 1993. "U.S. EPA Conservation Verification Protocols - A Guidance Document for Electric Utilities Affected by the Acid Rain Program of the Clean Air Amendments of 1990, March 1993."

UNFCCC Clean Development Mechanism (CDM) program Website. http://cdm.unfccc.int/index.html

Vreuls H., S. Thomas, and J. Broc for the Wuppertal Institute on behalf of EMEEES Consortium 2009. "General Bottom-up Data Collection, Monitoring, and Calculation Methods." http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_Bottom_up_draft_overview081006.pdf

Waxman H., E. Markey 2009. "H.R. 2454: American Clean Energy and Security Act of 2009". http://www.cbo.gov/ftpdocs/102xx/doc10262/hr2454.pdf

Western Renewable Energy Generation Information System (WREGIS) Website. http://www.wregis.org/

Wisconsin Department of Administration Division of State Facilities 2009. "Guidelines for Energy Saving Performance Contracts for State Agencies and Energy Service Companies." http://www.doa.state.wi.us/docview.asp?docid=7388&locid=4

World Resource Institute 2005. "Greenhouse Gas Protocol: The GHG Protocol for Project Accounting." http://www.wri.org/publication/greenhouse-gas-protocol-ghg-protocol-project-accounting

Wuppertal Institute on Behalf of the Evaluation and Monitoring for the European Union Directive on Energy End-Use Efficiency and Energy Services (EMEES) Consortium 2009. "Measuring and reporting on energy savings for the Energy Services Directive - how it can be done: Results and recommendations from the EMEEES project." http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_Final_Report.pdf

Appendix A: Summary of EM&V-related provisions of proposed Federal energy legislation

Appendix A provides a summary of relevant provisions from HR2454 (the Waxman-Markey bill) and S1462 (Bingaman bill) that affect the development and scope of EM&V protocols.

A.1 HR 2454 provisions on energy efficiency resources and EM&V

The following text is from Title I (Clean Energy) of HR2454, which calls for a "Combined Efficiency and Renewable Electricity Standard". Title II (the Energy Efficiency section) of the bill includes provisions that support a number of energy efficiency initiatives. However, evaluation requirements associated with Title II are not covered because we only consider requirements associated with an EERS.

In the definitions section of Title I, "customer facility savings" are defined as: a reduction in end-use electricity consumption (including recycled energy savings) at a facility of an end-use consumer of electricity served by a retail electric supplier, as compared to—

> ''(A) in the case of a new facility, consumption at a reference facility of average efficiency;
>
> ''(B) in the case of an existing facility, consumption at such facility during a base period, except as provided in subparagraphs (C) and (D);
>
> ''(C) in the case of new equipment that replaces existing equipment with remaining useful life, the projected consumption of the existing equipment for the remaining useful life of such equipment, and thereafter, consumption of new equipment of average efficiency of the same equipment type; and
>
> ''(D) in the case of new equipment that replaces existing equipment at the end of the useful life of the existing equipment, consumption by new equipment of average efficiency of the same equipment type.

Also, in the definitions section of this Title 'Electricity Savings" are defined as: reductions in electricity consumption, relative to business-as-usual projections, achieved through measures implemented after the date of enactment of this section, limited to—

> ''(A) customer facility savings of electricity, adjusted to reflect any associated increase in fuel consumption at the facility;
>
> ''(B) reductions in distribution system losses of electricity achieved by a retail electricity distributor, as compared to losses attributable to new or replacement distribution system equipment of average efficiency;
>
> ''(C) CHP savings; and

‘‘(D) fuel cell savings.

Related to Electricity Savings is the definition of:

‘‘Total Annual Electricity Savings”, which is savings during a specified calendar year from measures implemented since the date of the enactment of this section, taking into account verified measure lifetimes or verified annual savings attrition rates, as determined in accordance with such regulations as the Commission may promulgate and measured in megawatt hours.

and

“Retail Electric Supplier’s Base Amount”, which is the total amount of electric energy sold by the retail electric supplier, expressed in megawatt hours, to electric customers for purposes excluding [certain generation sources]

The Title also seems to allow “Recycled Energy Savings” as a measure. This is often considered an efficiency measure and in defined in the Title as: a reduction in electricity consumption that results from a modification of an industrial or commercial system that commenced operation before the date of enactment of this section, in order to recapture electrical, mechanical, or thermal energy that would otherwise be wasted.

In the Title are the annual compliance obligations these are defined in two paragraphs [subsection (b)]:

For each of calendar years 2012 through 2039, not later than March 31 of the following calendar year, each retail electric supplier shall submit to the Commission an amount of Federal renewable electricity credits and demonstrated total annual electricity savings that, in the aggregate, is equal to such retail electric supplier’s annual combined target as set forth in subsection (d), except as otherwise provided in subsection (h).

For purposes of this subsection, submission of demonstrated total annual electricity savings means submission of a report that demonstrates, in accordance with the requirements of subsection (f), the total annual electricity savings achieved by the retail electric supplier within the relevant compliance year.

Language on reporting of savings in this Title includes:

Requirements.— The regulations promulgated under this section shall establish requirements governing the submission of reports to demonstrate, in accordance with the protocols and standards for measurement and third-party verification established under this subsection, the total annual electricity savings achieved by a retail electric supplier within the relevant year.

Review and Approval.—The Commission shall review each report submitted to the Commission by a retail electric supplier and shall exclude any electricity savings that have not been adequately demonstrated in accordance with the requirements of this subsection.

In the Title there is a relatively lengthy section titled “Standards For Measurement Of Savings”.

> As part of the regulations promulgated under this section, the Commission [i.e. the Federal Energy Regulatory Commission] shall prescribe standards and protocols for defining and measuring electricity savings and total annual electricity savings that can be counted towards the compliance obligation set forth in subsection (b) [see above].
>
> Such protocols and standards shall, at minimum—
>
> ‘‘(A) specify the types of energy efficiency and energy conservation measures that can be counted;
>
> ‘‘(B) require that energy consumption estimates for customer facilities or portions of facilities in the applicable base and current years be adjusted, as appropriate, to account for changes in weather, level of production, and building area;
>
> ‘‘(C) account for the useful life of measures;
>
> ‘‘(D) include deemed savings values for specific, commonly used measures;
>
> ‘‘(E) allow for savings from a program to be estimated based on extrapolation from a representative sample of participating customers;
>
> “(F) include procedures for counting CHP savings, recycled energy savings, and fuel cell savings;
>
> ‘‘(G) include procedures for documenting measurable and verifiable electricity savings achieved as a result of market transformation efforts;
>
> ‘‘(H) include procedures for counting electricity savings achieved by solar water heating and solar light pipe technology that has the capability to provide measurable data on the amount of megawatt-hours displaced;
>
> ‘‘(I) avoid double-counting of savings used for compliance with this section, including savings that are transferred pursuant to paragraph (3);
>
> ‘‘(J) ensure that, except as provided in subparagraph (L), the retail electric supplier claiming the savings played a significant role in achieving the savings (including through the activities of a designated agent of the supplier or through the purchase of transferred savings);
>
> ‘‘(K) include savings from programs administered by a retail electric supplier (or a retail electricity distributor that is not a retail electric supplier) that are funded by State, Federal, or other sources; ‘

"(L) in any State in which the State regulatory authority has designated 1 or more entities to administer electric ratepayer-funded efficiency programs approved by such State regulatory authority, provide that electricity savings achieved through such programs shall be distributed equitably among retail electric sup- pliers in accordance with the direction of the relevant State regulatory authority; and

''(M) exclude savings achieved as a result of compliance with mandatory appliance and equipment efficiency standards or building codes. '

Other relevant text includes:

Standards for Third-Party Verification of Savings.—The regulations promulgated under this section shall establish procedures and standards requiring third-party verification of all reported electricity savings, including requirements for accreditation of third-party verifiers to ensure that such verifiers are professionally qualified and have no conflicts of interest.

Alternative Measurement And Verification Procedures And Standards.—As part of an application submitted under subparagraph (A), a State may request to use alternative measurement and verification procedures and standards to those specified in paragraphs (1) and (2), provided the State demonstrates that such alternative procedures and standards provide a level of accuracy of measurement and verification at least equivalent to the Federal procedures and standards promulgated under paragraphs (1) and (2).

A.2 S1462, Bingaman provisions on energy efficiency resources and EM&V

The following text is from Title I, Subtitle C (Federal Renewable Electricity Standard) of S 1462, which called for a "Federal Renewable Electricity Standard". Title II, which is the Enhanced Energy Efficiency section, covered a number of efficiency programs. However, evaluation requirements associated with Title II are not covered since this write up is only considered with requirements associated with the resource standards.

The defining provisions of the Subtitle with respect to efficiency requirements are:

- "….. each electric utility that sells electricity to electric consumers for a purpose other than resale shall obtain a percentage of the base quantity of electricity the electric utility sells to electric consumers in any calendar year from renewable energy or energy efficiency."
- "An electric utility shall meet the requirements …. [by a number of methods including:] submitting Federal energy efficiency credits issued under subsection (i), except that those credits may not be used to meet more than 26.67 percent of the requirements …. in any calendar year;"

The approaches for showing compliance are efficiency credit trading programs. The language establishing the programs is:

''Not later than January 1, 2011, the Secretary shall establish a Federal renewable energy credit trading program, and a Federal energy efficiency credit trading program, under which electric utilities shall submit to the Secretary Federal renewable energy credits and

Federal energy efficiency credits to certify the compliance of the electric utilities with subsection (b)(1)."

In the Subtitle there are definitions of what constitutes electricity savings, presumably for purposes of creating efficiency credits. The language provides an overview of how baselines are to be defined. The relevant language is:

''(A) CUSTOMER FACILITY SAVINGS.—The term 'customer facility savings' means a reduction in the consumption of end-use electricity at a facility of an end-use consumer of electricity served by an electric utility, as compared to—

''(i) consumption at the facility during a base year, taking into account reductions attributable to causes other than energy efficiency investments (such as economic downturns, reductions in customer base, favorable weather conditions, or other such causes); or '

"(ii) in the case of new equipment (regardless of whether the new equipment replaces existing equipment at the end of the useful life of the existing equipment), consumption by similar equipment of average efficiency available for purchase at the time that new equipment is acquired."

''(B) ELECTRICITY SAVINGS.—The term 'electricity savings' means—

''(i) customer facility savings of electricity consumption adjusted to reflect any associated increase in fuel consumption at the facility;

''(ii) reductions in distribution system losses of electricity achieved by a retail electricity distributor, as compared to losses attributable to new or replacement distribution system equipment of average efficiency (as defined by the Secretary by regulation); and

''(iii) the output of new combined heat and power systems, to the extent provided under paragraph (5).

''(C) QUALIFIED ELECTRICITY SAVINGS.— The term 'qualified electricity savings' means electricity saving that meet the measurement and verification requirements of paragraph (4)."

STANDARDS.—No credits shall be issued for electricity savings achieved as a result of compliance with a national, State, or local building, equipment, or appliance efficiency standard.

The EM&V requirements are described in this language:

''(4) Measurement and Verification of Electricity Savings.—Not later than January 2010, the Secretary shall promulgate regulations regarding the measurement and verification of electricity savings under this subsection, including regulations covering—

''(A) procedures and standards for defining and measuring electricity savings that will be eligible to receive credits under paragraph (3), which shall—

''(i) specify the types of energy efficiency and energy conservation that will be eligible for the credits;

‘‘(ii) require that energy consumption for customer facilities or portions of facilities in the applicable base and current years be adjusted, as appropriate, to account for changes in weather, level of production, and building area;
‘‘(iii) account for the useful life of electricity savings measures;
‘‘(iv) include specified electricity savings values for specific, commonly-used efficiency measures; and
‘‘(v) exclude electricity savings that—
(I) are not properly attributable to measures carried out by the entity seeking the credit; ‘‘
(II) have already been credited under this section to another entity; or
(III) do not result from actions not intended to achieve electricity savings;”

‘‘(B) procedures and standards for third- party verification of reported electricity savings; and”
‘‘(C) such requirements for information, reports, and access to facilities as may be necessary to carry out this subsection.”

Appendix B: Summary of energy efficiency program evaluation, measurement and verification guidance documents and forums

Appendix B provides brief summaries of selected evaluation, measurement & verification (EM&V) guidelines, protocols, or standards that have been developed or are under development by industry, nonprofit, governmental, national and international organizations. We have tried to select protocols and standards that are representative of industry practice. These EM&V protocols or standards establish procedures and methods to quantify savings from energy efficiency projects and programs in a transparent and repeatable fashion. These documents and the on-going efforts to document and improve best practices form the basis for EM&V as practiced at the state, regional, national and international levels for the calculation of savings due to energy saving and demand response projects.

Appendix B is organized as follows. In section B.2, we provide a list of representative EM&V guidance documents that are used to conduct EM&V for a range of energy efficiency programs. For each guidance document, we review the purpose, scope and intended audience of the EM&V guidance document (e.g. impact evaluation, process evaluation, market effects) and types of efficiency programs and market sectors for which the EM&V guidance document is applicable or intended (e.g., resource acquisition programs, demand response, market transformation programs, building commissioning). In section B.3, we describe ongoing public forums that are developing protocols or standards or best practices EM&V guidance materials. In section B.4, we review and summarize information on states (and regions) with some form of EM&V protocol documents that are used to guide their evaluation efforts. Section B.5 briefly describes the emerging area of energy efficiency "top down" evaluation.

B.1 Existing EM&V Guidance Documents

State-Level Documents

1.1 California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals, April 2006

http://www.calmac.org/events/EvaluatorsProtocols_Final_AdoptedviaRuling_06-19-2006.pdf* or *http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/EM+and+V

Purpose: The CA EM&V Protocols provide guidance and requirements for planning and conducting evaluations of California's energy efficiency programs and program portfolios launched after December 31, 2005. These protocols are significantly grounded in the *California Evaluation Framework.*

Types of Energy Efficiency Programs: Energy efficiency and resource acquisition programs; market transformation programs; information and education programs

Markets: Residential, commercial, industrial, and agricultural facilities
Evaluation Types

- *Direct and Indirect Impact Evaluation, and Measurement and Verification*
  - Gross energy/demand savings
  - Net energy/demand savings
  - Co-benefits (non-energy/indirect impact benefits)
- *Process Evaluations*
- *Market Effects Evaluation*
- *Emerging Technology*
- *Codes and Standards*
- *Effective Useful Life (EUL)*

Audience: Regulatory staff and policy makers, resource planners, program portfolio managers, program planners and implementers, and evaluators.

1.2 The California Evaluation Framework 2004 *http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/EM+and+V* or *http://www.calmac.org/publications/California_Evaluation_Framework_June_2004.pdf*.

Purpose: An EM&V guidance document that provides a rigorous and consistent systems approach for planning and conducting evaluations of California's energy efficiency programs that focus on resource acquisition. Goal is to be able to document the effects of all energy efficiency programs in order to facilitate comparisons with other EE programs and supply-side options.

Types of Energy Efficiency Programs: Energy efficiency resource acquisition programs, market transformation programs, information and education programs.

Markets: Residential, commercial, industrial, and agricultural facilities

Evaluation Types

- *Impact Evaluation, and Measurement and Verification*
  - Gross energy/demand savings (fuel oil, natural gas and electricity)
  - Net energy/demand savings
  - Market and non-energy effects
  - Cost Effectiveness
- *Process Evaluations*
- *Information and Education Program Evaluation*
- *Market Transformation Program Evaluation*

Audience: Regulatory staff and policy makers, resource planners, program portfolio managers, program planners and implementers, and evaluators.

1.3 California Public Utilities Commission (CPUC) 1998, Revised March 1999. Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs. Prepared by the California Demand Side Advisory Committee (CADMAC). (EM&V)

http://www.calmac.org/cadmac-protocols.asp

This EM&V document, which is superseded by the *2004 California Evaluation Framework and the 2006 California Energy Efficiency Evaluation Protocols*, identified the protocols and procedures used by the four major California investor-owned utilities to document and verify the costs and benefits of major Demand-Side Management (DSM) program activities for purpose of shareholder earnings and resource planning. The document also described and identified the regulatory process for measurement protocols used to assess reported program costs and benefits.

Types of Energy Efficiency Programs: Resource acquisition

Markets: Residential, non-residential

Evaluation Types

- *Impact Evaluation, and Measurement and Verification*
  - Gross energy/demand savings (fuel oil, natural gas and electricity)
  - Net energy/demand savings
  - Market and non-energy effects
  - Cost Effectiveness
- *Process Evaluations*

Audience: Regulatory staff and policy makers, power planning personnel, program portfolio managers, program planners and implementers, and evaluators.

1.4 CIEE Market Effects and Market Transformation: Their Role in Energy Efficiency Program Design and Evaluation, White Paper, 2009

http://www.calmac.org/publications/Market_Effects_and_Market_Transformation_White_Paper.pdf.

Purpose: This report is intended to serve as a resource book of concepts, strategies, and practical solutions for challenges that typically arise in programs whose objectives include market transformation. The focus is on the use of evaluation and other types of research to guide program development and delivery and to assess progress and results. The white paper also offers a number of specific recommendations for consideration by the CPUC and the California utilities as they move forward to design and implement the 2009 – 2011 energy efficiency programs.

Types of Energy Efficiency Programs: Resource acquisition

Markets: Residential and Non-residential

Evaluation Types: Market transformation

Audience: Regulatory staff and policy makers, resource planners, program portfolio managers, program planners and implementers, and evaluators.

1.5 California Public Utilities Commission (CPUC) Load Impact Estimation for Demand Response: Protocols and Regulatory Guidance (M&V), 2008

www.calmac.org/events/FinalDecision_AttachementA.pdf

Purpose: The Demand Response protocols and guidance address both ex post evaluation and ex ante estimation of DR impacts. The load impact protocols not only provide input to determining DR resource cost-effectiveness, but also assist in resource planning and long-term forecasting. These protocols establish (a) minimum requirements for load impact estimation for DR resources and provide guidance concerning issues that must be addressed and methods that can be used to develop load impact estimates for use in long term resource planning; (b) provide guidance for ex post evaluation of event-based resource options, ex post evaluation of non-event based resources and ex ante estimation for all resource options, although the differences across the three categories are relatively minor

Types of Energy Efficiency Programs: Acquisition of DR Resources

Markets: Residential, non-residential

Evaluation Types

- *Impact Evaluation, and Measurement and Verification*
  - Gross demand savings
  - Net demand savings
  - Cost Effectiveness

Audience: Regulatory staff and policy makers, resource planners, program portfolio managers, program planners and evaluators.

1.6 The California Commissioning Collaborative: Guidelines for Verifying Existing Building Commissioning Project Savings - Using Interval Data Energy Models: IPMVP Options B and C, Rev 1, 2008 (EBCx-M&V Guideline)

http://resources.cacx.org/library/HoldingSearchResults.aspx

Description of Organization: The California Commissioning Collaborative (CCC) sponsored this project as part of its on-going effort to develop specific M&V guidance to verify savings in existing building commissioning (EBCx) projects. These guidelines represent one of several methods that may be employed. The CCC plans to develop additional guidance documentation in the near future.

Purpose: EBCx-M&V Guideline describes how to apply IPMVP M&V concepts and ASHRAE methodologies to existing building commissioning (EBCx) projects. It is designed to help commissioning service providers, building owners and managers, and energy efficiency program managers understand how to manage, design, and complete robust M&V procedures for individual EBCx projects. It provides guidance on designing M&V strategies,

identifying and using data resources, selecting an energy modeling methodology, scheduling M&V activities within the process of an EBCx project, and leveraging the many synergies between the IPMVP and ASHRAE processes.

Types of Energy Efficiency Programs: Resource acquisition - commissioning

Markets: Existing buildings

Evaluation Types

- *Impact Evaluation, Measurement and Verification*
  - Gross energy/demand savings
  - Net energy/demand savings

Audience: commissioning service providers, building owners and managers, and energy efficiency program managers

1.7 2010 California Statewide Customized Offering Procedures Manual for Business - Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric (SDG&E) and Southern California Edison (SCE) (M&V), Version 1, January 2010

SCE – *http://www.sce.com/customized_solutions/*

SDG&E –
http://www.sdge.com/documents/business/savings/bid/ESBPolicyManual.pdf

PG&E -
http://www.pge.com/mybusiness/energysavingsrebates/rebatesincentives/ief/

Purpose: The M&V guidelines for California state-wide Customized Offerings programs (Standard Performance Contract programs, NRR-DR) define requirements for developing measure-specific measurement and verification (M&V) plans (measured savings approach) to quantify the energy savings and the peak electrical demand reduction resulting from a project's energy efficiency measures. These guidelines generally derive from the 2009 International Performance Measurement and Verification Protocol (IPMVP).

Types of Energy Efficiency Programs: Resource acquisition: performance-based programs

Markets: Non-Residential Customers (Commercial, industrial, agricultural facilities) who receive energy services from California's investor-owned utilities

Evaluation Types

- *Impact Evaluation, Measurement and Verification*
  - Gross energy/demand savings
  - Net energy/demand savings
  - Net-to-Gross adjustment factors

Audience: Business customers, project sponsors (ESCOs/Third Parties), utility administrators.

1.8 Minnesota Office of Energy Security - Measurement and Verification Protocols for Large Custom Conservation Improvement P Projects - Version 1, April 2008

http://www.state.mn.us/mn/externalDocs/Commerce/MV_Protocols_122809031058_LargeProjectMVProtocols.pdf

Purpose: Minnesota M&V protocols were developed in order to standardize M&V activities for large custom energy efficiency projects among utilities in Minnesota. The protocols provide three primary options for performing M&V, adapted from IPMVP Options A through C. The options are to be applied on a per-measure basis.

1. Third-party Engineering Review –similar to IPMVP Options A or B.
2. Equipment Sub-Metering – similar to IPMVP Option B.
3. Facility Metering – similar to IPMVP Option C

Types of Energy Efficiency Programs: Resource acquisition

Markets: Large non-residential

Evaluation Types

- Impact Evaluation, and Measurement and Verification
  - Gross energy/demand savings
  - Net energy/demand savings

Audience: Energy service companies, policy makers, evaluators, program planners and administrators

1.9 New Jersey's Clean Energy Program Protocols to Measure Resource Savings, December 2009

http://www.njcleanenergy.com/main/public-reports-and-library/market-analysis-protocols/energy-savings-protocols/energy-savings-pr

Purpose: These statewide EM&V protocols provide methods for determining energy and resource savings, including electric energy capacity, natural gas, and other resource savings, and to measure electric energy and capacity from renewable energy and distributed generation systems for technologies and measures supported by New Jersey's Clean Energy Program. The protocols provide the methods to measure per unit savings for program tracking and reporting.

Types of Energy Efficiency Programs: Resource acquisition

Markets: Residential, Non-residential

Evaluation Types

- *Impact Evaluation, and Measurement and Verification*
  - Gross energy/demand savings
  - Net energy/demand savings
  - Cost effectiveness

Audience: Energy service companies, regulatory staff and policy makers, resource planners, program portfolio managers, program planners and implementers, and evaluators, equipment distributors or manufacturers

1.10 NYSERDA 1.1.1 The New York State Energy Research and Development Authority (NYSERDA): Energy $martSM Commercial/Industrial Performance program – M&V, 2008

http://www.nyserda.org/Funding/1101t3manual.pdf
http://www.nyserda.org/Energy_Information/evaluation.asp

Purpose: The options and methods used in NYSERDA's C/I Performance Program are adopted from those defined in the 2000 International Performance Measurement and Verifications Protocol (IPMVP) and the 1996 Federal Energy Management Program (FEMP) M&V Guideline. Four basic options are outlined in the IPMVP.

Types of Energy Efficiency Programs: Resource acquisition: performance-based programs

Markets: existing buildings, new construction, industrial facilities, and vehicle fleets

Evaluation Types:

- Impact Evaluation, and Measurement and Verification
  - Gross energy/demand savings
  - Net energy/demand savings
  - Economic Impacts
- Process Evaluation
- Market Effects

Audience: ESCOs, regulatory staff and policy makers, program portfolio managers, program planners and implementers, and evaluators.

1.11 Oregon Department of Energy, Guide to Energy Savings Performance Contracting –(Sections 9 & 10), M&V, 2006

http://www.oregon.gov/ENERGY/CONS/school/docs/ESPCGuide.pdf

Purpose: The Oregon Department of Energy (ODOE) prepared this guide to help state agencies, school districts, and local governments improve their buildings using energy savings performance contracting. The guide also provides methods to measure energy savings and gives advice on project monitoring and management that are consistent with 2001 IPMVP options B, C, and D.

Types of Energy Efficiency Programs: Resource acquisition: performance-based programs

Markets: Local and State government facilities

Evaluation Types:

- Impact Evaluation and Measurement and Verification
  - Gross energy/demand savings
  - Net energy/demand savings

Audience: ESCOs, state agencies, policy makers, evaluators, program planners and administrators.

Other important New York EM&V documents are the New York Technical Manual and Reporting Guidelines, both developed by the Department of Public Service for use on the Energy Efficiency Portfolio Standard Programs.

http://www.dps.state.ny.us/TechManualNYRevised10-15-10.pdf
http://www.dps.state.ny.us/Reporting_Manual_6-30-09.pdf

1.12 Texas Commercial and Industrial Standard Offer Program – Measurement and Verification Retrofit Guidelines, 2005

http://www.puc.state.tx.us/rules/rulemake/30331/m&v_guidelines.pdf
AEP**:** ***http://aepefficiency.com/cisop/participation/measurin.htm***
Oncor: ***http://www.takealoadofftexas.com/index.aspx?id=commercial-standard-offer#***
Centerpoint: ***www.centerpointcisop.com***
Entergy: ***http://www.entergy-texas.com/content/Energy_Efficiency/*** and ***http://www.entergy-texas.com/energy_efficiency/res_mv.aspx***
Xcel:***http://www.xcelefficiency.com/TX/COM/Xcel_CommercialSOPMVGuidelines_2010.pdf***

Purpose: Texas M&V guidelines for retrofit and new construction projects under the Commercial and Industrial Standard Offer Programs (SOP) provide measure-specific M&V approaches representing increasing levels of detail and rigor. These approaches vary depending on the type of retrofit and equipment, operational predictability and project complexity. With the exception of lighting measures that qualify for deemed savings approaches in Texas, these M&V approaches adhere to the standards of the IPMVP.

- Deemed savings (in select applications)
- Simplified M&V methods
- Full M&V methods
- Alternate M&V methods may be proposed by Sponsor, but must adhere to IPMVP and be approved by Utility

Types of Energy Efficiency Programs: Resource acquisition: performance-based programs

Markets: Residential, commercial, industrial, government, and nonprofit facilities, new construction

Evaluation Types

- Impact Evaluation, and Measurement and Verification
  - Gross energy/demand savings
  - Net energy/demand savings

Audience: Energy service companies, equipment distributors or manufacturers, community-based organizations, mechanical or lighting contractors, any other entity providing energy efficiency services, regulatory staff and policy makers, program planners and evaluators.

1.13 Wisconsin Depart of Administration–Guidelines for Energy Saving Performance Contracts for State Agencies and Energy Service Companies, 2009

http://www.doa.state.wi.us/docview.asp?docid=7388&locid=4

Purpose: This M&V guide provides administrative and technical guidance to state agencies, energy service companies, and others involved in preparing technical reports and drafting energy performance-based contracts for review and approval and also stipulates the type of M&V activities that must be undertaken. It directs ESCOs to follow the performance measurement and verification guidelines adopted by the Federal Energy Management Program (FEMP) as the basis for validating energy savings and paybacks. FEMP measurement and verification guidelines are based on four general approaches to assessing savings (Options A, B, C, and D) which are designed to cover the spectrum of project complexity.

Types of Energy Efficiency Programs: Resource acquisition

Markets: State buildings

Evaluation Types

- Impact Evaluation, and Measurement and Verification
  - Gross energy/demand savings
  - Net energy/demand savings

Audience: ESCOs, state agencies, policymakers, evaluators, program planners and administrators

Regional Level Documents

1.14 Northeast Energy Efficiency Partnerships (NEEP) Regional EM&V Forum-Methods and Savings Assumptions Guidelines, May 2010

http://neep.org/emv-forum/forum-products-and-guidelines

Overview: The Regional Evaluation, Measurement and Verification Forum (EM&V Forum) supports the development and use of common and/or consistent protocols to evaluate, measure, verify, and report the savings, costs, and emission impacts of energy efficiency. The EM&V Forum is facilitated by the Northeast Energy Efficiency Partnerships (NEEP). Supported by a New England Conference of Public Utilities Commissioners resolution and a complementary Mid-Atlantic Conference of Regulatory Utilities Commissioners resolution, the Forum is also funded by Federal, state, and private foundation sources. A steering committee and project committees, consisting of people from regulatory agencies, investor-owned utilities, Federal and state agencies, trade groups, and not-for-profit organizations provide input and oversight. The Regional EM&V forum is executing a three-year plan (2009-2011) to promote standardized EM&V.

Purpose: The NEEP EM&V Methods and Savings Assumptions Guidelines have been developed to provide clarity, transparency, and a common understanding of methods to consider in determining gross energy and demand savings, and savings assumptions for any one program/measure type, and/or in combination, depending on the specific energy efficiency project, program or portfolio objectives. The Guidelines are intended only to guide the design of comprehensive studies that estimate multiple impact parameters for a priority set of energy efficiency program/project types or measures.

Types of Energy Efficiency Programs: Resource Acquisition

Markets: Residential, commercial, and industrial.

Evaluation Type:

- *Impact Evaluation and M&V*
  - Gross energy/demand savings
  - Net energy/demand savings
  - Baseline conditions
  - Measure life and persistence.

Audience: State and regional policy makers, evaluators, program administrators, and others

1.15 PJM Manual 18B: Energy Efficiency Measurement & Verification, Rev. 1, 2010 - PJM Forward Market Operations.

http://www.pjm.com/documents/manuals.aspx

Description of Organization: PJM Interconnection is a regional transmission organization (RTO) that coordinates movement (buying, selling, and delivery) of wholesale electricity. PJM serves all or parts of 13 states and the District of Columbia.

Background: An EE Resource may be used as Capacity Resource in the PJM Capacity Market starting with the 2011/12 Delivery Year. Planned energy efficiency projects will be allowed to offer into Reliability Pricing Model Auctions or to be committed in a Fixed Resource Requirement Alternative Capacity Plan for up to four consecutive Delivery Years.

In order to receive capacity payments from PJM, energy efficiency resource providers must comply with the M&V standards in PJM Manual18B.

Purpose: Manual 18B provides a framework for project-specific M&V methods and techniques that will be used to determine and verify the demand reduction resulting from an energy efficiency resource. It lists all four IPMVP Options as acceptable measurement and verification methodologies and permits engineering calculations and audit results and load shape analysis as acceptable alternative methodologies. The manual serves the following purposes:

- Provides a foundation for an M&V plan utilizing a "best practice" approach, which considers technical accuracy and cost-effectiveness.
- Provides guidance on what is essential for a robust Initial M&V Plan for an EE Resource.
- Describes the components of Initial M&V Plans, Updated M&V Plans and Post-Installation M&V Report Submittals.

Type of Energy Evaluation Programs: Resource Acquisition: Peak Demand Impacts

Evaluation Types:

- Impact evaluation and M&V.
  - Peak demand savings

Audience: Applicants to the Reliability Assurance agreement, Operation Agreements and OATT Operating Agreement of PJM Interconnection, L.L.C.; resource providers and those interested in providing EE Resources that will be made available to provide reliable service to loads within the PJM Region; Load Serving Entities (LSEs) for load served in the PJM Region; PJM members and staff; parties that may be responsible for performing a M & V Audit

1.16 ISO New England Manual for Measurement and Verification of Demand

http://www.iso-ne.com/rules_proceds/isone_mnls/index.html.

Purpose: This M&V manual specifies required information, details, approaches, methodologies, conditions, calculations, variables, parameters, monitoring, validations, reporting, certifications, responsibilities, and plan format for M&V of Demand Reduction Values to be used for On-Peak Demand Resources, Seasonal Peak Demand Resources, Real-Time Demand Response Resources, and Real-Time Emergency Generation Resources. It outlines four acceptable measurement and verification methodologies consistent with the IPMVP. ISO New England's M-MVDR manual also allows for justifiable methods that are not consistent with the IPMVP.

Types of Programs: Demand resources (e.g., energy efficiency, demand response), Distributed generation resources

Markets: Residential, Non-residential

Evaluation Types:

- *Impact Evaluation and M&V*
  - Gross Demand savings
  - Net Demand Savings

Audience: Project Sponsors, evaluators, policy makers

Federal & National Level Documents

1.17 National Action Plan for Energy Efficiency, 2007. Model Energy Efficiency Impact Evaluation Guide (***www.epa.gov/eeactionplan***)
http://www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf

Purpose: The NAPEE EM&V guide has become a well-referenced resource for utility and public sector energy efficiency program impact evaluations. This Guide describes a structure and several industry-standard approaches for calculating energy, demand, and emissions savings resulting from facility (non-transportation) energy efficiency programs that are implemented by cities, states, utilities, companies, and similar entities. By using best practices and consistent procedures, evaluations can support the adoption, continuation, and expansion of efficiency programs. The primary audience for this Guide is energy efficiency program designers and evaluators looking for guidance on the evaluation process and key issues relating to documenting energy and demand savings, documenting avoided emissions, and comparing demand- and supply-side resources. Introductory portions are also intended for policy-makers seeking information about the basic principles of efficiency evaluation. Appendices provide definitions, information on other types of evaluations, references/resources, and a detailed discussion of uncertainty.

Types of Energy Efficiency Programs: Resource acquisition

Markets: Residential, commercial and industrial facilities

Evaluation Types:

- *Impact Evaluation and M&V*
  - Gross energy/demand savings (fuel oil, natural gas and electricity)
  - Net energy/demand savings, and
  - Co-benefits (non-energy benefits)
  - Cost effectiveness
  - emissions

Audience:

- Energy efficiency program planners, designers, evaluators, and policy-makers

1.18 U.S. EPA Conservation Verification Protocols – A Guidance Document for Electric Utilities Affected by the Acid Rain Program of the Clean Air Amendments of 1990, March 1993

Purpose: The Conservation Verification Protocols (CVP) allows two general approaches for estimating savings: the monitored savings approach (preferred – measurement of energy use) and the stipulated savings approach which includes procedures for estimating savings, as well as simple equations and standard values for estimating stipulated savings from a limited number of measures for which expected savings are well understood. This path also includes criteria for developing program-specific engineering estimates. The CVP also includes guidelines for verifying the persistence energy savings from conservation measures.

Types of Energy Efficiency Programs: - Acid Rain Program (Clean Air Act Amendments of 1990)

Markets: Non-residential - utility programs

Evaluation Type:

- *Impact Evaluation and Measurement and Verification - Project-based*
  - Gross energy/demand savings
  - Net energy/demand savings, and
  - Co-benefits (non-energy benefits)

Audience: Public and investor-owned utilities, state regulatory commissions

1.19 U.S. DOE Federal Energy Management Program (FEMP) M&V Guideline for Federal Projects, V.3, 2008

***http://www1.eere.energy.gov/femp/pdfs/mv_guidelines.pdf*.**

Purpose: The FEMP M&V document provides procedures and guidelines (compatible and consistent with the IPMVP) for measuring and verifying the savings resulting from energy efficiency equipment, water conservation, improved operation and maintenance, renewable energy, and cogeneration projects implemented through Federal energy savings performance contracts.

Types of Energy Efficiency Programs: - Energy efficiency resource acquisition

Markets: Federal government buildings/facilities

Evaluation Type:

- *Impact Evaluation and Measurement and Verification - Project-based*
  - Gross energy/demand savings
  - Net energy/demand savings, and
  - Co-benefits (non-energy benefits)

Audience: Public and investor-owned utilities, state regulatory commissions, evaluators

1.20 U.S. DOE Energy Efficiency and Renewable Energy (EERE) Guide for Managing General Program Studies , 2006

http://www1.eere.energy.gov/ba/pba/pdfs/evaluation_mgmt_guide_final_2006.pdf

Purpose: This EM&V document provides technical guidance for calculating energy and demand savings and avoided emissions from energy efficiency programs via a set of practical processes and methodologies. It focuses on evaluation specifically for program approaches relying primarily on direct energy savings. It describes the steps involved in selecting the appropriate measurement and analysis approach for the program and evaluation goals. It also provides important context and background for implementing the IPMVP as part of evaluation. It provides some basic approaches to including limited market effects measurement in impact evaluation for the calculation of net savings

Types of Energy Efficiency Programs: - Resource acquisition, market transformation

Markets: energy efficiency and deployment programs

Evaluation Type:

- *Impact Evaluation*
  - Gross energy/demand savings
  - Net energy/demand savings
  - Co-benefits (non-energy/indirect impact benefits)
  - Cost effectiveness
- *Process Evaluations*
- *Market Assessment*

Audience: Program implementers and R&D program managers who have responsibility for planning, commissioning, and managing evaluation studies within the U.S. DOE's EERE office

1.21 Energy Efficiency and Renewable Energy (EERE) Impact Evaluation Framework for Technology Deployment Programs, 2007

http://www1.eere.energy.gov/ba/pba/pdfs/impact_framework_tech_deploy_2007_main.pdf

Purpose: This DOE EERE Framework provides specific tools to use in identifying the linkages between program activities or outputs and the resulting impacts or outcomes. Identifying these linkages helps to clarify and prioritize what should be measured in the evaluation, thus enabling evaluators to apply with greater effectiveness the more technically oriented measurement and analysis tools. *Complements EERE Guide for Managing General Program Studies – DOE (2006)*

Types of Energy Efficiency Programs: - Research Activities as well as Market Transformation and Resource acquisition programs

Markets: Federal, state, and local governments and public entities and institutions including government and non-governmental organizations, business entities such as manufacturers, business, and professional service providers; and end-users.

Evaluation Type:

- *Impact Evaluation-retrospective*
  - Gross energy/demand savings
  - Net energy/demand savings
  - Co-benefits (non-energy/indirect impact benefits)
  - Cost effectiveness
- *Market Assessment:*

Audience: Specifically designed to assist energy program managers, planners and evaluators of technology deployment programs in Federal, state, and local governments and in public entities and institutions

1.22 Guideline 14-2002 – Measurement of Energy and Demand Savings, , American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

http://www.ashrae.org/

ASHRAE Guideline 14-2002 closely tracks and provides support to the IPMVP.

Purpose: The ASHRAE M&V guidelines are primarily used in the context of energy service company (ESCO) performance contracts. The intent is to provide guidance (instrumentation and data management) on minimum acceptable levels of performance for determining energy efficiency savings, using measurements in building energy management projects. ASHRAE Guideline 14 complements the IPMVP by delving deeper into the topics of uncertainty, regression analysis, and instrumentation, and by providing working examples of M&V for specific applications.

Types of Energy Efficiency Programs: Energy performance contracts

Markets: Residential, Commercial, and Industrial buildings.

Evaluation Type:

- *Impact Evaluation and M&V*
  - Gross energy/demand savings
  - Net energy/demand savings

Audience: ESCOs, energy efficiency program designers, evaluators and policy makers

International Level Documents

1.23 International Performance Measurement and Verification Protocol (IPMVP): Concepts and Options for Determining Energy and Water Savings – EVO-1000000-1-2007. www.evo-world.org.

Purpose: The IPMVP is a guidance document that defines common terminology, identifies documentation requirements and reporting periods, and describes high-level practices in quantifying savings based on energy measurements and analysis. It presents a framework of four M&V Options that allow broad flexibility.

- *IPMVP Volume I: Concepts and Options for Determining Savings (2009 Edition).* Guidance document describing common practice (framework and four measurement and verification options) in measuring computing and reporting savings achieved by energy or water efficiency projects at end user facilities.
- *IPMVP Volume III: Applications* Volume III provides guidance on application-specific M&V issues for new construction projects.

Types of Energy Efficiency Programs: Resource acquisition programs

Markets: New and existing residential, commercial, industrial, and agricultural facilities

Evaluation Type:

- *Impact Evaluation, and Measurement and Verification*
  - Gross energy/demand savings
  - Net energy/demand savings, and
  - Co-benefits (non-energy benefits)

Audience: Energy-performance contractors, facility managers, building designers, energy/water efficiency program designers, implementers, evaluators, policy makers,

1.24 European Ex-Post Evaluation Guidebook for DSM and EE Service Programmes, SRC International A/S, April 2001

www.aid-ee.org/documents/00MethodologyExpostevaluation.PDF

Purpose: This EM&V guidebook is a hands-on document that addresses evaluation needs in both captive and competitive energy markets. It describes available evaluation methods, their possible application, and a detailed, step-by-step description of how to plan and implement them.

Markets: Residential, tertiary, industry and transport

Type of Energy Efficiency Programs: Resource acquisition, market transformation, information programs, T&D programs

Evaluation Type:

- *Impact evaluation and M&V.*
  - Gross energy/demand savings
  - Net energy/demand savings
  - Net to Gross Adjustment factors
  - Cost effectiveness
  - GHG emission reduction
- *Market and Process Evaluations*
- *Load Management Evaluation*

Audience: policy makers, program designers, planners, evaluators

1.25 Guidelines For The Monitoring, Evaluation and Design Of Energy Efficiency Policies - How Policy Theory Can Guide Monitoring & Evaluation Efforts and Support The Design of SMART Policies, October 2006 - *Intelligent Energy Europe project "Active Implementation of the European Directive on Energy Efficiency" (AID-EE)*

http://www.aid-ee.org/documents/000Guidelinesforthemonitoringevaluationanddesign.PDF

Purpose: This study conveys the experience of using theory-based policy evaluation to policy makers, and makes it possible to integrate the evaluation method in the design of policy instruments. The report provides a practical guide for using theory-based policy evaluation for the monitoring, ex-post evaluation and, design of policy instruments aiming at energy efficiency improvement.

Markets: Residential, tertiary, industry and transport

Type of Energy Efficiency Programs: Resource acquisition

Evaluation Type:

- *Impact evaluation and M&V.*
  - Gross energy/demand savings
  - Net energy

Audience: policy makers, program designers, administrators, and evaluators

1.26 Evaluation Measurement & Verification Framework For Ontario Power Authority (OPA) Conservation and Demand Management (CDM) Programs-v.1, 2007

http://www.powerauthority.on.ca/benefits/evaluation-measurement-and-verification

Purpose: The OPA EM&V Protocols are guidelines that describe acceptable methods for evaluating, measuring and verifying OPA conservation program activities and the associated effects. The OPA Evaluation Protocols include the types of evaluations to be completed over the life cycle of a program, expected outputs or results from the evaluation reports, acceptable methods for use in drawing up sample designs, guidelines for verifying energy and peak savings, and a frequency or schedule specifying the timing of reports relative to the program launch date.

Markets: Residential and non-residential

Type of Energy Efficiency Programs: Resource acquisition

Evaluation Type:

- *Impact evaluation and M&V.*
  - Gross energy/peak demand savings
  - Net energy/peak demand
  - Cost Effectiveness
- Market Impacts
- Process Evaluation

Audience: OPA policy and program staff, third-party program administrators, evaluation contractors, government, other jurisdictions, and other stakeholders.

B.2 Development Forums for EM&V Guidelines: Regional, Federal and International Levels

2.1 Regional Evaluation, Measurement and Verification Forum (managed by Northeast Energy Efficiency Partnership)

http://www.neep.org/emv-forum

Description: The Regional Evaluation, Measurement and Verification Forum (EM&V Forum) supports the development and use of common and/or consistent protocols in order to evaluate, measure, verify, and report the savings, costs, and emission impacts of energy efficiency. The Forum has representatives from eleven states and conducts projects to develop common EM&V protocols/guidelines that support the calculation of energy efficiency and other demand-side resource impacts, including energy and demand savings, costs, and emissions. The Forum also supports the tracking and reporting of such impacts to support state and regional energy, economic, and environmental policy goals.

Contact Information : Julie Michaels, 781-860-9177, jmichals@NEEP.org

Status: ongoing

Markets: Residential and Non-residential

Evaluation Types: primarily impact

2.2 U.S. DOE American Recovery and Reinvestment Act (ARRA) Reporting and EM&V Requirements For the State Energy Program (SEP)

http://www1.eere.energy.gov/wip/recovery_act_guidance.html

Description: The American Recovery and Reinvestment Act provided a significant influx of funds to support energy efficiency programs and activities. ARRA objectives include job retention, job creation, economic development, and saving energy. Evaluation guidelines have been promulgated by the U.S. Department of Energy (DOE) in the recently issued Recovery Act Reporting Guidelines Program Notice. This document covers evaluation of

State Energy Programs and focuses on the following list of recommended metrics at the state and national level: energy and demand savings, renewable energy capacity and generation, carbon emissions reductions, job creation (including number, type, and duration), economic impacts (in addition to job creation), and adoption of new technologies.

Contact Information: Faith Lambert at 202-586-2319 or faith.lambert@ee.doe.gov.

Status: Effective date March 1, 2010

Purpose: The DOE reporting and evaluation requirements are provided to assist States in planning and conducting evaluations of their State Energy Program (SEP) Recovery Act programs. These standards allow evaluation efforts to be implemented using a number of research approaches and provide flexibility in determining how SEP/ARRA evaluation results reporting objectives are met. These guidelines recommend technical standards for the methods and research approaches used in evaluation studies. The document also offers guidance on some technical aspects of evaluations by referring interested parties to a number of relevant EM&V guidelines. The DOE specifically recommends that field data collection methods must be consistent with the four IPMVP M&V options.

Markets: Residential and non-residential

Evaluation Types:

- Impact Evaluation
  - Gross energy/demand savings
  - Renewable energy capacity and generation
  - Carbon emission reductions
  - Job creation

Audience: This guidance document applies to State Energy Program entities (i.e. States or Territories) named in a Notification of Grant Award under the ARRA.

2.3 Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services (EMEEES): Measuring and Reporting Energy Savings for the ESD-how it can be done. Results and Recommendations, June 2009

http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_Final_Report.pdf

Description

The Wuppertal Institute on behalf of EMEEES Consortium (an international project consortium with 21 partners from 14 European countries) assisted the European Commission in developing a concrete evaluation and monitoring framework specifically designed to evaluate the energy efficiency measures implemented to achieve the 9% or more energy savings target set out for the EU Member States by 2016 (Energy service directive (ESD) 2006/32/EC). To further support this effort, the project also developed 20 bottom-up and 14

top-down cases of these general methods, representing the largest part of the potential ESD savings Member States have pledged in their National Energy Efficiency Action Plans.

Contact: Dr. Stefan Thomas/Dr. Ralf Schüle, Wuppertal Institute for Climate, Environment and Energy, email: info@evaluate-enerrgy-savings.eu, or www.wupperinst.org +49 (0) 202-2492-110

Status: The European Commission is expected to finalize additional rules for energy savings calculations this year.

Purpose: The new standards provide concrete methods for the evaluation rules from different perspectives: energy savings based on top-down energy savings indicators (using existing and officially approved statistical data and results, defined by sector and/or type of end-use from national averages), energy savings based on bottom-up information (e.g., from the evaluation of actions and programs), micro energy savings (for appliances and system components), and integrated top-down and bottom-up approach (schemes for monitoring the overall impact of all measures implemented in a Member State – a harmonized calculation model using both methods). The consortium also offered three levels of harmonization (evaluation rigor). Finally, further study and adjustments will be required once member states begin to report their energy savings data.

Markets: Residential, tertiary, industry and transport

Audience: EU members, policy makers, program designers, implementers and evaluators

2.4 General Bottom-up Data Collection, Monitoring, and Calculation Methods – Harry Vreuls, Stefan Thomas, and Jean-Sébastien Broc for the Wuppertal Institute on behalf of EMEEES Consortium[40] - EM&V

http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_Bottom_up_draft_overview081006.pdf

Description: The Wuppertal Institute explores and develops models, strategies and instruments to support sustainable development at local, national and international levels. Special emphasis is put on analyzing and supporting technological and social innovations that decouple prosperity and economic growth from the use of natural resources.

Purpose: This study was created as part of an effort to develop concrete methods for "bottom up" calculations to support harmonized reporting of energy savings by European Union member states. In Europe, bottom-up methods start with data collected on a specific energy efficiency measure and comprise savings per participant and number of participants. Results

[40] *General Bottom-Up Data Collection, Monitoring, and Calculation Methods* by Harry Vreuls, Stefan Thomas, and Jean-Sébastien Broc for the Wuppertal Institute on behalf of EMEEES Consortium. 30 April 2009.

are then aggregated for all measures. The report provides direction on calculating unitary gross energy savings and on calculating savings in relation to the data collection methods employed in the EU. Where applicable, the savings calculations are correlated to IPMVP Options, including Options B, C, and D. Methodologies are then discussed for establishment of energy consumption baselines. The report also describes approaches for accounting for double-counting and technical interactions, multiplier effects, and free-rider effects.

Markets: Residential, tertiary, industry and transport

Audience: EU members, policy makers, program designers, implementers and evaluators

2.5 International Energy Agency (IEA) Demand Side Management Agreements Task XXI on Standardization of Energy Savings Calculations, 2009.

http://www.ieadsm.org/Content.aspx?ID=15

Overview: This study conducted under the auspices of the IEA DSM Agreements provides a framework of the basic concepts, rules and system to stimulate the development of standards on energy savings calculations and related greenhouse gas emissions and ensure global comparability of these standards.

Status: ongoing

Purpose **(**Expected Results): The overall aim of Task XXI is to identify basic concepts, calculation rules and systems for Energy Savings Calculations (ESC) standards. Additionally, a methodology would be developed to nominate and describe several Demand Response products. Within this framework of basic concept and calculation rules, the relation to reduction of environmental impacts in greenhouse gas emissions from energy savings would be incorporated. The Task will also explore how and by what type of organizations these standards could be use and improved to increase international comparable evaluation of policies and measures.

Product: The project will result in several reports that will become available at the IEA DSM website from 2010 onwards. The first report will provide the basic concepts and energy savings calculation rules and will use the input from the experts for up to 15 priority technologies. This will be followed by an overview on how existing guidelines could be utilized or modified to make results from energy savings calculation – including related GHG emissions – more comparable and more harmonized in the future.

Markets: Residential, tertiary, industry and transport

Audience: governments, policy makers, program designers, implementers and evaluations, DSM professionals

2.6 International Partnership for Energy Efficiency Cooperation (IPEEC) – A partnership of G8 countries, China, India, South Korea and the European Community established in 2008 – EM&V

http://vibe1.nrel.gov/ipeec-login?p_p_id=56_INSTANCE_lO6t&p_p_lifecycle=1&p_p_state=exclusive&p_p_col_id=column-1&p_p_col_count=1 (Note – It is a website under construction and you have to create a new account)

Overview: The International Partnership for Energy Efficiency Cooperation (IPEEC) is a new high-level international forum to facilitate actions that yield high energy efficiency gains. One of IPEEC's goals is to stimulate improvements in methodologies of energy measurement, auditing and verification procedures and certification protocols.

Purpose: One of IPEEC's main goals is to improve methods for energy measurement, auditing and verification procedures, certification protocols and other tools to determine progress toward domestic energy efficiency goals and to achieve optimal energy efficiency performance over the lifetime of building and industrial processes, relevant products, appliances and equipment.

2.7 Research Supporting an Update of BPA's Measurement and Verification Protocols, Final Report, April 2010

http://www.nwcouncil.org/library/2010/2010-10.htm
http://www.bpa.gov/Energy/N/Projects/cr_discount/pdf/site_specific_verification.pdf

Contact: Todd Amundson, BPA project manager

Overview**:** Research Into Action, Inc. and a team of experts conducted a review of current M&V practices at Bonneville Power Administration (BPA) in connection with release of the Draft Sixth Northwest Power Plan (Sixth Plan) of the Northwest Power and Conservation Council (NPPC). In this plan, the NPPC forecasts a need to increase the region's implementation of energy efficiency projects. Increased energy savings acquisition necessitates an increase in savings assurance activities, including M&V.

Status:
Phase II is currently underway – RIA and its team will revise existing and/or develop new M&V protocols for BPA's consideration.
Phase I – review of BPA current M&V practices has been completed with recommendations for revising and augmenting the protocols.

Summary of Findings: The study recommends revising the existing protocols to follow the guidance provided by the IPMVP, so that BPA's M&V practices are IPMVP-adherent. Specifically, develop or revise five or six of the following protocols:

- End-Use Metering – revision of an existing protocol
- Energy Use Indexing – revision of an existing protocol

- Existing Building Commissioning – a new protocol
- Packaged Commercial HVAC – a new protocol
- M&V Protocol Selection – a new protocol providing guidance on selecting the appropriate M&V protocol for the measure and site
- Sampling – a new protocol
- Regression – a new protocol

2.8 Northwest Regional Technical Forum (RTF) – Pacific Northwest Deemed Measure Review and Simplified Measurement and Verification Protocols Projects

http://www.nwcouncil.org/energy/rtf/subcommittees/deemed/
rtfAdmin@nwcouncil.org

Description of Organization: The Northwest Regional Technical Forum (RTF) is an advisory committee that develops standards to verify and evaluate conservation savings

Contact: Gillian Charles, Council, gcharles@nwcouncil.org (503) 222-5161 (800) 452-5161

Status: On-going. The RTF recently issued two requests for proposals for a deemed measure review project and a simplified measurement and verification (M&V) protocols project. The RTF selected SBW Consulting as the contractor for both projects and subsequently merged two subcommittees into one to provide oversight for both projects.

Purpose:
Deemed Measure – to strengthen technical analyses and input assumptions used for deemed energy efficiency measures by the RTF and recommend the addition or removal of deemed measures by the RTF. Work and work products under this contract will involve a review and comparison of deemed electrical energy savings used throughout the Northwest region with those used nationally.
Simplified M&V – to develop a suite of measure-specific, simplified M&V protocols approved by the RTF for use in Pacific Northwest electric energy efficiency programs. By providing simplified M&V protocols, the RTF intends to help reduce the barriers commonly associated with development and implementation of custom M&V plans. A review of M&V protocols and calculators used in energy efficiency programs throughout the Region and the country will be reviewed and recommendations made for streamlining measurement implementation, resulting in the creation of a suite of RTF-approved simplified M&V protocols

2.9 North American Energy Standards Board (NAESB) – Measurement and Verification of Demand Response Programs.

http://www.naesb.org/pdf4/ferc041709_dsm_filing.pdf
The retail electric market standards for V 1.2 -
http://www.naesb.org/req/req_final.asp

Description of Organization: The North American Energy Standards Board (NAESB) has begun a process that may lead to the development of M&V standards that would apply to both wholesale and retail energy markets. NAESB is also working with North American Electric Reliability Corporation (NERC) to ensure that NERC's demand response data collection effort conforms to a consistent measurement and verification standard.

Purpose: The NAESB DSM EE subcommittee completed its ***first phase*** of work which addressed the measurement and verification characteristics of demand response products and services to be used in the wholesale electricity market. These standards are intended to provide a common framework for transparency, accountability and consistency. The standards are composed of 31 business practice standards and 40 definitions that focus on four product and service categories—energy service, capacity service, reserve service and regulation service—and establish criteria for the use of equipment, technology and procedures to quantify the demand reduction value delivered.
The retail electric DR standards that were developed in coordination with the wholesale standards were ratified by NAESB membership on November 16, 2009, subsequently published as part of the NAESB retail electric market standards Version 1.29 on December 31, 2009

Status: For a ***second phase*** of standards development, NAESB is now developing the more detailed technical standards for the measurement and verification of demand response products and services for the wholesale electric market. The wholesale electric standards development for the second phase is directed to glossary, performance evaluation methodology and the existing business practices. The retail electric market efforts are proceeding in tandem with wholesale efforts to support coordination. It is planned that the NAESB subcommittee will complete its work for the second phase in June 2010.

In a related effort, the DSM-EE subcommittee is also developing standards for energy efficiency based upon work of the National Action Plan for Energy Efficiency.

B.3 States and Regions that have or are developing EM&V protocols

Seven states – California, Minnesota, New Jersey, New York, Oregon, Texas and Wisconsin – have developed their own EM&V protocols which require the use of specific methods to evaluate the impacts of efficiency programs. Florida and Iowa rely primarily on the IPMVP protocol. At least five states – Illinois, Maryland, Michigan, Ohio, and Pennsylvania – have completed new EM&V protocols and/or resource documents (e.g., Technical Reference Manual) within the last two years. Moreover, a number of other states are ramping up their energy efficiency program activities and are initially developing technical resource manuals as part of their EM&V guidelines. Energy efficiency administrators in the Pacific Northwest under the auspices of the Northwest Conservation and Power Council Regional Technical Forum have an ongoing effort to develop and update EM&V protocols for energy efficiency programs. The

Northeast Energy Efficiency Partnerships (NEEP), which includes 11 states, is supporting the development and use of common or consistent protocols to evaluate, measure, verify and report savings and cost impacts from energy efficiency.[41] ISO-New England and PJM have developed M&V protocols for programs in which demand response or energy efficiency resources are eligible to participate; their protocols focus on assessing impacts (i.e., load reductions) during specified peak periods.

Table 1: State or Regional EM&V Protocols for Energy Efficiency

States	Existing	New Efforts
California	**X**	
Florida	**IPMVP only**	
Iowa	**IPMVP only**	
Illinois		**X**
Maryland		**X**
Michigan		**X**
Minnesota	**X**	
New Jersey	**X**	
New York	**X**	
Ohio		**X**
Oregon	**X**	
Pennsylvania	**X**	
Texas	**X**	
Wisconsin	**X**	
Northwest Power and Conservation Council Regional Technical Forum	**X**	
NEEP EM&V Forum	**X**	
BPA		**X**
ISO New England	**X**	
PJM	**X**	

[41] http://www.neep.org/emv-forum - States that are participating in the NEEP EM&V Forum include Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont, New York, New Jersey, Maryland, Delaware, and the District of Columbia.

B.4 Brief Literature Review of Top-Down Energy Efficiency Evaluation Methods

At present, virtually all energy efficiency program evaluations conducted in the US rely on bottom up evaluation approaches.[42] However, there is increasing interest in top down evaluation approaches and this section provides background on three top down evaluation activities. Top-down evaluation refers to methods relying on statistical indicators defined by sector, utility service territory, state, region, or country. The use of top-down methods to evaluate energy savings means that the amount of energy savings or energy efficiency progress are calculated using these statistical indicators before and after implementation of energy efficiency actions/policies.

Top-down means starting from global data such as state statistics for energy consumption and then possibly correlating any realized energy savings with energy efficiency actions. The major advantages of top-down evaluation methods (as compared to bottom-up methods) are lower costs and the potential direct indication of sector, state, national reductions in energy consumption. The primary potential drawbacks of top-down evaluation are the difficulty in attributing energy savings to specific energy efficiency policies and/or particular programs and actions.

4.1 European Union – EMEEES – TD steps

http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_WP5_Summary_report_May_2009.pdf

http://www.evaluate-energy-savings.eu/emeees/downloads/WP_5_EMEEES_case_studies_report_Final.pdf

The EU-EMEEES Top-down (TD) approach refer to methods relying on statistical ("energy efficiency indicators or top-down) indicators defined by sector and/or type of end-use for national averages. Adjustments are made for factors (e.g., autonomous trend, market price) that contribute to energy savings but are not linked to policies. Total energy savings are calculated from statistical indicators by removing the influence of factors that are not linked to energy efficiency. The TD approach was tested under various conditions:

A. The 'pure' TD calculation of additional energy savings due to energy efficiency improvement measures was tested in various case studies by the EMEEES project.

For Specific energy consumption indicators:

1. Set the EU default value for the autonomous technical progress of specific energy consumption indicators (e.g., for cars and appliances) based on a regression analysis

[42] Energy savings obtained through the implementation of a specific energy efficiency improvement measure are determined and then added to energy savings results from other energy efficiency measures to determine "total" savings from a project, program, portfolio or state.

for all countries with data available, and on the average of the three countries with the slowest trend found in the analysis.
2. Set the EU default for the price elasticity (between 0.1 and 0.2). Correct the reference trend with this elasticity, if the market price of energy is moving upwards.
3. Calculate additional energy savings from the differences between the reference trend (step 1), corrected for effects of increasing energy market price (step 2), and the actual development of the indicator.

For Unit energy consumption and diffusion indicators: perform a regression analysis for each country and identify plausible autonomous trends, if possible. The remaining steps are the same as #2 above.

B. The 'pure' TD calculation of all energy savings – only applicable for specific energy consumption indicators: Calculate all energy savings from the difference between the value of the indicator in the base year and the actual development of the indicator.

4.2 Energy Demand Analysis and Modeling System (EDAM)

Measuring the savings from energy efficiency policies: a step beyond program evaluation, Marvin Horowitz www.springerlink.com/content/l7140878t3411j02/

Overview: EDAM is a modeling system that determines how the aggregate effectiveness of various energy efficiency initiatives will be measured or compared from country to country or area to area. The principle that guides EDAM is that the impact of any long-term public policy whose intention is to alter the future path of aggregate energy consumption should, over several years, be detectable. It is basically a low-cost method for annually monitoring and comparing the aggregate progress of energy efficiency programs and policies.

Purpose: EDAM provides an unrestricted analytic framework that accommodates known differences between locations and sectors. It also provides an inexpensive middle ground between rigid imposition of a one-size-fits-all metric and costly, uncoordinated, from-the-ground-up studies. EDAM is intended to standardize and simplify energy demand modeling so that it can be applied to all locations around the world where annual energy and economic data are available.

EDAM is not a replacement for conducting impact evaluations of individual energy efficiency programs. Individual program impact evaluations are essential for program management. However, once a reliable modeling system is in place for measuring overall policy impacts, less time and effort can be spent on trying to achieve high levels of accuracy with individual program evaluations, leaving more time and effort for improving the quality of programs and policies.

4.3 California Energy Consumption Evaluation Pilot Study Using the Top-Down (TD) method – Itron, 2010

Overview: In order to better understand the total effect of efficiency programs on overall energy sales as well as the effects of non-program structural and other factors that influence consumption, the CPUC Energy Division is interested in developing a pilot program that would supplement bottom-up EM&V with TD measurement and analysis of energy efficiency and demand response program effects for various end-use sectors.
TD estimation of savings from energy efficiency programs and policies has theoretical appeal for several reasons:

- TD savings estimates could provide a low-cost means to assess bottom-up estimates of state, utility, and even program savings.
- The ultimate outcome of these programs is the reduction of total consumption.
- Energy efficiency evaluation results corroborated by econometric approaches could be more compelling to mainstream economists who influence national and state energy policies, if concerns about program efficacy associated with estimation of free riders, spill over, persistence, take-back and self-selection bias are mitigated.
- Policy and program efforts, especially in California, may now be large enough to be captured by econometric methods as a result of the alignment of portfolio and policy effects and the goals of the CPUC's Long-Term Strategic Plan and the State's greenhouse gas reduction policies.

Total Energy Consumption Evaluation Methodology-Challenges:
The greatest challenge is the lack of good historical data related to the numerous determinants of energy demand at various levels of detail and disagreement regarding model specification. Data problems can produce measurement error and potential bias. These data problems are the same for any cross-sectional data from other jurisdictions. There are also a number of other problems that can afflict econometric analyses including model misspecification, omitted variables, heteroscedasticity, and correlation among independent variables.

Proposed Steps and Approach:

1. Assess/test various top-down approaches to identify and assess data gaps methodological controversies, and concerns about specification bias, and to estimate study implementation costs. These assessments would take into account California-specific data availability, demographics, economy, and policy environment.
2. Based on these independent assessments, one or more TD approaches would be selected for the pilot study for a program cycle period (e.g., 2006-2009), depending on data availability.
3. Use the bottom-up savings estimates to assess the validity and reliability of top-down evaluation estimates. The three-year program cycles offer excellent opportunities to explore using bottom-up savings estimates to triangulate and calibrate the top-down model specifications, and vice versa.

Appendix C: Draft Outline for Evaluation, Measurement & Verification National Standard

Table of Contents
Acronyms

1. Executive Summary
    a. Brief introduction to process and document
    b. Purpose of document – *to describe the process by which a state will document the energy savings and other metrics associated with its demand side management activities and to indicate range of methods to be used as well as the process for continuous improvement and third-party review.*
    c. Summarize key requirements

2. Introduction and Background
    a. Purpose of this document - summarize appropriate Commission/DOE regulations and enabling legislation
    b. Describe the period of time covered by this standard
    c. Indicate contents

3. Energy Efficiency Activities covered by the Framework
    a. Define the energy efficiency activities covered

4. Evaluation Principles, Objectives and Metrics
    a. Evaluation principles that drive the effort - high level items
    b. High level evaluation objectives
    c. Key portfolio metrics
        i. Energy numbers (include annual and/or life cycle, and per hour, month, year, etc.)
            1. kW (net/gross) (First year/Lifecycle) (recommend both)
            2. kWh (net/gross) (First year/Lifecycle) (recommend both)
            3. Therms (net/gross) (First year/Lifecycle) (recommend both)
        ii. Costs and other benefit data
        iii. Market transformation metrics
        iv. Other

5. Evaluation Cycle
    a. Describe the evaluation cycle with respect to the EM&V activities and reporting
    b. Hierarchy of planning steps for each cycle
        i. EM&V Standard (this document)
        ii. Per Cycle Portfolio-level EM&V Plan – high level plan prepared each major cycle indicating which evaluation activities (updating baselines, updating deemed savings values, market, process, impact evaluations for which programs, etc.) will be conducted during that cycle, budgets, budget

allocations between activities, which programs/measures get verification versus verification and evaluation, etc. who approves?, and a schedule
    1. *may want to include a high level outline of this document*
iii. Detailed research plans; these will be prepared for each EM&V effort (market and per program or portfolio process and impact evaluations)
    1. *may want to include a high level outline of this document*

6. Scale and Certainty
    a. Expectations for savings determination certainty
        i. Best practices
        ii. Control for systematic error via documentation and best practices, trained experts, etc.
        iii. Control for random sampling error by defining a confidence and precision level of at least 80/20 for any sampling to be done.
        One strategy is to require 80/20 as a starting point, with the option of higher (or lower) precision for key measures, end-uses and/or programs. Each evaluation plan can specify the confidence/precision that will be achieved in the sampling plan for that particular evaluation, describing why the level was chosen and the trade-offs. The reviewers can determine whether this makes sense for a given cycle.

7. Transparency and Reporting
    a. High level statement about transparency and reporting of analyses subject to customer confidentiality
    b. Overall schedule for reporting during each cycle; high level discussion of what will be covered in the EM&V reports and when they will be delivered
    c. Report expected contents
    d. How are impact evaluation savings applied – looking back/going forward

8. Evaluation Methods and Key Assumptions
    a. What impact evaluation approaches will be used and how will they be selected?
    b. Baselines against which savings are judged (existing standards, codes and standards, dynamic baselines)?
    c. Deemed savings and deemed calculated savings "values"
        i. How and when will this source of values be updated
    d. Performance will be reported on basis of net or gross savings? What is included in net savings (free riders, spillover, etc.).
    e. Whether (and if so, at which point in the reporting process) T&D savings considerations included
    f. How 'granular' will be the results *(determined as needed in research plans)*

9. Who Will Conduct The Evaluations
    a. How is independent evaluation defined
    b. Process for 3rd party consultant selection

10. Data Management Strategies

a. Tracking system requirements to be used
b. How this system will be used for QA/QC and reporting

This can include program control processes; that is, when does the installation

11. What is data submittal process and dispute resolution process

Attachments:

A. Definitions of key terms
B. High level content outlines of required documents and reports