Chapter 1: Introduction

The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures

Created as part of subcontract with period of performance September 2011 – September 2016.

This version supersedes the version originally published in April 2013. The content in this version has been updated.

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NREL Technical Monitor: Charles Kurnik

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Subcontract Report
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September 2017

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NREL
NATIONAL RENEWABLE ENERGY LABORATORY

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Preface

This document was developed for the U.S. Department of Energy Uniform Methods Project (UMP). The UMP provides model protocols for determining energy and demand savings that result from specific energy-efficiency measures implemented through state and utility programs. In most cases, the measure protocols are based on a particular option identified by the International Performance Verification and Measurement Protocol; however, this work provides a more detailed approach to implementing that option. Each chapter is written by technical experts in collaboration with their peers, reviewed by industry experts, and subject to public review and comment. The protocols are updated on an as-needed basis.

The UMP protocols can be used by utilities, program administrators, public utility commissions, evaluators, and other stakeholders for both program planning and evaluation.

To learn more about the UMP, visit the website, https://energy.gov/eere/about-us/ump-home.

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Acronyms

DOE	U.S. Department of Energy
EM&V	evaluation, measurement, and verification
FEMP	Federal Energy Management Program
IPMVP	International Performance Measurement and Verification Protocol
M&V	measurement and verification
NREL	National Renewable Energy Laboratory
NTG	net-to-gross
SEE Action	State and Local Energy Efficiency Action Network
TRM	technical reference manual
UMP	Uniform Methods Project

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1 Overview

The Uniform Methods Project (UMP) began in 2012 with funding from the U.S. Department of Energy (DOE) to establish a set of model protocols for determining gross energy and demand savings that result from energy efficiency measures and programs implemented through state and utility energy efficiency programs.[1] The protocols provide detailed descriptions of the commonly accepted evaluation methods to help ensure that similar programs are measured in the same way.

The UMP has developed two types of protocols:

1. **Measure-specific protocols** describe recommended evaluation methods for a specific measure, technology, project, or program design type under specified conditions.
2. **Cross-cutting protocols** complement measure-specific protocols by covering evaluation topics, techniques, and technical issues common to all measures.

The methods described in each protocol are—or are among—the most commonly used and accepted in the energy efficiency industry for the specified measure and application conditions.[2] The protocols are authored by experienced evaluators, draw from the existing body of research and best practices for energy efficiency program evaluation, measurement, and verification (EM&V)[3] and are vetted through peer and public stakeholder review processes.

In 2017, the UMP completed a review of all protocols to assess the need for updates or revisions based on changes in the prevailing industry standard methods, lessons learned from recent evaluation activity, and other stakeholder feedback. The UMP revised nine protocols and republished all other protocols to acknowledge their continuity in reflecting the latest evaluation methods.

[1] The UMP protocols are designed primarily for ratepayer-funded energy efficiency programs; however, the protocols can also be used to determine savings from individual projects such as those implemented by energy services companies under a performance contract.

[2] The protocol for data centers is the only exception to this statement. Programs for data centers are relatively new, and the evaluation industry has yet to arrive at a preferred measurement and verification (M&V) approach for the measures offered through these programs. With the data centers protocol, the UMP attempts to describe a preferred approach.

[3] M&V is distinct from evaluation in that it focuses on determining savings for individual measures and projects, while evaluation aims to quantify the impacts of a program.

2 About the Protocols

The methods described in each protocol represent generally accepted practices within the EM&V profession. Although they are not necessarily the *only* manner in which savings can be reliably determined, program administrators, policymakers, and evaluators can adopt these methods with the assurance that they are (1) consistent with accepted practices and (2) have been vetted by experts in the field of energy efficiency program evaluation. If widely adopted, these protocols will help establish a common basis for assessing and comparing the performance and effectiveness of energy efficiency policies and investment decisions across programs, portfolios, and jurisdictions.

These protocols do not provide stipulated values for energy savings. However, their widespread use would provide a common analytic foundation for determining "deemed" values while still allowing for the use of inputs appropriate for the unique circumstances of a project or program.

In general, the measure-specific protocols describe the methods for determining *gross* energy and demand savings. Chapter 21, "Estimating Net Savings: Common Practices," is cross-cutting and describes approaches for determining *net* savings for different measures and programs.

These protocols are designed to provide estimates of gross savings at a high level of rigor; however, they do not prescribe specific criteria for either statistical confidence or precision of savings estimates. Such thresholds are assumed to be set by the stakeholders, as determined by their unique objectives and priorities. Instead, the protocols provide a framework for deciding on and applying such criteria consistently, and for reporting the uncertainty associated with the resulting savings estimates.

3 Rationale

Investment in energy efficiency has increased steadily in the United States over the last decade. In many jurisdictions, energy efficiency now accounts for a significant share of utilities' integrated resource portfolios and, in several jurisdictions, is recognized as the "fuel of first choice," thus amplifying its critical role in electric resource reliability and adequacy.

This trend of increasing investment in energy efficiency will likely continue as utilities strive to meet the energy efficiency resource standards that have been adopted through legislative or regulatory mandates in 26 jurisdictions—and are being considered in several more. In at least half of these jurisdictions, the standards are designed to achieve aggressive savings of 10% or more of forecast load by 2020; in six jurisdictions, savings of more than 20% are expected (ACEEE 2011).

With greater reliance on energy efficiency as a means of meeting future energy demand, there is a growing need for publicly available information on energy efficiency programs, how their savings are determined, and how the achieved savings are reported. Well-documented and consistent use of protocols developed and vetted by experienced practitioners and shared among stakeholders and the public reinforce the reliability of the savings achieved by energy efficiency programs. The UMP protocols offer evaluation methods for determining energy savings based on generally accepted practices in the energy efficiency industry for common measures and programs. Widespread adoption of the UMP protocols also provides a basis for comparing the impacts of energy efficiency portfolios and policy initiatives across the country.

To help reduce the uncertainty associated with determining energy efficiency savings, the UMP protocols also offer guidance for implementing the techniques and interpreting their results.

DOE envisions the following specific goals for this project:

- Offer evaluation methods that strengthen the credibility of energy efficiency program savings calculations.
- Provide clear, accessible, step-by-step procedures to determine savings for the most common energy efficiency measures and programs.
- Support consistency and transparency for how savings are calculated.
- Reduce the costs of developing and managing the evaluation, measurement and verification (EM&V) of energy efficiency projects and programs.
- Allow a comparison of savings across similar programs and measures in different jurisdictions.
- Improve the acceptability of reported energy savings by financial and regulatory communities.

4 The Audiences and Objectives

DOE commissioned the UMP effort to provide, for voluntary adoption, a set of protocols for determining savings that are achieved through state and utility efficiency programs.

By providing a method for evaluating the effectiveness and viability of energy efficiency, these protocols serve stakeholders by:

- Offering regulators a reliable basis and the means for assessing the prudency of rate payer-funded investments in energy efficiency and determining compliance with savings targets.
- Offering utility resource planners and program administrators greater certainty about program performance and reducing planning and regulatory compliance risks.
- Supplying independent EM&V contractors with a standard set of tools and techniques to enhance the accuracy of their findings.
- Providing a learning opportunity for EM&V practitioners and a basis for calculating deemed and algorithm-based savings in technical reference manuals (TRMs) that are being developed or updated in various jurisdictions.
- Providing a resource for program administrators, implementers, and evaluators to determine data collection methods to facilitate the EM&V process.

By making the methods for calculation and verification of savings more transparent and uniform, these protocols can help mitigate the perceived risks of investing in energy efficiency and stimulate greater investment.

5 Definitions

Market participants in the energy efficiency industry (such as end-use energy consumers, project designers, contractors, program implementers and administrators, utility resource planners, and evaluators) may define savings resulting from energy efficiency differently. The UMP uses standard industry definitions consistent with the State and Local Energy Efficiency Action Network (SEE Action) *Energy Efficiency Program Impact Evaluation Guide* to differentiate how savings are reported at the design, implementation, and evaluation stages of a program's life cycle:

- **Projected savings.** Values reported by a program implementer or administrator before the efficiency activities are complete.[4]
- **Gross savings.** Changes in energy consumption that result directly from program-related actions taken by participants in an energy efficiency program, regardless of why they participated.
- **Claimed (gross) savings.** Values reported by a program implementer or administrator after the activities are complete.[5]
- **Evaluated (gross) savings.** Values reported by an independent, third-party evaluator[6] after the efficiency activities and impact evaluation are complete.
- **Net savings.** Change in energy use attributable to a particular energy efficiency program. These changes may implicitly or explicitly include the effects of factors such as free-ridership, participant and nonparticipant spillover, and induced market effects.
- **Net-to-gross (NTG) analysis.** Estimation of the NTG ratio, which is the net savings as a fraction of gross savings.

[4] In certain cases, the projected savings may be based on deemed values approved by regulators.
[5] In certain cases, these savings may have been adjusted by a predetermined NTG ratio.
[6] The designations of "independent" and "third-party" are determined by those entities involved in the use of the evaluations and thus may include evaluators retained by the program administrator or a regulator, for example.

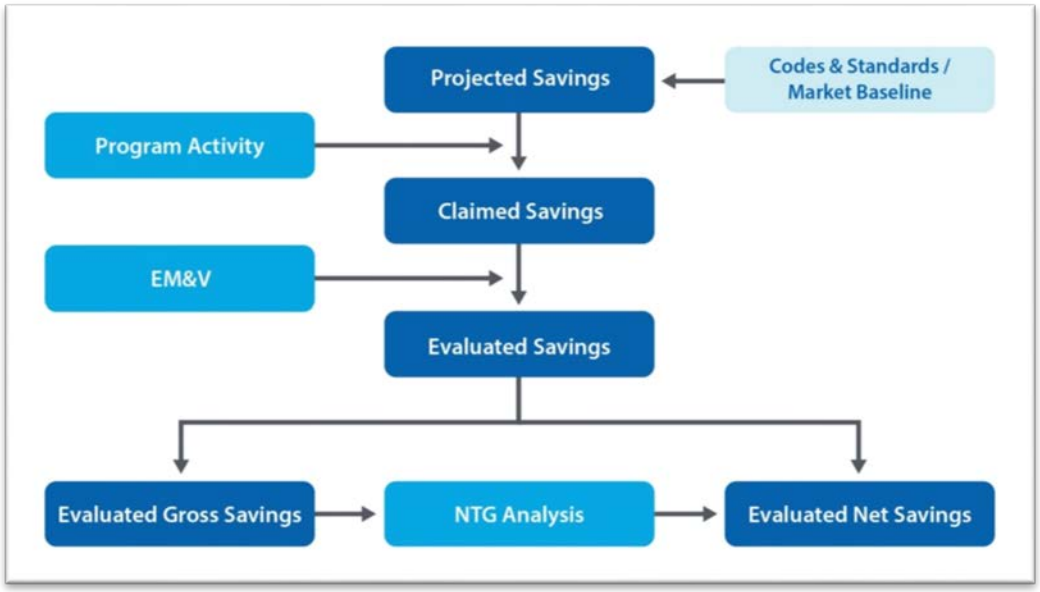

Figure 1. Savings definitions

The UMP protocols focus primarily on estimating evaluated first-year gross savings, except where estimates of net savings may be derived as part of the same method. A more complete discussion of the elements of NTG adjustments and the methods for measuring them are described in *Chapter 21: Estimating Net Savings – Common Practices*. The definition of net savings (for example, whether it includes participant and/or nonparticipant spillover) and the manner in which NTG is applied also vary across jurisdictions as a matter of policy. Therefore, UMP does not offer specific recommendations on how NTG should be measured or applied.

6 Protocol Content

Since its inception in 2012, the UMP created protocols for 17 energy efficiency measures, which are primarily applicable to residential and commercial facilities, and six cross-cutting topics.

6.1 Measure-Specific Protocols

Table 1 shows the 17 measure-specific protocols completed to date. Several of these protocols have been updated to reflect information that has become available since these protocols were first developed. The complete list of protocols developed to date is available on the UMP website.

The UMP prioritized measures that (1) represent a diverse set of end uses in the residential and commercial sectors, (2) are present in most energy efficiency portfolios in nearly all jurisdictions, and (3) have a significant remaining savings potential.

Table 1. UMP Measure-Specific Protocols

Chapter	Protocol Topic	Residential	Commercial	Publish Date
2	Commercial and industrial lighting		X	April 2013; revised 2017
3	Commercial and industrial lighting controls		X	April 2013
4	Small commercial and residential unitary and split system HVAC heating and cooling equipment-efficiency upgrade	X	X	April 2013; revised 2017
5	Residential furnaces and boilers	X		April 2013
6	Residential lighting	X		December 2014; revised 2015; revised 2017
7	Refrigerator recycling	X		April 2013; revised 2017
8	Whole-building Retrofit with consumption data analysis	X	X	April 2013; revised 2017
14	Chillers		X	September 2014
15	Commercial new construction		X	September 2014
16	Retrocommissioning		X	September 2014
17	Residential behavior	X		January 2015; revised 2017
18	Variable frequency drive		X	November 2014
19	HVAC controls (DDC/EMS/BAS)		X	November 2014
20	Data center IT efficiency measures		X	January 2015

Chapter	Protocol Topic	Residential	Commercial	Publish Date
22	Compressed air		X	November 2014; revised 2017
23	Combined heat and power		X	November 2016
24	Strategic energy management		X	May 2017

6.1.1 Protocol Organization

Each UMP protocol explains the underlying technology, the end uses affected by the measure, the method for calculating the measure's gross savings, and the data requirements. Also, each protocol attempts to provide sufficient detail without being overly prescriptive, allowing flexibility and room for professional judgment.

The content in the measure-specific protocols is organized in a similar structure to provide consistency. Each protocol provides the following information:

- **Measure description.** A brief description of the measure covered by the protocol
- **Application conditions of protocol.** Details on the types of delivery channels, program structures, or other conditions that are or are not covered by the protocol
- **Savings calculations.** The prevailing algorithm(s) used to estimate energy savings with an explanation of the parameters
- **M&V plan.** The recommended evaluation approach, including the International Performance Measurement and Verification Protocol (IPMVP) Option, where appropriate, for determining values for the parameters required in the savings calculation
- **Sample design.** Overview of considerations on how to segment the population to provide a representative sample for evaluation, which is discussed in conjunction with the M&V Plan in some protocols
- **Other evaluation issues.** Any additional information deemed pertinent by the author(s) and/or reviewers, including brief discussions of persistence or NTG considerations; often this information is supplemented by the crosscutting protocols
- **References.** Complete citations of reference and resource materials discussed in the protocols, including example evaluation reports that demonstrate the recommended evaluation method.

In addition, the protocols revised in 2017 include two new sections:

- **Revisions.** Summary of key changes from the previous version of the protocol
- **Looking Forward.** Discussion of upcoming or potential changes based on ongoing research, new evaluation tools, future changes in the market, or other experimental methods.

Each measure is unique; therefore, some protocols have additional sections to provide more details on specific areas of interest or consideration.

6.2 Cross-Cutting Protocols

Cross-cutting protocols outlined in Table 2 complement the measure-specific protocols by covering technical issues and topics common to all measures. These crosscutting topics provide guidance on specific topics as stand-alone documents or may be referenced in measure-specific protocols. These supplemental, crosscutting discussions help extend the measure-specific method for determination of savings to evaluating whole programs.

Table 2. UMP Cross-Cutting Protocols

Chapter	Protocol Topic	Publish Date
1	Introduction	April 2013; revised 2017
9	Metering	April 2013
10	Calculation of peak demand and time impacts	April 2013; revised 2017
11	Sample design	April 2013
12	Survey design and implementation	April 2013
13	Assessing persistence and other evaluation issues	April 2013
21	Common practices in estimating net savings	September 2014; revised 2017

6.3 Relationship to Other Protocols

The UMP protocols are based on long-standing EM&V practices and well-established scientific principles. They draw from and build on previous attempts to develop systematic approaches to estimating the impacts of energy efficiency. Those efforts were conducted by various entities, including Oak Ridge National Laboratory (ORNL 1991), the Electric Power Research Institute (EPRI 1991), the U.S. Environmental Protection Agency (EPA 1995), and DOE (1996, 2008).

Several of these protocols were developed to address specific policy objectives, such as the verification of utility program savings, the determination of savings from special performance contracts, and environmental compliance.

The UMP protocols also draw on the IPMVP (DOE 2002). Each measure-specific protocol identifies the IPMVP Option with which it is associated, expands on the IPMVP Option by adding measure-specific detail, and describes the procedures for application to measure-, program- and portfolio-level evaluations.

In addition, the UMP protocols draw from and build on EM&V protocols developed to establish standards and consistency for evaluation activities within specific jurisdictions, These jurisdictional protocols include resources developed in California, by the Regional Technical Forum in the Pacific Northwest, and by the Northeast Energy Efficiency Partnerships' EM&V Forum.

A valuable companion document to the UMP protocols is the *SEE Action Energy Efficiency Program Impact Evaluation Guide* (SEE Action 2012). The SEE Action guide provides both an introduction to and a summary of the practices, planning, and associated issues of documenting energy savings, demand savings, avoided emissions, and other non-energy benefits resulting from end-use energy efficiency programs.

Designed to be complementary with the *SEE Action Energy Efficiency Program Impact Evaluation Guide*, the UMP protocols are more detailed and specific for particular measures and projects. (The preparation of these protocols was closely coordinated with that guide.)

For many technologies, evaluation tools and methods continue to improve, and the industry will continue to benefit from advancements to evaluation methods so system performance can be estimated more accurately in the future. The evaluation methods will continue to evolve in response to these changes.

7 About Evaluation, Measurement, and Verification Budgets

The EM&V effort—and expenditures—should be scaled to both the program being evaluated and the accuracy necessary to inform the decision for which evaluation results matter. The value of the information provided by the EM&V activity is determined by the resource benefits of the program and the particular policy objectives and research questions the EM&V activity aims to address.

Historically, the costs of determining energy savings are embedded in the larger context of evaluation activities undertaken as part of large-scale program portfolios. The level of effort and the corresponding cost of implementing the UMP protocols vary. In addition, EM&V costs vary depending on the regulatory requirements that dictate the levels of statistical confidence and precision. A survey of evaluation budgets for large program portfolios available from regulatory filings in several jurisdictions indicates portfolio-level EM&V expenditures ranging from 2% of total portfolio costs in Indiana to 6% of total portfolio costs in other jurisdictions.[7]

These budget estimates should be considered as only rough guidance as they are mostly self-reported and the definitions of cost elements may vary. This is particularly true considering how internal verification processes may differ from independent, third-party evaluations (SEE Action 2012, Section 7.5.2).

Evaluation resource requirements also depend on how often evaluations are conducted. The frequency evaluations are performed depends on a number of considerations, including the type and complexity of the measure and its expected contribution to portfolio savings, the uncertainty about the savings, the lifecycle stage of the program in question, and regulatory requirements. UMP has no specific recommendation about how often programs should be evaluated.

[7] Similar estimates are also available for Illinois (3%), Indiana (5%), Michigan (5%), and Pennsylvania (2%-5%), and Arkansas (2%-6%).

8 Considering Resource Constraints

The UMP protocols draw on best practices to recommend approaches for providing accurate and reliable estimates of energy efficiency savings, within the confines of the typical evaluation budget for that particular program. However, the UMP protocols do not offer recommendations about the levels of rigor and the specific criteria for accuracy of the savings estimates. Those issues are largely matters of policy, ease and cost of data acquisition, and availability of resources.

To provide maximum flexibility, protocols may contain recommendations for alternative, lower-cost means of deploying the protocol, such as relying on secondary sources of data for certain parameters and identifying guidelines for selecting appropriate sources of such data. Practitioners should document when they have used these alternative means.

The costs of deploying the UMP protocols vary depending on the features of the energy efficiency program being evaluated, the participant characteristics, the desired levels of rigor and accuracy, and whether the evaluator employed any alternatives. Thus, cost estimates for implementing the protocols are not provided. Instead, the utilities and program administrators adopting the protocols should consider benchmarking their programs and gauging their EM&V budgets against those of other entities with experience in conducting EM&V for similar programs.

8.1 Options for Small Program Administrators

UMP recognizes that even the lower-cost options provided in the UMP protocols may be impractical where resources are constrained or programs are small (such as those offered by small utilities) (GDS Associates, Inc. 2012).[8] In these circumstances, program administrators may consider using deemed savings values from:

- TRMs created by regional or state entities
- Evaluations of similar programs performed by other regional utilities. (These can serve as the basis for determining energy efficiency savings, provided that the evaluation still verifies the installation and proper operation of the energy efficiency measure or device.)

Deemed savings may be adjusted to allow for climate or other factors (regional or economic/demographic) that differ from one jurisdiction to another. Given the differences in how TRMs determine savings for identical measures, program administrators should use deemed savings values based on calculations and stipulated values derived using the UMP protocols when possible. Those using this approach should update their deemed savings values periodically to incorporate changes in appliance and building codes and the results of new EM&V studies (such as the primary protocols developed under the UMP or other secondary sources).

Where possible, program administrators may consider other cost-saving measures, such as pooling EM&V resources and jointly conducting evaluations of similar programs through local

[8] According to the Small Business Administration, small utilities are currently defined as electric-load-serving entities with annual sales of less than 4 million megawatt-hours.

associations. This resource-pooling has been done successfully with small utilities in California, Minnesota, Michigan, and the Pacific Northwest, as well as across the Northeast region via the Northeast Energy Efficiency Partnerships.[9]

Small or resource-constrained utilities and program administrators may also consider either coordinating with larger, regional utilities or adopting the results of evaluations of similar programs implemented by larger utilities.

[9] http://www.neep.org/

9 Project Management and Oversight

The UMP is funded by DOE and is being managed by the National Renewable Energy Laboratory (NREL). Since the project launched in 2011, the Cadmus Group, Inc., has managed technical aspects of the project, including protocol development, and provides technical oversight. The management structure was designed to be inclusive of a broad set of stakeholders to engage expertise and input across the industry and ensure technical excellence.

Figure 2 describes the management structure for the UMP:

- NREL manages membership and communication with the project Steering Committee and administers the public comment process.
- Cadmus manages the subject matter technical experts who develop protocols and the project Technical Advisory Group.
- The Steering Committee[10] is made up of thought leaders with perspectives on policy issues who approve project structure, guide selection of measures or topics for protocols, review final work products, and promote protocol adoption.
- The Technical Advisory Group[11] reviews all protocols and provides EM&V guidance on the validity, usability, and attribution components through the development process for each protocol.

As project sponsor, DOE oversees all aspects of the project, articulates overarching project goals, and ensures the UMP products meet DOE policy objectives.

Figure 2. UMP Management Structure

[10] Members of the Steering Committee are listed on the UMP website: https://www.nrel.gov/ump/steering-committee.html

[11] Members of the Technical Advisory Group are listed on the UMP website: https://www.nrel.gov/ump/technical-advisory.html

The following sections describe the management strategies employed to facilitate the final appeal and acceptance of the UMP work products.

9.1 Project Oversight by Variety of Stakeholders

NREL formed the project steering committee to provide general direction and guidance. The steering committee consists of regulators, utility managers, energy planners and policymakers, and representatives of industry associations. Members of the UMP Steering Committee are listed on the UMP website: https://www.nrel.gov/ump/steering-committee.html.

9.2 Authorship by Experts

Nationally recognized experts on specific energy efficiency measures, technologies, and research techniques draft each protocol in consultation with their peers. Each protocol represents the best method as agreed to by several leading experts, not just the lead author.

9.3 Review by Technical Advisory Group

A technical advisory group made up of experts from major consulting firms engaging in EM&V throughout North America reviews draft and final protocols to verify that the proposed method is a valid way to measure savings, and to ensure the protocol is written in a way that is understandable to evaluators that will use it.

Members of the UMP Technical Advisory Group are listed on the UMP website: https://www.nrel.gov/ump/technical-advisory.html.

9.4 Review by Stakeholders

All protocols are subject to a public review process, administered by NREL, which allows stakeholders to provide feedback on draft protocols before they are released in their final form.

9.5 Monitoring Use and Adoption

To monitor protocol use and adoption, Cadmus tracks references to protocols in various program and evaluation materials, including frameworks and guidelines, EM&V requests for proposals, EM&V workplans and reports, and TRMs, as well as other citations in industry reports or articles. The project maintains a record of such adoptions and periodically reports on known uses.

9.6 Protocol Refresh and Revision

To ensure the project protocols remain useful and up-to-date, especially as evaluation methods evolve to employ new tools and techniques, NREL maintains an email to receive feedback from stakeholders, periodically soliciting feedback from the Steering Committee, Technical Advisory Group, protocol experts, and industry.

In 2016, three years after the first set of protocols was published, the project team polled past UMP authors and other contributors to collect feedback on the need for revisions to existing protocols. Based on feedback from the authors and other stakeholders, the project initiated a process in 2017 to:

- Revised nine existing protocols to incorporate changes and clarifications in the methods, relevant new research and updated references, and other stakeholder feedback; and
- Republish the remaining protocols to acknowledge their continued viability of those protocols as originally published.

The project continues to take feedback through the project website (https://energy.gov/eere/about-us/ump-home) and email address (ump@nrel.gov).

References

ACEEE (2011). *Energy Efficiency Resource Standards: A Progress Report on State Experience*. Report Number U112. Washington, D.C.: American Council for an Energy Efficiency Economy. http://www.aceee.org/research-report/u112.

Birr, D.; Donahue, P. *Meeting the Challenge: How Energy Performance Contracting Can Help Schools Provide Comfortable, Healthy, and Productive Learning Environments*. The National Association of Energy Services Companies, Washington, D.C.

DOE (1996). *The North American Energy M&V Protocols*. Washington, D.C.: U.S. Department of Energy, DOE-GO 10096-248.

DOE (2002). *International Performance Measurement and Verification Protocols, Concepts and Options for Determining Water and Energy Savings, Vol. 1*. Washington, D.C.: U.S. Department of Energy. http://www.nrel.gov/docs/fy02osti/31505.pdf

DOE (2008). *Federal Energy Management Program (FEMP) M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3.0*, Washington, D.C.: U.S. Department of Energy.

SEE Action (2011). National Energy Efficiency Evaluation, Measurement and Verification (EM&V) Standard: Scoping Study of Issues and Implementation Requirements at https://www4.eere.energy.gov/seeaction/system/files/documents/emvstandard_scopingstudy.pdf

EPA (1995). *Conservation Verification Protocols, Version 2*, Washington, D.C.: U.S. Environmental Protection Agency, EPA-430/B-95-012.

EPRI (1991). *Impact Evaluation of Demand-Side Management Programs, Vol. 1: A Guide to Current Practice*. Palo Alto, CA: Electric Power Research Institute, EPRI CU-7179.

GDS Associates, Inc. (2012). *GDS Analysis of Proposed Department of Energy Evaluation, Measurement and Verification Protocols.* Marietta, GA: GDS Associates, Inc. https://www.nreca.coop/wp-content/uploads/2013/12/EMVReportAugust2012.pdf

ORNL (1991). *Handbook of Evaluation of Utility DSM Programs*. Oak Ridge, TN: Oak Ridge National Laboratory, ORNL/CON-336.

SEE Action (2012). *Energy Efficiency Program Impact Evaluation Guide*. Prepared by Evaluation, Measurement, and Verification Working Group. https://www4.eere.energy.gov/seeaction/system/files/documents/emv_ee_program_impact_guide_0.pdf

Violette, D. M.; Rathbun, P. (2014). Chapter 17: Estimating Net Savings: Common Practices. Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures; Period of Performance: September 2011-December 2014. Golden, CO: National Renewable Energy Laboratory, NREL/SR-7A40-62678. http://www.nrel.gov/docs/fy14osti/62678.pdf