Northeast Energy Efficiency Partnerships, Inc.

The Need for and Approaches to Developing Common Protocols to Measure, Verify and Report Energy Efficiency Savings in the Northeast

Final Report

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NORTHEAST ENERGY EFFICIENCY PARTNERSHIPS, INC.

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Foreword

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Executive Summary

Policymakers and utility and air regulators in the Northeast are increasingly turning to energy efficiency (EE) as a least-cost resource and both a short- and long-term strategy to address multiple policy objectives including: mitigating rising energy costs and customer bills; meeting resource adequacy and transmission expansion needs in congested areas; increasing fuel diversity in order to ensure greater energy security and reliability; and reducing greenhouse gas emissions to achieve climate change goals.

With the growing reliance on EE as a strategy to meet these and other key economic and environmental goals, there is an increased need to ensure that the measurement, verification and reporting of savings from EE investments are:[1]

- Reasonable and defensible, providing sufficient credibility, accuracy, and certainty;
- Transparent, based on documented sources that are readily available; and
- Consistent, in terms of reporting requirements so that savings can be tracked and aggregated on a comparable basis.

Currently, Northeast states measure, value and report electric EE program savings according to measurement and verification (M&V)[2] methodologies, economic frameworks, and assumptions approved by their respective regulatory commissions. The methods and frameworks used within each state have, to date, provided reliable EE savings data for the purposes they were developed: to inform program cost-effectiveness, recovery of lost base revenues, and awarding performance incentives based on achieved goals. However, if EE is to be increasingly used as a resource to help meet regional energy system, economic and environmental policy goals, then common protocols will be necessary to ensure consistent and appropriate levels of rigor that match the needs of these varied applications.

This report addresses: (1) the specific policy needs for common protocols to measure, verify and report energy savings in the Northeast, (2) the level of transparency and consistency in existing M&V protocols and economic frameworks used in the Northeast states; and 3) lessons to learn from experience with M&V protocols in other states and regions of the country. The report provides conclusions and recommendations to policymakers for how common regional protocols can be developed to serve key policy interests. The intended audience includes stakeholders in the Northeast (e.g., policy makers and regulators, evaluators, modelers, program implementers including utilities) as well as other states that are likewise grappling with how improved and more consistent M&V approaches can simplify and enhance their efforts to advance energy efficiency.

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[1] These criteria are based on: "*Building From First Principles of Good Energy Modeling."* Ken Colburn, Executive Director of Northeast States for Coordinated Air Use Management (NESCAUM). Presented at: Northeast Energy Efficiency Partnerships, Inc. 2004 Conference on "Energy Efficiency: Policy and Applied Policy" on November 17-18 in Waltham, MA. http://bronze.nescaum.org/committees/modeling/Colburn.ppt. Draft paper in progress.

[2] Measurement and verification is the confirmation that energy efficiency investments produce the claimed energy and demand savings.

The findings of this report are based on interviews with EE program evaluators, and a review of M&V documents used in the Northeast states as well as selected states and regions around the country. The project was informed by an Advisory Committee, represented by a broad group of program administrators, utility and air regulatory staff, a regional air quality organization, and an electric system operator.

Key Findings

A. Common Regional M&V and Reporting Protocols for Energy Efficiency Programs and Projects are Needed in the Northeast

Energy efficiency is a high value resource that can play a significant role in helping meet the Northeast states' energy, economic and environmental goals. It is plentiful, well understood, readily available, dependable and very cost-effective.[3] The remaining potential for cost-effective savings in homes, buildings and industry is particularly important in the context of regional energy and demand growth, existing supply constraints, historically high energy costs and projected supply shortages, and reducing greenhouse gas emissions.

Critical to advancing the impact of EE in the region is to establish policies that treat EE as a resource or commodity in the context of energy system and environmental frameworks. ***Fundamental to successfully treating EE as a resource is to create a common currency for savings that is credible and transparent*** (e.g., a kWh saved in Vermont is the same as a kWh saved in New York). Developing common measurement, verification and reporting protocols for EE savings would help to:

1. **Integrate EE into resource procurement processes**: Developing consistent protocols to measure, verify and report EE savings in the region would help assess EE as a resource on a comparable basis through such frameworks as: (a) clean energy or EE portfolio standards;[4] (b) portfolio management;[5] and (c) demand response programs, designed to reduce short-term capacity needs and/or transmission constraints.[6] Where these frameworks currently exist or are being developed in the region, consistent and transparent M&V protocols would

[3] An estimated 17,100 GWH and 4,310 MW of energy and demand savings, respectively, is available to the New England region through cost-effective energy efficiency investments by 2008, and a total of 34,375 GWH in energy savings and 8,380 MW in demand reduction through 2013. The average cost of saving electricity is about 65 percent cheaper than generating electricity. Optimal Energy, Inc. and NEEP: *The Economically Achievable Energy Efficiency Potential in New England,* November 2004, Updated May 2005.

[4] In the Northeast, some form of clean energy or energy efficiency portfolio standards (EEPS) have been adopted in Connecticut, New York, (Consolidated Edison) and Pennsylvania, and is under consideration in New Jersey. In other parts of the country, portfolio standards have been adopted in California, Illinois, Nevada, Texas and Hawaii. See Section III A.3 for more information.

[5] Portfolio management approaches have been adopted in California, Montana, Arizona and Arkansas.

[6] The ISO-NE demand response program focuses on load shedding or shifting, and does not include permanent peak reductions that can be obtained through energy efficiency (the exception is an emergency gap RFP issued in 2003 in SW CT where a very small component of the RFP was awarded to conservation projects). New York's demand response program involves a more integrated approach that includes Permanent Peak Reduction Efforts, which have represented nearly 40 percent of the KW reductions through the state's program. PJM's demand response program, like ISO-NE's, does not include energy efficiency or conservation, only load management.

ensure that EE savings are sufficiently reliable to meet state or regional resource procurement needs, and can be readily compared, aggregated, and ultimately integrated into regional system plans.

Efforts to increasingly treat EE as a resource also requires consistent valuation of EE in terms of not only savings, but also its cost (cents per kWh) and avoided cost value (avoided generation, transmission and distribution costs), allowing EE investments to be readily and consistently compared to other resource options.

2. **Incorporate EE more effectively into regional electric power system planning.** In order to use EE as a resource, consistent M&V and reporting protocols are necessary to determine EE's total impact on the electricity system. Not only do common protocols make sense within a single power pool (e.g., New England), but protocols across the three power pools in the Northeast will ensure consistency when modeling interchange and trade between independent system operators.

3. **Assess the impact of EE on reducing natural gas demand for electric power generation.** Energy efficiency can play a significant role in reducing forecasted natural gas demand in the region.[7] Common protocols for EE savings will help policymakers, system planners and other modelers determine the current and potential impact that EE savings can have in reducing the demand for natural gas supplies in the region.

4. **Improve regional EE modeling and forecasting.** Common protocols would benefit **v**arious regional modeling efforts, including regional climate change modeling and EE potential studies[8], which require the need to consistently characterize EE projects not only in terms of savings and costs but also in terms of how EE savings assumptions are likely to change in the future.

5. **Serve as the basis for consistently tracking and reporting emissions reductions associated with EE investments in the region.** As the participating Northeast states develop a carbon cap and trade system under the Regional Greenhouse Gas Initiative (RGGI), consistent and transparent M&V protocols for energy savings are a necessary element of being able to track and report emissions reductions associated with EE investments that are funded through the initial sale of carbon allowances.[9] Common protocols would also help measure the effectiveness of EE investments in meeting state and regional climate change

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[7] NEEP estimates that energy efficiency investments in the New England region can reduce power plant natural gas demand by between 7 and 45 percent by 2013, depending on how much of the region's economically achievable EE potential is captured. Optimal Energy, Inc. and NEEP: *The Economically Achievable Energy Efficiency Potential in New England,* November 2004, Updated May 2005.

[8] Regional modeling efforts include the NE-MARKAL model developed by the Northeast States for Coordinated Air Use Management; and the IPM model used to model the carbon cap under the Regional Greenhouse Gas Initiative. Other modeling efforts that would benefit from consistent characterization of EE projects are those undertaken by energy system planners.

[9] Under the RGGI Memorandum of Understanding (MOU), each state agrees to allocate 25 percent of the proceeds from the initial sale of carbon allowances for a customer benefit or strategic energy purpose, which can include promoting energy efficiency. For more information, see http://www.rggi.org/docs/mou_12_20_05.pdf.

and other pollutant reduction goals on a comparable basis, whether funded through system-benefits charge programs or carbon allowance proceeds.

The needs described above focus on developing common M&V and reporting protocols for **electric energy efficiency**. While beyond the scope of this project, these needs also largely apply to developing common regional protocols for other existing, developing or potential energy efficiency programs, including **natural gas and oil efficiency.** Likewise, developing common protocols for measuring electric energy and peak demand reductions available from renewable energy resources would be very valuable.

B. Current M&V and Reporting Protocols Differ among the Northeast States

Based on a review of existing state M&V and reporting protocols and the economic frameworks used to measure program cost-effectiveness in the Northeast states, NEEP found that:

1. **The transparency of M&V protocols varies from state to state in the region.** Most Northeast states rely on a long history of accepted practice and approved savings by their respective regulatory commissions as the basis for how they measure and verify their EE program savings. Some states have documented the formulas and standard input assumptions used to calculate energy and demand savings, while others have not. These documents, however, do not typically include verification or evaluation protocols.

2. **M&V protocols vary in the Northeast in a number of ways.** Based on a review of M&V approaches and a sample of protocols used for certain measures, NEEP found that:
   a. Baseline conditions are not always consistently defined when estimating savings.
   b. States use similar algorithms to calculate *gross* savings, but the calculation of *net* savings differs.[10]
   c. Stipulated/deemed savings estimates and standard input assumptions can range significantly.
   d. Evaluation methods used to verify initial savings estimates are similar; however, the level of rigor of the evaluations varies across the states.

3. **Reporting of initial and verified savings can differ greatly.** Program administrators typically report preliminary tracking savings data to their regulators, but most states do not retrospectively adjust their initial savings based on evaluation/verification. While differences in initial and verified savings may not be significant for all programs and measures, they can range by as much as 40 percent or more for some programs in any given year.

4. **Inconsistencies exist in how EE savings are reported to regulatory commissions and to system planners.** The majority of program administrators in the region report savings to their regulatory commissions at the net customer meter level, except New Jersey and Vermont, which report savings at the net generator level. Reported savings data can also

[10] Gross savings are adjusted to reflect savings that can be attributed to the EE programs, otherwise known as net savings. Adjustments can include spillover effect, free-ridership, and persistence rates. Some states apply all adjustments or a combination of them, and to differing degrees.

vary in terms of whether it is annual, lifetime and/or cumulative savings. Because this data is often relied upon for policy analysis or modeling purposes, aggregating the savings reported by each state to a regional level is difficult.

5. **States have different reporting schedules and different levels of regulatory review.** Currently, all program administrators report EE savings on a calendar year basis, except in Maine, which reports on a fiscal year (July-June) basis. Some states report preliminary savings data as early as February, while others report savings data as late as August or September. Most states require regulatory approval of savings, while a couple of state commissions review the savings data but do not issue approval orders (CT, NY).

6. **Most New England program administrators use common assumptions and methods to value EE programs, which differ from what is used in other Northeast states.** Program administrators in New England generally use the same avoided wholesale energy cost to value their EE programs, and are working towards common methods to value system peak demand reductions and avoided transmission and distribution costs. Avoided cost methods used in New York and New Jersey differ somewhat, although the subtleties are unclear. Additionally, when comparing the cost of EE to other resources on a cost per kWh or kW basis, states often define cost per kWh differently, making it difficult to compare the value of EE investments across states.

7. **Most states use similar economic frameworks (i.e., cost-effectiveness tests) to determine EE program priorities and budgets.** Most states use a Total Resource Cost or Societal test (or a modified version), with the exception of Connecticut and Rhode Island, which primarily rely on the Utility test. Cost-effectiveness analysis is a tool used to help guide program design and prioritize program budgets, for which consistency across the Northeast states is not necessary for the purposes of resource procurement, regional system planning and environmental policies. However, in regions where program administrators operate in multiple states, such as in New England, consistency in cost-effectiveness requirements may be warranted.

C. The Northeast Can Leverage Experience and Resources from Other States and Regions

Based on the experiences of other states or regions in the country, NEEP found that:

1. **The International Performance and Measurement Verification Protocol (IPMVP) is widely used elsewhere and can help inform the development of common protocols in the Northeast**. The IPMVP is a flexible M&V guideline that offers varying levels of rigor and cost. It is the accepted industry standard used by energy service companies (ESCOs) for performance contracting projects, largely for government EE projects (e.g., municipal buildings, schools, etc.), and is referenced in EPA guidance documents[11] as a

[11] US EPA, Creating an Energy Efficiency and Renewable Energy Set-Aside in the NO_X Budget Trading Program: Determining NO_X Credits with Measurement and Verification of Electricity Savings, Volume 3 of 3, Draft, December 5, 2003; US EPA, State Set-Aside Programs for Energy Efficiency and Renewable Energy Projects Under the NO_X Budget Trading Program: A Review of Programs in Indiana, Maryland, Massachusetts, Missouri, New

protocol that can be, and has been, used by states to support their EE or renewable energy set-aside programs under the NO_X SIP Call (State Implementation Plan) program. While IPMVP was initially developed to support financial contract terms between ESCOs and their clients, it is increasingly being used or recommended in a number of states as the M&V guideline for EE savings to support system planning needs, portfolio standards and carbon reduction programs.

2. **The Northwest Regional Technical Forum (RTF) is a model for common regional M&V protocols where consistent savings data informs system planning in the region, and tracks progress towards EE goals.** Developed and informed by a working group representing four states in the Northwest, the RTF provides a web-based forum for reporting EE savings using default protocols (including IPMVP for C&I custom projects). The RTF functions within individual state regulatory rules, requirements and reporting schedules, and is informed and updated by utility specific evaluation efforts. It also provides a cost-effectiveness framework for calculating program benefits and costs.

Conclusions

To date, individual state EE savings data have been reliable for the purposes they were developed. However, NEEP's research points to several modifications necessary to more fully support an evolving set of needs related to regional energy system planning and environmental policies. These changes include improvements to consistency, documentation and comparability.

As the region prepares to increase investments in EE along with other clean energy resources, it is in the states' interests to establish common protocols for measuring, verifying, and reporting energy and capacity savings in a consistent and transparent manner that meets minimum requirements for rigor. Lacking this, system planners and policy makers would find it difficult to reliably incorporate energy efficiency into power system planning or reliably assess the impacts of energy efficiency policies and programs to meet energy, economic or environmental goals.

Recommendations

Based on its findings and conclusions, NEEP recommends that the New England states, New York and New Jersey:

- **Commit to developing common M&V protocols and reporting formats for EE program/project savings.**

- **Establish a regional protocols Working Group represented by state air regulators, utility regulators, electric and gas efficiency program administrators, and electric power system planners to develop common regional protocols and reporting formats.**

Jersey, New York, and Ohio, Draft, September 16, 2005. EPA notes that additional requirements must be specified to fully define M&V requirements.

- **Explore adopting the IPMVP as the guideline for evaluating and verifying savings EE projects/programs to the extent practicable.**

- **Build upon existing M&V protocols and state practices in the Northeast to guide the development of common protocols for non-retrofit programs and projects.**

- **Consider the Northwest Regional Technical Forum as a model from which the Northeast can leverage resources and experience using existing capacities to provide technical analysis and modeling for regional energy and environmental policies.**

- **Ensure that the development of common regional protocols will be designed to fill a full range of utility and state needs so as to not require program administrators to keep multiple sets of books to document their program costs or savings.**

A logical and timely approach for developing common protocols is to do so within the context of one or more ongoing regional efforts. This could include the regional implementation of a carbon cap and trade system, in which establishing common protocols for EE savings will be critical to ensuring that EE plays an effective role in helping the region reduce its greenhouse gas emissions. This effort covers most states in the Northeast, includes a funding mechanism to support EE investments through the initial sale of carbon allowances, and identifies EE as a complementary energy policy that states agree to maintain or expand to decrease the use of less efficient or relatively higher polluting power plants.

Common protocols could also be developed through existing regional forums that address energy policies, including efforts through the Coalition of Northeast Governors, the New England Conference of Public Utility Commissioners, or the New England Governors Conference, in coordination with regional system planning efforts to address system reliability and resource adequacy issues.[12]

[12] ISO-NE has identified conservation and demand response as one of the "four pillars of a balance and reliable power system," and the need for comprehensive planning to provide a roadmap to achieve the four pillars. See ISO-NE presentation by CEO Gordon van Welie at http://www.raabassociates.org/main/roundtable.asp?sel=64.

I. The Need for Common Protocols in the Northeast

Policymakers and utility and air regulators in the Northeast are increasingly considering energy efficiency (EE - for a full list of acronyms and definitions, see Attachment A) as the least-cost, quick-to-implement short and long-term strategy to help meet resource adequacy and transmission expansion needs in geographically targeted congested areas, to mitigate increasing energy costs, and to reduce greenhouse gas emissions.

Energy efficiency is a high value resource that can play a significant role in helping meet the Northeast states' energy, economic and environmental goals. It is plentiful, well understood, readily available, dependable and very cost-effective.[13] The remaining potential for cost-effective savings in homes, buildings and industry is particularly important in the context of regional energy and demand growth, supply constraints, historically high energy costs and projected shortages, and reducing greenhouse gas emissions.

Current EE strategies include system-benefits charge (SBC) funded programs, building energy code upgrades (and ensuring compliance), and the adoption of high efficiency appliance standards. These strategies, however, capture only about 20 percent of the economically achievable EE potential in the region.[14] Critical to advancing EE in the region beyond the impacts of existing strategies is to establish additional policies and strategies that treat EE as a resource or commodity in the context of key energy system and environmental frameworks. ***Fundamental to successfully treating and evaluating EE as a resource throughout the region is to create a common currency for savings that is credible and transparent.***

Below are examples of various existing, developing or potential state and regional policies or initiatives in which common protocols to measure, verify and report EE savings are necessary if EE is to be effectively relied upon as a resource.

A. Procuring EE as a Resource

Growing interest in relying on EE as a resource has led to procurement frameworks in which EE is used to meet resource adequacy goals. These frameworks include (a) clean energy or EE portfolio standards; (b) portfolio management; and (c) demand response programs.

<u>Energy Efficiency Portfolio Standards (EEPS)</u>: An EEPS requires that a specific percentage of a state's forecasted load growth or electricity sales be met through EE (and in some cases other clean energy resources). The portfolio standard can apply to a distribution companies' default/basic service procurement requirements or to all retail suppliers in the state. In the Northeast, some form of a clean energy or energy efficiency portfolio standard has been adopted

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[13] An estimated 17,100 GWH and 4,310 MW of energy and demand savings, respectively, is available to the New England region through cost-effective energy efficiency investments by 2008, and a total of 34,375 GWH in energy savings and 8,380 MW in demand reduction through 2013. The average cost of saving electricity is about 65% cheaper than generating electricity. Optimal Energy, Inc. and NEEP: *The Economically Achievable Energy Efficiency Potential in New England,* November 2004, Updated May 2005.
[14] Optimal Energy, Inc. and NEEP: *op. cit.,* May 2005.

in Connecticut, New York (Consolidated Edison Company of New York, Inc.) and Pennsylvania, and is under consideration in New Jersey. Outside of the Northeast, various versions of an EE portfolio standard have been adopted in California, Texas, Illinois, Nevada, and Hawaii.

Portfolio Management (PM): PM focuses more broadly on hedging or mitigating financial risk through increased resource diversity and varied procurement contract terms. PM recognizes that both vertically integrated and distribution-only utilities have an essential role to play in managing the electricity resources used to serve electric customers. The management of these resources will be most efficient and provide the greatest benefits to customers and society if it includes *all* cost-effective resources on the demand-side and the supply-side. The PM approach is, to date, used in both states that have restructured their electricity industry and those that have not. In the states of California, Montana and Arizona, PM is assigned to distribution companies which are required to diversify contracts by length and resource (and in some cases EE is the required resource of first choice, including in Arizona and California). In other states and regions with vertically integrated utilities, such as in Vermont and the Pacific Northwest, continuation or restoration of some form of integrated resource planning exists, capturing important elements of PM.

Demand Response (DR): Demand response programs are designed to reduce short-term capacity needs and/or transmission constraints. In New England, the Independent System Operator's (ISO-NE) demand response program focuses on load shedding or shifting, and does not include permanent peak reductions that can be obtained through energy efficiency (the exception is an emergency gap RFP issued in 2003 in Southwest Connecticut where a very small component of the RFP was awarded to conservation projects). On the other hand, New York's demand response program involves a more integrated approach that includes permanent peak reduction efforts, which represent nearly 40 percent of the kW reductions obtained through the state's program. The PJM System Operator also has a demand response program, which like ISO-NE's, focuses on load management and does not include energy efficiency or conservation.

To the extent that Northeast states adopt some form of the above frameworks, developing consistent protocols to measure, verify and report EE savings would help to facilitate the assessment of EE as a resource on a comparable basis across the region, and would ensure that EE savings are reliable, can be readily aggregated, and ultimately incorporated into regional system plans.

B. Tracking Emissions Reductions Associated with EE Investments

As the participating Northeast states develop a carbon cap and trade system under the Regional Greenhouse Gas Initiative (RGGI), consistent and transparent M&V protocols for energy savings are a necessary element of being able to track and report emissions reductions associated with EE investments that are funded through the initial sale of carbon allowances.[15]

[15] Under the RGGI Memorandum of Understanding (MOU), each state agrees to allocate 25 percent of the proceeds from the initial sale of carbon allowances for a customer benefit or strategic energy purpose, which can include promoting energy efficiency. For more information, see http://www.rggi.org/docs/mou_12_20_05.pdf.

In addition, common protocols to measure, verify and report EE savings would allow for the ability to track the impact of EE savings in terms of their carbon emission reductions relative to individual state and regional climate change goals. Absent this ability, policymakers will not be able to effectively assess – on a comparable basis – the impact of EE in helping meet the region's carbon reduction goals. This is especially relevant to the regional approach adopted under the New England Governors Conference and Eastern Canadian Premiers (NEGC/ECP) climate change efforts.

Without a common "currency" for EE savings to inform carbon as well as other pollutant reductions, differences in current M&V and reporting protocols can either under- or over-state the overall regional impact of EE to reduce power plant emissions, potentially resulting in shortfalls in meeting emission reduction targets.

C. Improving Regional EE Modeling and Forecasting

Various regional modeling efforts require the need to consistently characterize EE projects, not only in terms of savings and costs, but also in terms of assumptions about how the parameters used to characterize EE projects are likely to change in the future. These efforts include analyzing the future impact of EE investments under a regional cap and trade system, as well as the role of EE in reducing other pollutant emissions in region (e.g., using the NE-MARKAL model being developed by Northeast States for Coordinated Air Use Management). These modeling efforts have raised issues about the need for greater transparency in the input assumptions used to estimate EE savings, and to more consistently characterize the savings and associated baselines to allow for comparability across states and the ability to readily aggregate data across the region. Developing common M&V protocols for energy efficiency programs in order to improve the analytical framework by which EE programs are assessed would better inform states on the ways to increase EE and cost-effectively reduce air pollution.

D. Incorporating EE into Regional Electric Power System Planning

The Northeast is currently facing tremendous increases in energy costs attributable to a number of factors, primarily related to tight natural gas supplies that heat homes and also fuel the region's increased dependence on natural gas fired power plants. While the siting of liquefied natural gas (LNG) terminals is being proposed throughout the region as a solution, the process and timeframe for approving and building these facilities is uncertain. In addition, a failed capacity market in New England presents a forecasted capacity shortage in the 2008-2010 timeframe, with no immediate solutions for how this demand will be met, and the potential for even greater increases in electricity costs to ratepayers.

Although policymakers in the region consider EE and load management (together referred to as demand-side management or DSM) to be key strategies to help address these challenges, energy efficiency – as a hugely plentiful, cost-effective resource in the region – is not modeled as a resource in the region's system plans beyond current levels of EE investments.[16] In general, the

[16] In New England, ISO's forecasted electricity energy and demand includes implicit assumptions about the savings impact of current building energy code and standards, as well as explicit forecasts of ratepayer funded DSM (energy efficiency/conservation and load management) net savings submitted by the utilities/program administrators. NY-

region's system operators do not have information or direction from state policymakers to model EE based on its availability as a resource (i.e., the economically achievable EE potential). Rather, EE is modeled in system forecasts based on an arbitrary SBC program funding level that does not reflect the availability, cost or risk of EE relative to other supply-side resources.

If policymakers and system operators are to increasingly incorporate EE as a resource in system plans as a result of expanding strategies to capture EE savings (as discussed in this section), then the M&V and reporting protocols for EE programs and projects need to be consistent across states so that savings can be readily aggregated to assess their total impact on the electricity system, and effectively incorporated into regional system plans. Not only do common protocols make sense across states in a single power pool, but also across the Northeast region's three power pools to ensure consistency in EE impacts when modeling interchange and trade between the power pool zones.

E. Assessing the Impact of EE on Reducing Natural Gas Demand

Energy efficiency can play a significant role in reducing forecasted natural gas demand electric power generation in the region.[17] Common protocols for EE savings would help policymakers, system planners and other modelers determine, on a more reliable and credible basis, the current and potential future impact that EE savings can have in reducing the demand for natural gas supplies in the region. This is particular important in the context of fully analyzing the risks and costs associated with citing and building liquefied natural gas (LNG) facilities compared with other resource options.

F. Improving the Comparability of EE Program Costs and Value

Greater consistency and transparency in the methods used to determine the cost ($/kWh) and value (avoided generation, transmission and distribution costs) of EE programs would allow for better comparison of EE relative to other resources. It would also allow policymakers, regulators, program administrators, and other interested parties to better compare program performance across states. Common regional protocols would also allow for regular exchange and sharing of information that would assist program administrators in their M&V processes.

The needs described above focus on developing common M&V and reporting protocols for **electric energy efficiency**. While beyond the scope of this project, these needs also largely apply to developing common regional protocols for **natural gas and oil energy efficiency** as or if and when these policies develop in the region. Likewise, developing common protocols for measuring electric energy and peak demand reductions available from renewable energy resources would be very valuable.

ISO and PJM system operators, trend forecasting is used which implicitly reflects DSM investments from prior years (although NYSERDA does its own forecasting with explicit EE assumptions). See further discussion in Chapter II.C.4.

[17] NEEP estimates that energy efficiency investments in the New England region can reduce power plant natural gas demand by between 7 and 45 percent by 2013, depending on how much of the region's economically achievable EE potential is captured. Optimal Energy, Inc. and NEEP: *The Economically Achievable Energy Efficiency Potential in New England,* November 2004, Updated May 2005.

As the region prepares to increase investments in energy efficiency along with other clean energy resources, policymakers need to establish common protocols for measuring, verifying, and reporting energy and capacity savings in a consistent and transparent manner that meets minimum requirements for rigor. Lacking this, system planners and policy makers cannot reliably incorporate energy efficiency into power system planning or reliably assess the impacts of energy efficiency policies and programs to meet energy, economic or environmental goals.

II. M&V Protocols Used in the Northeast

To generally assess whether M&V and reporting protocols in the Northeast meet the criteria needed to ensure that EE savings can be relied upon to meet specific policy needs, NEEP conducted informal interviews with program evaluators, and researched existing M&V documents to determine: a) the level of transparency in M&V protocols; b) the commonalities and differences in existing M&V protocols; c) reporting requirements across the states; and d) the economic frameworks used to determine the value and cost-effectiveness of EE programs. Attachment B provides a summary of interviews with program evaluators.

An important distinction to bear in mind in this chapter is the M&V and reporting protocols that pertain to the physical savings (i.e., kWh and kW) associated with EE investments (addressed in Sections A, B and C below), versus the economic or monetary value of the EE savings (addressed in Section D).

A. Level of Transparency in M&V Protocols

Most Northeast states rely on a long history of accepted practice and approved savings by their respective regulatory commissions as the basis for how they measure and verify their energy efficiency program savings. NEEP found that a few states in the Northeast have formally documented the formulas and standard input assumptions used to calculate energy and demand savings in a technical reference manual or equivalent, providing some level of transparency. These documents, however, do not include any verification protocols (i.e., specifying a required verification methodology or level of rigor). Descriptions of verification or evaluation methods are described in the impact evaluations directly. These states include Vermont (Technical Reference Manual), New Jersey (Protocols to Measure Resource Savings), and just recently, Connecticut (2006 Program Savings Documentation). Because these states have formal documents that are readily available, these states were largely used to more closely compare the consistency in standard algorithms and input assumptions, as discussed further below.

In other states (Massachusetts, Rhode Island, and New Hampshire), no formal M&V protocols documents exist. This does not necessarily mean that savings are not well documented (savings calculations and verification methodologies are typically found in evaluation studies). This information, however, is not compiled into a single, readily available document as in other states, thereby providing less transparency.

In New York, the New York State Energy Research and Development Authority (NYSERDA) relies on the International Performance Measurement and Verification Protocol (IPMVP) for its commercial and industrial performance programs (CIPP), and has no formal protocols document for its other programs – rather, various field verification methods are used. NYSERDA has a systematic evaluation and review process of its EE programs, where the frequency and level of rigor of evaluation depends on the size of the program budget, reported kWh and kW savings, and internal priorities.

In Maine, no program evaluations have yet been performed because Efficiency Maine is still ramping up its fairly new portfolio of programs. A proceeding, however, is underway to determine level of third party verification.

B. A Comparison of M&V Protocols in the Northeast

In assessing the commonalities and differences in M&V protocols in the region, NEEP focused on comparing:

1. Baseline conditions;
2. Algorithms used to calculate gross and net savings;
3. Stipulated/deemed savings estimates and standard input assumptions; and
4. Evaluation methods used to verify initial savings estimates.

Specific examples of how these protocols differ across various states for certain types of EE projects or programs is provided in Attachment C, and cited throughout this section.

1. <u>Baseline conditions are not always consistently defined when estimating savings</u>.

Important to consistently estimating energy savings is to have consistent – not necessarily uniform – baseline data. Currently, baselines in the Northeast are developed as part of evaluations and are updated on an as-needed basis, as evaluation budgets permit and/or as states update their building energy codes.

The baseline definition or condition used as the basis for calculating EE savings can depend on the type of program or measure, and can vary by state, as shown in Attachment C. For some programs, like *new construction or major renovation*, the baseline is typically defined as standard practice (i.e., the state's current building energy code or common practice where common practice leads to a more energy efficient result than code). In this case, the baseline can vary from state to state depending on what energy code is in place and the maturity of EE program efforts and their effect on typical practice in the area (see Attachment D).

For retrofit programs, the baseline is sometimes the existing or retrofit measure that is being replaced, such as in the case of residential lighting where an incandescent bulb is the measure being replaced by a compact fluorescent bulb. In the case of *early replacement/retirement* retrofit measures and/or programs, some states define the baseline as either: a) the existing measure or technology (New York[18], Vermont); b) standard practice or what is required under the state's building energy code (New Jersey); or c) a blend of existing technology and current standard practice/code (Massachusetts, Connecticut), which accounts for "baseline shift."[19] For example, in the case of C&I prescriptive lighting, the baseline used in different states is either a standard T-12 ballast (existing equipment), a T-8 ballast (the current standard), or a combination

[18] NYSERDA is beginning a research project in 2005 to determine how long to take credit for the first year's savings by determining how early was the early replacement.
[19] Baseline shift addresses the issue of whether a working piece of equipment being replaced still has a significant amount of useful life remaining or is the equipment something that is near the end of its useful life and therefore would have been replaced by a standard efficiency measure anyway.

of both. In cases where baseline shift is not consistently accounted for, the savings reported could be overstated.

Given that the largest potential additional EE savings in the region lie in early-retirement retrofit market for C&I prescriptive and custom projects, it is important to ensure consistency in how baselines should be updated. Otherwise, this may result in systematically over- or under-counting savings. The development of common regional protocols would help address the fundamental differences identified above, including appropriate baseline definitions and how best to maintain baselines to account for baseline shift, especially in the case of early replacement/retirement programs. Absent common protocols, EE savings may not be sufficiently reliable nor comparable for purposes of resource procurement, energy system planning, or tracking progress towards environmental goals.

2. States calculate net EE savings differently.

M&V protocols and approaches typically make the distinction between *gross* and *net* energy and demand savings from EE programs. Gross savings quantify the estimated change in energy consumption and/or demand that results directly from EE program-related actions taken by participants in the program, regardless of why they participated. Through evaluations and other studies or assumptions, gross savings are adjusted to determine net savings, which reflect only EE savings that can be attributed to the program. Net savings are used for the purposes of measuring program cost-effectiveness and awarding program administrators for performance. In the Northeast, net savings are also used to inform projected energy and demand reductions in regional system planning.[20]

NEEP compared gross savings algorithms used to calculate selected measures in a sample of states and found that they are largely similar, although can be difficult to compare due to differences in terminology (see “Algorithm” column in Attachment C). The most important distinction among states is that they have different rules on what adjustments are applied to gross savings to calculate *net* savings.

Market Effects: Gross savings are typically adjusted up or down to reflect energy and demand savings due to market effects, such as spillover (participant or non-participant) and free-ridership. Participant spillover are the additional EE actions that program participants take outside a program as a result of having participated in the program, while non-participant spillover are changes in the energy use of non-participants as a result of a program. Free-ridership is the fraction of gross program savings that would have occurred despite the program, where a free-rider is a non-participant who adopted a particular efficiency measure or practice but would have done so anyway absent the EE program. Spillover effect is a positive adjustment to savings, while free-ridership is a negative adjustment, the combination of which results in a net market effect. NEEP found that states vary in what market effect adjustments are made to gross savings, as shown in Table 1. Six of the eight states include some form of spillover effect, while four of

[20] This differs from the Northwest (see Chapter III.B) where gross savings are used for forecasting purposes on the basis that they should reflect EE investments regardless of who pays (i.e., including free-riders). In New England, further discussion on this issue is needed to better understand how ISO-NE captures embedded efficiency improvements (beyond current energy codes and standards), such as those associated with free-riders.

the eight states include an adjustment to reflect free-ridership. Some states include net market effects (i.e., the difference between spillover and free-ridership) in their reported energy and demand savings, while others include them only in their cost-effectiveness analyses.

Table 1. Summary of Spillover, Free-Ridership and Persistence Adjustments

State	**Spillover**		**Free-Ridership**	**Persistence and Retention**
	Participant	Non-Participant		
CT	Yes	Yes	Yes	Yes
ME	No	No	No	No
MA	Yes	Yes	Yes	Yes
NH	Yes	Yes	No	Yes
NJ	No	No	No	Yes
NY	Yes	Yes	Yes	Yes*
RI	Yes	No	No	Yes
VT	No	Yes	Yes	Yes*

** Persistence is sometimes captured in the assumed measure life.*

Market effects are typically informed by studies such as market characterizations, market assessments, and attribution studies (e.g., spillover or free-ridership studies).[21] Program administrators in the Northeast sometimes undertake these studies individually or jointly at a state and/or regional level. However, there are no consistent protocols in the Northeast for how market effects are determined. NEEP found that California is one example where market effects protocols have been developed for EE programs that involve information, education, marketing, promotion, and outreach efforts that do not have specific energy saving goals but still can create energy impacts (see Chapter III discussion on California protocols and Attachment G, Table 2). For example, the need for developing common protocols in the Northeast to measure market effects is important in the context of measuring the market effects of ENERGY STAR® product programs and other market transformation programs. Common protocols would help to ensure that as states show increased adoption of ENERGY STAR® products, they can consistently report what part of the market change – and the associated energy and demand savings impacts – was induced by SBC-funded EE programs.

Persistence or Retention Rates: Persistence reflects whether or not an installed measure is still installed (measure retention) over the anticipated lifetime of the measure, or can take into account changes in how the measure is used and how savings may change over time due to technology degradation. Some states apply an explicit persistence or retention factor as part of a net savings algorithm, while in other states, "persistence" is captured in the assumed measure life and therefore, while accounted for, may not be readily transparent (see Table 1). Importantly, where states do account for most or all net-to-gross adjustments, the frequency of studies used to

[21] Market assessments track changes in markets with specific focus on market indicators that are likely to be impacted by an EE program. Market assessments use an initial market characterization as a baseline to track program/market indicators over time and, where appropriate, update the basic market characterization. Attribution studies identify the impacts of the program interventions beyond what would have happened without the program and g be energy markets and provides

estimate spillover, free-ridership and persistence can vary from state to state. Especially in the case of persistence, anecdotal information suggests that there is a wide range of variation in the extent to which program administrators account for this factor.

Realization Rates: Together, the adjustments made to gross savings determine a net-to-gross ratio – often referred to as a "realization rate."[22] In years when an evaluation is not performed on a particular program or measure, a realization rate is typically applied to initial gross savings estimates based on prior year net-to-gross ratios in order to calculate net savings. Realization rates typically fall in the range of 65 to 150 percent.[23] This wide range may partly be due to adjustments that are unique to a particular program or measure, but may also be a result of differences in what adjustments are applied to gross savings.

Overall, NEEP found that there are significant differences in how the Northeast states calculate net savings, which can be addressed through the development of common protocols. This is especially important in the context of being able to aggregate savings data to a regional level for the purposes of system planning.

3. Stipulated or deemed savings estimates and standard input assumptions can vary significantly.

While the purpose of this project was primarily to address the issue of consistency and differences in M&V methodologies, NEEP also looked at stipulated or deemed savings values for similar standard prescriptive measures.

Like with other M&V terms, the definition of stipulated or deemed savings, which can also be referred to as standard or default savings, varied somewhat depending on the source. However, the most commonly used definition appears to be:

> "Deemed savings are typically agreed upon savings values by at least one but often more stakeholder organizations associated with the use of the values. For existing measures, deemed savings are based on engineering estimates and/or past impact evaluations, and are typically adjusted periodically as new evaluations are conducted. For new measures, in the absence of past impact evaluations, deemed savings are based on best engineering data or professional opinion. In both cases, deemed savings are used for measures with little variation in operating use or dependence on weather."[24]

NEEP found that stipulated or deemed savings for similar or same measures can vary across the Northeast considerably. For example, deemed savings values for residential lighting (compact

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[22] NEEP found that program administrators use the term differently, where in some cases, the realization rate is an adjustment that is separate from, or only partly represented by, the factors presented in Table 1. The ambiguity in what constitutes a realization rate could be resolved through the development of common M&V definitions.

[23] Based on a review of realization rates provided in National Grid's *2004 Energy Efficiency Annual Report for Massachusetts Electric company and Nantucket Electric Company*, October 2005; and *United Illuminating and Connecticut Light & Power Company Program Savings Documentation for 2006 Program Year*, CT DPUC Docket 05-10-02.

[24] Based on definitions provided by evaluation experts including: Nick Hall, TecMark; Mike Messenger, California Energy Commission; Ed Vine, Lawrence Berkeley National Lab; Ralph Prahl, Prahl Associates; and Ken Keating, Bonneville Power Authority.

fluorescents or CFLs) range from 38 kWh/yr to 95 kWh/yr (see Attachment C). This wide range in kWh/year may be due to any one or a combination of the following reasons:

a) Different assumptions about the average CFL wattage, in which case this is a definitional issue and greater transparency in the measure description is needed;
b) Characteristics that are unique to the program administrator or the state (e.g., heating/cooling degree days for air conditioning measures) in which case inconsistencies should be transparent and understood; and/or
c) Significant variations in standard input assumptions (e.g., measure life, hours of use) that may be justified but warrant further comparison.
d) Different program strategies for targeting high payoff applications (e.g., programs that target high use buildings or end-uses which lead to higher savings)

Similarly, variations in input assumptions used to calculate prescriptive measure savings may exist across states, but these differences should be transparent and understood. In past surveys, some program administrators informed NEEP that they would value having a central, regional database that documents the input assumptions used to calculate savings for common measures. This would allow program administrators to compare and share savings data and assumptions, similar to databases used elsewhere in the country.[25]

4. <u>Evaluation methods used to verify initial savings estimates are similar, however, the level of rigor of the evaluations varies across the states.</u>

Various M&V methods exist to collect and analyze gross savings data based on the type of program, cost, precision and uncertainty. In the Northeast, the type of M&V method used depends on the program and the available budget. In some states (Connecticut, Massachusetts, New Hampshire, New York and Rhode Island), these decisions are largely informed by program administrators in conjunction with a state collaborative process. In other states, regulatory oversight or guidance dictates the level and frequency of evaluations (New Jersey, Vermont and Maine).

Evaluation methods include savings data collection and data analysis. *Data collection* methods typically include: engineering calculations, surveys, modeling, end-use metering, on-site audits and inspections and collection of utility bill data. M&V activities in the Northeast include the collection of measured data (e.g., end-use metering, on-site audits), and where measured data are not collected, evaluators rely on engineering estimates/calculations[26] and/or deemed savings estimates. Methods for *analyzing* the savings data (i.e., verification) include a range of options such as engineering methods (engineering algorithms and building simulation models), statistical models (billing analysis, regression models), end-use metering, and integrative methods. Descriptions of these different evaluation methods are provided in Attachment E.

[25] A central database for common savings assumptions is used in California as part of the Database for Energy Efficiency Resources (DEER), as well as in the Northwest, where the Regional Technical Forum (RTF) maintains a database on common default savings and input assumptions. See Section III for more information.

[26] Engineering algorithms are equations showing how energy (or peak) use is expected to change due to the installation of an energy efficiency measure. The accuracy of the engineering estimate depends upon the accuracy of the inputs, and the quality of that data entering an engineering algorithm can very dramatically, based on the evaluation method.

NEEP compared the evaluation methods used for a sample of measures in several states, and found that there are differences in the level of rigor used to estimate and verify EE savings. For ease of comparison, NEEP compared the states' evaluation methods relative to the International Performance Measurement and Verification Protocol (IPMVP) (see Attachment C and further discussion of IPMVP in Section III). For standard prescriptive measures (e.g., residential lighting), all states use stipulated or deemed savings, which are partially informed by prior year evaluations or on-site measured data (the equivalent of IPMVP Option A). However, for some states (CT, MA) evaluation methods may be equivalent to IPMVP Options B or C in years when evaluations are performed, thereby providing a more rigorous analysis of savings. These same findings apply to prescriptive measures that have some variation in input values (e.g., commercial lighting). In the case of custom projects, evaluation methods range from Option A to Option C, although Option B is used by all the surveyed states in some capacity.

Comparing evaluation methods across the states, in this case based on IPMVP, provides one level of information regarding the rigor in savings estimates. Other important factors include how frequently evaluations are conducted, as well as the number of end-uses analyzed within an evaluation, where some states or program administrators analyze a wider range of end-uses (e.g., multiple types of commercial lighting measures as opposed to just one or two) than others, making these evaluations more robust. In the Northeast, the frequency of evaluations in each state depends on the program and the available budget. Some states conduct evaluations on an as-needed basis as budget permits, while others are more systematic, as described in Attachment B.

Importantly, evaluation budgets can vary considerably and dictate how much effort is spent on verifying savings. For comparison, Maine and New York spend about two percent of their total budget on evaluation, while Connecticut spends three percent. Massachusetts spends between three and five percent of its budget on evaluation, and New Hampshire spends five percent.

C. A Comparison of Savings Reporting Requirements

1. Program administrators typically report preliminary tracking data to their regulators, but do not retrospectively adjust their initial savings based on evaluation/verification.

Impact evaluations are mostly used prospectively to adjust algorithms and input assumptions applied to following year estimated savings, and are not used retrospectively to true up preliminary savings data. The exceptions to this are Massachusetts, New York, Rhode Island, and Vermont, which do true-up savings. This is important for the purposes of resource adequacy and system planning purposes, as well as tracking emission reductions to ensure that verified, and not preliminary, savings serve as the basis of calculations or analyses.

2. Inconsistencies exist in how savings are reported in terms of generator vs. customer levels and annual vs. lifetime savings.

For the most part, program administrators in the region report energy and demand savings to their commissions at the net customer meter level, with the exception of New Jersey and

Vermont, which reports savings at the net generator level (accounting for transmission and distribution line losses). Additionally, inconsistencies exist in terms of whether annual, lifetime and/or cumulative savings are reported. For system planning, resource adequacy and carbon emission policy purposes, reporting savings at the net generator level is appropriate. In New England, utilities submit data to ISO-NE at the net customer meter level, which ISO-NE then converts to the generator level using an average transmission and distribution (T&D) line loss factor.

3. States have different schedules for reporting program savings, as well as different levels of regulatory review and approval.

For some of the ultimate purposes of regional protocols (e.g., integrating EE into system planning) similar reporting cycles may be important. Currently, all states report savings based on a calendar year, the exception being Maine which reports savings for the fiscal year July-June. Additionally, some states report preliminary savings data as early as February of each year while others report preliminary or evaluated savings data later in the year (August/September). Most states require regulatory approval of savings, while a couple of state commissions do not formally approve reported savings (Connecticut and New York). The differences in reporting schedules may be important in the context of providing data in a timely manner to inform resource procurement and emission reduction policy efforts.

4. Program administrators make their own assumptions about projected EE savings beyond current year program installations to inform regional system planning.

Separate from the need for M&V protocols for installed EE savings is the need for protocols to inform and guide forecasted or projected savings. In terms of system planning, this finding is largely unique to New England, where program administrators submit forecasted demand-side management savings (including savings from EE and load management programs) to ISO-NE that are based on utility or program administrator assumptions about future investments in EE, where these assumptions are not necessarily informed by policymakers. For example, somewhat arbitrary assumptions are made that SBC program funding will decline in the future or completely sunset. As a result, the ISO-NE's DSM forecast in its 2005 CELT Report[27] shows that DSM savings peak in 2009 and decline thereafter. Developing common protocols to inform or guide what policy assumptions are used as the basis for EE projections may be warranted to ensure projections are reasonable.

D. Protocols Used to Measure Program Value and Cost-effectiveness

Northeast states currently value electric EE program savings according to economic frameworks and assumptions approved by their respective regulatory commissions. For the purposes of this report, NEEP focused on comparing how states value EE programs in terms of their avoided costs and cost per kWh. These are especially important to inform and guide policymakers and system planners on the value of EE relative to other resource options. NEEP also compared how states analyze program cost-effectiveness in terms of what economic test is used.

[27] See 2005 Capacity, Energy, Loads and Transmission (CELT) Plan at http://www.iso-ne.com/trans/celt/report/2005/2005_celt_report.pdf.

1. Methods and assumptions for valuing EE Programs

Avoided Costs. The New England states have participated in joint avoided cost studies over the years to estimate a regional avoided wholesale electricity cost to use in their cost-effectiveness analyses. The latest avoided cost study[28] recommends the use or application of:

- A common New England avoided wholesale electricity cost;
- A consistent method to calculate avoided transmission and distribution (T&D) costs;
- Consistent assumptions and methodologies to measure Demand Reduction Induced Price Effects (DRIPE); and
- The same peak demand-costing period, as defined by ISO-NE and the Federal Energy Regulatory Commission in the context of Locational Installed Capacity (LICAP), where system peak is defined as the single highest demand hour during the summer.

New England states are in the process of reviewing these recommendations and it is not yet clear to what extent they will be adopted.

In the context of developing common protocols to value EE savings, certain assumptions adopted by program administrators in New England (e.g., the avoided wholesale electricity cost) are unique to that region's power pool and are not applicable to other Northeast power pool regions. However, the methods used to calculate avoided generation and T&D costs should ideally be similar or the same. Additionally, similar factors or variables should be accounted for consistently, such as the methodology used to calculate DRIPE. This value represents the impact of EE programs in reducing demand at the margin, which therefore reduces the wholesale market-clearing price and results in lower electricity costs to the entire power pool region. Individual New England states are now in the process of deciding whether and how to incorporate this EE benefit in their avoided cost calculation.[29] NYSERDA calculates the reduction in overall wholesale prices attributable to its programs and factors this estimate into one of its four program cost-effectiveness scenarios. New Jersey currently does not account for this factor in its assessment of EE economic benefits.

The recent New England avoided cost study also recommends that program administrators use the same peak demand costing period defined as the single highest system demand hour during the summer to more accurately reflect wholesale market pricing rules according to the newly implemented standard market design. New Jersey utilities use PJM's seasonal avoided energy and capacity cost patterns, where the coincident peak demand savings periods are broadly defined across multiple hours and months,[30] as opposed to a single peak hour as recommended in New England. NYSERDA also defines its coincident peak demand savings period similar to New Jersey's. It is not clear if these different approaches to valuing peak demand savings make sense across the different power pool regions. Further analysis of this issue should address

[28] *Avoided Energy Supply Costs in New England,* prepared for the Avoided-Energy-Supply-Component (AESC) Study Group. Prepared by ICF Consulting. Final Report December 23, 2005.
[29] Further, some states are considering incorporating the effect of "spot market" DRIPE, while others are incorporating the effect of "full market" DRIPE. See ICF Consulting report for details.
[30] New Jersey Clean Energy Program – Protocols to Measure Resource Savings. September 2004

whether common protocols to value peak demand savings are needed, especially if these values are used to inform and guide policymakers and system planners on the value of EE relative to other resource options.

Cost per kWh. Another way to value EE programs – or a portfolio of programs – is to consider the cost per kWh saved. Most states in the region calculate a cost per kWh for the entire portfolio of their programs as a way to compare EE as a resource relative to the cost of generating electricity. For example, Massachusetts and Connecticut report an average cost of 4 cents per kWh, while Vermont, New Jersey and NYSERDA report 3 cents per kWh.[31] While these values – which reflect a levelized cost over the lifetime of the EE investments – are in the same ballpark, it is unclear if they are calculated using consistent methods and assumptions. Differences can include what costs are included as well as how lifetime savings are calculated.

In the case of the cost portion of the equation, inconsistencies can exist if states have different assumptions of what should be included as a cost. For example, it is unclear whether some states include only program costs incurred by the administrator, or also program participant costs (i.e., what a participant contributes to the incremental cost of a high efficiency measure, since EE programs typically cover only part of its cost). Additionally, in calculating a levelized cost of EE to compare to the cost of generating electricity, it is unknown what different states assume for a discount rate, and importantly, how the cost of generating electricity is both defined and calculated. In some states, the cost per saved kWh is compared to wholesale electricity costs, while in others the value of EE is compared to retail electricity costs. In order to effectively compare program value on a cost per kWh basis across states, common definitions for costs are necessary.

In terms of the denominator, a number of differences can exist in how savings are estimated. As discussed earlier, some of these may be appropriate across states while some may be due to the use of different methods to calculate and report savings. To summarize, these can include:

- Variations in state climates (e.g., number of heating vs. cooling degree days).
- Variations in hours of daylight and hours of use.
- Differences in population demographics both within states and across states.
- Differences in the measure life and discount rate used to calculate lifetime savings.
- Other commercial and/or industrial characteristics unique to a particular state that can affect assumptions of how a measure is used.
- Differences in baseline assumptions, to which the high efficiency measure is compared.
- Whether or not savings associated with spillover effect or free-ridership are included.
- Generally, differences in measurement and verification (e.g., levels of rigor, extent of on-site testing/analysis, frequency in evaluations and number of end-uses analyzed, etc.) would lead to variations in savings estimates.

[31] Sources: *Working Together for an Energy Efficient Vermont*, Efficiency Vermont 2004 Annual Report; *Energy Efficiency Investing in Connecticut's Future*, Report of the Energy Conservation Management Board, Year 2004 Programs and Operations; *New York Energy $mart™ Program Cost-Effectiveness Assessment*, June 2005; *2002 Energy Efficiency Activities in Massachusetts*, Division of Energy Resources Report, Summer 2004

Developing common protocols to determine cost per kWh on a program and portfolio basis could better inform policymakers and program administrators about the value of the programs and how they compare across the region.

2. Tests Used to Measure Program Cost-effectiveness

In the context of developing common protocols to ensure that EE savings are sufficiently reliable for purposes of energy system planning, resource adequacy and environmental policies, the issue of cost-effectiveness as a whole is not as relevant. EE program cost-effectiveness is a screening analysis largely undertaken to determine how best to allocate dollars to different programs. As such, NEEP does not find a compelling reason for the need to develop common cost-effectiveness protocols in terms of what test is used to screen programs. However, many of the issues discussed in this chapter are important components of determining cost-effectiveness, including what adjustments are made to gross savings to calculate net savings, and how programs are valued in terms of their avoided costs. Additionally, in regions where program administrators operate in multiple states, such as in New England, consistency in cost-effectiveness requirements may be warranted.

Cost-effectiveness analyses typically report the present worth of benefits and costs, as well as their difference (i.e., net benefits) and their ratio for each program being screened. Benefits not only include the electricity supply costs avoided by the EE investments (as discussed earlier), but also other energy as well as non-energy benefits. Costs include the program costs and may also include the cost to the program participants.

In general, the cost-effectiveness tests used throughout the Northeast are mostly similar, with the exception of two states that rely primarily on a Utility Test (Connecticut and Rhode Island) as opposed to a Total Resource Cost (TRC) test or some version of a Societal test (see Tables 2A and Table 2B). However, in many states, a secondary test is used. For example, in Connecticut the TRC test is also considered, especially for certain programs (e.g., low income programs).

Table 2A. Description of Key Cost-effectiveness Tests Used in the Northeast

Test Name	Measurement Approach	General Costs Included	General Benefits Included
Utility Test	Measures net costs taking perspective of utility. Excludes participant costs	Utility costs	Avoided supply, T&D, generation and capacity costs during load reduction periods
Program Administrator Test	Measures net costs based on administrative costs only	Program administrator costs; incentives; increased supply costs during periods of increased load	Net avoided supply costs; marginal cost of reduction in T&D, generation and capacity during load reduction periods
Total Resource Cost (TRC)	Measures net costs taking perspective of utility, but includes participant and non participant costs. Applied at program and/or measure level. Usually focuses on measures for a single year.	Program costs paid by utility and participants; increase in supply costs during load increase periods	Avoided supply costs; reduction in T&D, generation and capacity costs
Societal Test	Based on the TRC, but takes perspective of society. Applied at program and/or measure level. Uses societal discount rate	All costs included in TRC plus externalities, some non-energy costs, including costs to participants and society	All benefits included in TRC plus externalities (avoided environmental damage), increased system reliability, fuel diversity, some non-energy benefits to participants and society

Table 2B. Summary of Cost-Effectiveness Tests Used in the Northeast

State	Type of Test
CT	Utility Test and Modified TRC
ME	Modified Societal
MA	Modified TRC
NH	Modified TRC
NJ	Societal
NY	TRC
RI	Modified Utility
VT	Societal

A key distinction between the tests used across the region is to what extent non-energy and other energy benefits are included as part of the program value. This can vary considerably based on available and quantifiable data.[32]

E. Findings and Recommendations

The key findings from NEEP's research include:

- The transparency of M&V protocols varies from state to state in the region.
- M&V protocols vary in the Northeast in a number of ways, such as:
  - States use similar algorithms to calculate *gross* savings, but the calculation of *net* savings differs.
  - Stipulated or deemed savings estimates and standard input assumptions can range significantly.
  - Baseline conditions are not always consistently defined when estimating savings.
  - Evaluation methods used to verify initial savings estimates are similar, however, the level of rigor of the evaluations varies across the states.

- Some program administrators report only initial savings estimates to their regulatory commission, while others retrospectively adjust initial savings based on evaluation and verification.
- Inconsistencies exist in how EE savings are ultimately reported to regulatory commissions and to system planners in terms of customer or generator level, as well as whether it is annual or lifetime savings.

[32] For more information on cost-effectiveness, see joint NEEP and Consortium for Energy Efficiency paper *How Do We Measure Market Effects? Counting the Ways, and Why It Matters*. Titus, Elizabeth, Monica Nevius and Julie Michals for the American Council for an Energy Efficient Economy (ACEEE) Summer Study 2003.

- States have different reporting schedules and different levels of regulatory review, which may be important for aggregating savings data to a regional level of system planning and environmental policies.
- New England program administrators are increasingly using common assumptions and methods to value EE programs. These methods may differ from what is used in other Northeast states.
- Most states use similar cost-effectiveness tests (Total Resource Cost or Societal test or a modified version thereof) to determine EE program priorities and budgets. The exceptions are Connecticut and Rhode Island, which primarily rely on the Utility test.

Based on these findings, NEEP recommends that:

- Protocols to measure, verify and report EE savings be more transparent. This is especially the case where states do not have a formal document in place.
- Common definitions be developed for M&V terminology.
- Differences in stipulated or deemed savings and standard input assumptions be clear and understood.
- Adjustments made to gross savings to calculate net savings be consistent to ensure that "net" savings are consistently defined across the region.
- Consistency in baseline conditions be developed.
- Further analysis of the differences in level of rigor in evaluations be undertaken to determine what is necessary to ensure EE savings are reliable for the purposes of system planning and environmental policies.
- Common reporting protocols be developed to: address whether initial savings estimates should be retrospectively adjusted based on the evaluation/verification of savings; ensure savings are consistently reported in terms of customer/generator levels and annual vs. lifetime and cumulative values for the appropriate purposes; and savings are reported in a timely manner to inform system planning and environmental policies.
- Methods and assumptions for calculating avoided costs across the Northeast region be further compared to determine if common protocols are appropriate.
- In regions where program administrators operate in multiple states, such as in New England, consistency in cost-effectiveness requirements may be warranted.

III. M&V Protocols Used in Other States and Regions

This section summarizes protocols used in other states and regions in the U.S. to measure and verify energy efficiency program savings, especially where EE savings are used in the context of system planning, resource procurement and quantifying emission reductions associated with federal emission trading programs, including the Environmental Protection Agency's (EPA) Acid Rain program and the NOx State Implementation Plan (SIP) Call.

A. The International Performance and Measurement Verification Protocols (IPMVP)

NEEP's survey of M&V protocols across the country focused on the International Performance and Measurement Verification Protocol (IPMVP). The IPMVP is the accepted industry standard used by energy service companies (ESCOs) for performance contracting projects, primarily retrofit projects in government buildings (municipal buildings, universities, schools and hospitals). While initially developed to support financial contract terms between ESCOs and their clients, it is increasingly being used or recommended in a number of states as the M&V guideline for EE savings to support system planning needs, portfolio standards and carbon reduction programs.

1. Overview of IPMVP

The IPMVP is a document drafted by a group of technical, procurement, and financial personnel in government, commerce, and industry to provide an overview of best practice techniques for verifying energy savings in order to create "an unbiased, technically rigorous and cost-effective method to measure and verify energy savings estimates that form the basis of the contract between a service provider and service receiver."[33] Since its creation in 1997, the IPMVP has been widely used by ESCOs, and funders of building EE projects to quantify EE measure performance and savings. The United States Department of Energy's Federal Energy Management Program (FEMP) uses the IPMVP for energy retrofits in federal buildings, while the EPA references it in guidance related to the NO_X State Implementation Plan (SIP) Call program.[34] At the state level, the IPMVP has also been adopted for use by California, Florida, Iowa, Texas, New York, and is recommended in Illinois. The Energy Group at the Institute of International Education has also indicated that the IPMVP is the best practice tool for monitoring and evaluating energy-efficiency projects for individual buildings and for groups of buildings for greenhouse gas credits.[35]

[33] *The International Performance Measurement & Verification Protocol: Concepts and Options for Determining Energy and Water Savings Volume 1.* Revised March 2002. Available at http://www.ipmvp.org
[34] US EPA, Creating an Energy Efficiency and Renewable Energy Set-Aside in the NO_X Budget Trading Program: Determining NO_X Credits with Measurement and Verification of Electricity Savings, Volume 3 of 3, Draft, December 5, 2003; US EPA, State Set-Aside Programs for Energy Efficiency and Renewable Energy Projects Under the NO_X Budget Trading Program: A Review of Programs in Indiana, Maryland, Massachusetts, Missouri, New Jersey, New York, and Ohio, Draft, September 16, 2005. EPA notes that additional requirements must be specified to fully define M&V requirements.
[35] *Best Practices Guide: Monitoring, Evaluation, Reporting, Verification, and Certification of Climate Change Mitigation Projects.* Prepared for: the Energy and Environment Training Program; Office of Energy, Environment and Technology Global Bureau; Center for Environment United States Agency for International Development

The underlying principles of the IPMVP are to:

- Increase certainty, reliability, and level of savings (with a focus on "sustainability" or persistence in savings, even multiple years after installation);
- Reduce transaction costs by providing an international, industry consensus approach and methodologies;
- Reduce financing costs by providing project M&V standardization, thereby allowing project bundling and pooled project financing;
- Provide a basis for demonstrating emission reduction and delivering enhanced environmental quality;
- Provide a basis for negotiating contractual terms to ensure that an energy efficiency project achieves or exceeds its goals of saving money and improving energy efficiency.[36]

What makes the IPMVP so attractive to ESCOs and many states is its inherent flexibility. The IPMVP allows its users to select from four measurement and verification approaches (Option A, B, C and D, shown in Table 3) in order to best match their specific project costs, savings requirements and particular EE measures or technologies.[37]

Table 3: IPVMP Measurement and Verification Options

M&V Option	How Savings Are Calculated	Cost
Option A: Focuses on physical assessment of equipment changes to ensure the installation is to specification. Key performance factors (e.g., lighting wattage or chiller efficiency) are determined with spot or short-term measurements and operational factors (e.g. lighting operating hours or cooling ton-hours) are stipulated based on analysis of historical data or spot/short-term measurements. Performance factors and proper operation are measured or checked annually	Engineering calculations using spot or short-term measurements, computer simulations, and/or historical data	Dependent on number of measurement points. Approximately 1-5% of project construction cost of items subject to M&V.
Option B: Savings determined after project completion by short-term or continuous measurements taken throughout the term of the contract at the device or system level. Performance and operations factors are monitored.	Engineering calculations using metered data	Dependent on number and type of systems measured and the term of analysis/ metering. Typically 3-10% of project construction cost of items subject to M&V.
Option C: After project completion, savings determined at the "whole-building" or facility level using current year and historical utility meter (gas or electricity) or sub-meter data.	Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multivariate (hourly or monthly) regression analysis.	Dependent on number and complexity of parameters in analysis. Typically 1-10% of project construction cost of items subject to M&V.
Option D: Savings determined through simulation of facility components and/or the whole facility	Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering	Dependent on number and complexity of systems evaluated. Typically 3-10% of project construction cost of items subject to M&V.

IPMVP Summary Table from: http://www.ci.seattle.wa.us/sustainablebuilding/Leeds/docs/IPMVP_summary.pdf

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Prepared by: Lawrence Berkeley National Laboratory Berkeley, California. November 2000 http://www.iie.org/programs/energy/pdfs/Monitor%20Verif%20Climate%20Change.pdf

36 http://www.ci.seattle.wa.us/sustainablebuilding/Leeds/docs/IPMVP_summary.pdf

37 *Crediting Energy Efficiency Measures Under Air Emissions Programs*. Steven Fine, ICF Consulting; Chloe Weil, U.S. Environmental Protection Agency. ACEEE Summer Study on Energy Efficiency in Buildings, 2000. Available at: http://www.icfconsulting.com/Publications/doc_files/CreditingEEMeasures.pdf

Each of the four options is applicable to different types of performance contracts based on the complexity of the EE measure(s); the expectations for risk and risk sharing; the potential for changes in key factors between the baseline and performance period; and the measures' savings value.[38] Therefore, the four options described in Table 3 vary in accuracy, cost of implementation, strengths, and limitations.[39] Further detail on these options is provided in Attachment E. For a detailed example of IPMVP, see http://www.calmac.org/events/RMA_IPMVP_Presentation_for_CALMAC_(final_slides).pdf.

A summary of IPMVP application in the U.S. is summarized in Table 4 and discussed further below.

Table 4. Application of IPMVP in the U.S.

User	IPMVP Option	Program
ESCOS	Mostly apply options A and C. Sometimes B	Used to verify savings for various energy efficiency measures and to assure that the parties to the contract (project) agree to the results
Northwest RTF	Utilities are free to select which IPMVP option is appropriate to their project. RTF gives some guidance by directing utilities to specific "protocols" depending on the measure selected, but ultimately utilities select IPMVP option.	
NYSERDA	Option B for most measures. However, for lighting projects with 500,000 kWh of annual savings or less, Option A may be used.	• New York Energy $mart^{SM} Commercial/Industrial Performance Program • Con Edison three-year rate plan where contracts with ESCOs will create natural gas energy savings
Texas	No option is specified	• Commercial and Industrial (C&I) Standard Offer Program (except for lighting measures qualifying for the use of deemed savings) as part of the state's Energy Efficiency Goal program (i.e. portfolio standard)
California	The Draft 2005 California Energy Efficiency Protocols specify IPMVP Options A, B or D as their evaluation and M&V protocols, depending on the level of rigor required for specific types of measures.	Used for California's Resource Acquisition Programs (i.e., to inform portfolio management)
Iowa	M&V plan must incorporate monitoring information for energy efficiency installations that is consistent with Option B, C or D of the IPMVP for energy saving activities in buildings.	The Iowa Department of Natural Resources requires for LEED certification
Florida	Requires IPMVP under its Energy Performance Contracting Manual for large public energy efficiency projects. No option specified.	

[38] http://www.eere.energy.gov/femp/pdfs/26265_seci.pdf
[39] http://www.ci.seattle.wa.us/sustainablebuilding/Leeds/docs/IPMVP_summary.pdf

2. Federal Applications of IPMVP

a) Federal Energy Management Program (FEMP)

The IPMVP and FEMP M&V guide are complementary documents that provide guidelines for quantifying results from energy savings projects. The two documents differ in that the IPMVP is a framework of definitions and broad approaches and the FEMP M&V Guide was developed specifically for the federal sector based on the 1997 version of IPMVP and provides more detailed guidance on the application of different M&V options for specific energy conservation measures.

b) EPA Conservation and Verification Protocols

The EPA created Conservation and Verification Protocols (CVP)[40] to provide verification of EE savings under incentives created by energy efficiency as part of the Acid Rain Program. They were created primarily for public power utilities, as investor-owned utilities most likely have their energy savings verified by specific procedures set forth by public utility commissions (PUCs). The CVP was developed before the IPMVP, and falls into IPMVP Option B.[41]

The CVPs allow for two general savings paths: Monitored (measured) Energy Use or Stipulated Savings, the former being the preferred approach.

The requirements for Monitored Energy Use are:

1. Specifying a reference case - for example the energy use of a group not participating in the conservation program.
2. Adjusting for differences in factors such as weather, operating hours, and production rates.
3. Determining net energy savings (the savings attributable to the utility conservation program) – usually the difference between the participating and non-participating group but can be estimated indirectly through market research, surveys, and inspections of non-participants.
4. Establishing the appropriate statistical confidence in the savings – savings have to be reported in terms of the utility's confidence, based on statistical analysis. A 75 percent confidence rating is required.
5. To address energy saving persistence – utilities can use: monitoring and inspection, inspection only, and a default (50 percent of first year savings over half the measure life).

The CVP includes a list of Stipulated Savings for 15 measures (e.g., energy efficient refrigerators, ground source heat pumps, exit sign lights, street lights). Other measures are allowed to rely on engineering estimates if: measurement costs would exceed 10 percent of program cost; no

[40] U.S. Environmental Protection Agency (EPA). 1995b. "Conservation and Verification Protocols, Version2.0." EPA 430/B-95-012. U.S. Environmental Protection Agency, Washington, D.C.
http://www.epa.gov/airmarkets/arp/crer/cvpsumm.html

[41] According to an ICF paper (http://www.icfconsulting.com/Publications/doc_files/CreditingEEMeasures.pdf) M&V requirements in the CVP are set so high (especially with regard to subsequent year allowances) that utilities either preferred to use their states' less rigorous quantification methodologies or opted not to participate in the process at all.

customer accounts for more than 20 percent of total savings; or energy savings are expected to be less than 5 percent of use of the smallest isolatable circuit (e.g., residential lighting efficiency improvements).

3. State Applications of IPMVP

Importantly, a number of states require the use of IPMVP for all or part of their EE program M&V requirements. These include New York, Texas, Florida, Iowa, Illinois, California and the Northwest.

a) New York

The New York State Energy Research and Development Authority's (NYSERDA) New York Energy $mart[SM] Commercial/Industrial Performance Program (CIPP) provides performance-based incentives to contractors for implementing gas-efficiency measures. This program allows eligible participants to work with ESCOs or contractors of their choice to achieve energy savings. Participants involved in this program must use the 2000 IPMVP and the 1996 Federal Energy Management Program (FEMP) M&V Guidelines.

Within the context of performance programs NYSERDA requires different levels of rigor through requiring specific IPMVP M&V options. For most measures, NYSERDA recommends Option B because of its high accuracy level. However, for lighting projects with 500,000 kWh of annual savings or less, an ESCO may use Option A of the IPMVP. The ESCO must provide engineering support of the operating hours for the project that NYSERDA then reviews and may require measurement and verification for projects where unreasonable operating hours or savings are claimed.[42]

NYSERDA also requires the use of the IPMVP under its system-wide program for Con Edison under the utility's three-year rate plan agreement. Con Edison must also facilitate energy competition by encouraging ESCOs to offer choices to customers for their electricity supplies and implement new energy efficiency and conservation programs to help offset electric load growth expected over the next few years without the need for additional generation and delivery facilities. (NY DPS CASE 04-E-0572).

In addition, for NOx SIP Call credits, the New York State Department of Environmental Conservation has approved the use of verifying energy savings from the CIPP via the IPMVP Option B. This allows the state to claim NO_X savings through this program.

b) Connecticut

The Connecticut Department of Public Utility Control (DPUC) recently adopted an Energy Efficiency Alternative Transitional Standard Offer (ATSO) program for customers of Connecticut Light and Power (CL&P) and United Illuminating (UI). The program enables customers to obtain energy efficiency services and/or products from ATSO Suppliers who enter into bids with CL&P and UI. As part of the program requirements, each ATSO bidder is

[42] http://www.nyserda.org/funding/855PON.html

required to submit a Monitoring and Verification Plan (M&V Plan) that complies with the principles of the IPMVP and that will be implemented by an independent qualified third party. The bidder may choose from any of the IPMVP options but is required to explain the rational behind their choice including how it will be implemented; issues related to data collection; and sampling and analysis plans.

While the bidder can choose from any IPMVP option the DPUC provides guidance by informing the bidder that savings estimates provided under Option A decrease as the measure complexity increases and that Option C should be limited to projects where the expected savings exceeds the metered energy consumption by at least 10 percent. For more information, see CT DPUC Final Decision in Docket No. 05-03-14 – *DPUC Investigation of Energy Efficiency Alternative Transitional Standard Offer Services For the United Illuminated Company and the Connecticut Light and Power Company Customers*.
http://www.dpuc.state.ct.us/FINALDEC.NSF/0d1e102026cb64d98525644800691cfe/50ebfba146b6df5985257068005c33d3/$FILE/050314-082405.doc

c) Texas

Texas was the first state in the U.S. to adopt an energy efficiency resource standard for utilities in its 1999 restructuring law, which was subsequently implemented by the Texas Public Utility Commission. [43] This law called for electric distribution utilities to offset ten percent of their forecasted load growth through energy efficiency by January 2004. As part of the program, the Commission requires that the demand and energy savings resulting from the utilities' Commercial and Industrial (C&I) Standard Offer Program (except for lighting measures qualifying for the use of deemed savings) comply with the measurement and verification standards of the IPMVP though they do not specify a specific option. The state allows project sponsors to use alternative measurement and verification options, however, such methods must be approved by the sponsoring utility and adhere to IPMVP standards.[44]

d) Florida

Florida requires IPMVP under its Energy Performance Contracting Manual. Florida law authorizes the use of the Energy Performance Contracting Manual by all of the state's school districts, community colleges, universities, and state and local government agencies entering into large capital-investment energy projects producing long-term energy-saving benefits. While the manual does not require a certain IPMVP option, the rational for choosing a specific option must be explained in a measurement and verification plan. For more information see http://www.energyservicescoalition.org/chapters/FL/manual/Florida%20Manual.pdf.

e) Iowa

The Iowa Department of Natural Resources recommends the use of IPMVP in its sustainable design principles for building design and construction guide. The guide, which promotes

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[43] The Public Utility Commission of Texas adoption of §25.181 relating to Energy Efficiency Goal with changes to the proposed text as published in the November 12, 1999 Texas Register (24 TexReg 9919). See http://www.puc.state.tx.us/rules/rulemake/21074/032700ar.pdf

[44] http://www.puc.state.tx.us/rules/rulemake/30331/m%26v%5Fguidelines.pdf

sustainable design principles, states that in order for buildings to obtain a LEED credit one must develop a Measurement and Verification plan that incorporates monitoring information of installed energy efficiency measures that is consistent with Option B, C or D of the IPMVP for energy saving activities in buildings. See http://www.iowadnr.com/energy/sustainable/files/chap6.pdf

f) Illinois

While Illinois does not specify an M&V protocol to support its EEPS, recommendations have been made by Commonwealth Edison Company as follows: "Measurement and verification potentially take much more time and funding than may be anticipated; however, they are critical for the success of the EEPS and should be integrated into the overall funding and schedule. It should be clear up front as to what basis compliance with the EEPS will be determined, i.e. gross energy reductions or net energy reductions, and what the standards are for determining those savings (e.g. standard industry practices, IPMVP). We believe it is important that measurement and verification should be future-oriented, i.e. it should be used for purposes of improving performance of programs in the future, as opposed to being used for hindsight prudence disallowance of costs." http://www.icc.illinois.gov/ec/docs/050309ecCommentscomed1.pdf

g) California

California is fundamentally different from the Northeast in that it is a single state with one regulatory body, a single ISO, and an experience of failed restructuring that has brought energy efficiency to the forefront of resource procurement policy.[45] The combination of these factors has made evaluation and M&V protocols of critical importance. Nonetheless, the developments in California are important to follow and to potentially apply to the Northeast where appropriate. For the purposes of this report, we summarize the recently proposed California Energy Efficiency Evaluation Protocols (CEEEP)[46], in particular the sections on Impact Evaluation and M&V Protocols, for which the primary focus is the use of IPMVP and different levels of rigor required to ensure reasonable certainty in estimated energy savings that will help meet the state's energy efficiency and resource procurement goals.

Levels of Rigor. Unique to the CEEEP, once a program is chosen to undergo an impact evaluation, the Joint Staff[47] will decide on the level of rigor that program needs in order to assure the reliability savings in the statewide portfolio. Rigor is defined as "the level of expected reliability (e.g., as a resource) the higher the level of rigor the more confident the state can be in the results of the evaluation being accurate and precise." Based on IPMVP Options A through D, each level of rigor sets forth a class of allowable methods that the evaluation must adhere to, but also offers flexibility to the evaluation contractor to choose the most cost-effective method for each program. Contractors may choose a level of rigor above what the Joint Staff recommends

[45] The California PUC set forth a cumulative electric savings goal of 26,508 GWh (6,892 MW peak) by 2013. See CPUC Interim Opinion: Energy Savings Goals for Program Year 2006 and Beyond. This goal is expected to meet 54% to 59% of the IOU's electricity sales growth by 2013. See http://www.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/40212.htm and http://www.cpuc.ca.gov/PUBLISHED/REPORT/28715.htm for more information.

[46] The Draft 2005 CEEEP can be viewed at http://www.cpuc.ca.gov/static/energy/electric/energy+efficiency/rulemaking/050920_draftevaluationprotocols.doc

[47] The Joint Staff is made up of the California Public Utilities Commission's Energy Division and the California Energy Commission.

but not below. ***This system of rigor allows the ISO and system planners to utilize both the savings and uncertainties from the evaluations for load forecasting and system planning.***

Types of Protocols in CEEEP. The CEEEP sets forth a series of protocols to guide the state's evaluation process for all EE programs. Of particular relevance to this project are the Impact Evaluation, Effects, and M&V Protocols:

- Impact Evaluation Protocol (IEP) - designed to prescribe the minimum allowable methods to meet a specified level of rigor that measures and documents the ex-post energy and demand impacts achieved as a result of implementing energy efficiency programs and program portfolios. This protocol uses the IPMVP, and applies to all resource acquisition programs.
- Market Effects Evaluation Protocol – designed to measure net market effects at a market level where one or more of the protocol covered energy efficiency funded programs target a market.
- Measurement and Verification Protocol (M&V) – supports the Impact Evaluation Protocol, and designed to prescribe how field measurements and data collection will be conducted to support impact evaluations, updates to ex-ante measure savings estimates, and process evaluations.

Resource acquisition programs must use the Impact Protocols (IPMVP), while information, education, marketing programs must use the Market Effects Protocol within the Impact Protocol Section. The IEP and the M&V are designed to be used together: the M&V sets forth requirements for data collection, monitoring and analysis activities associated with the calculation of gross energy and peak demand saving from individual customer sites or projects, while the IEP guides the gross and net energy impacts at the program level.

The Impact Evaluation and Markets Effects Protocols. Within the **Impact Evaluation Protocol** there are three sets of protocols that produce gross and net kWh, kW, and therm impacts based on varying rigor options: The Gross Energy Impact Protocol; The Gross Demand Impact Protocol; and The Participant Net Protocol. While the above protocols estimate energy and demand impacts, the CEEEP also includes a **Market Effects Evaluation Protocol**, which estimates changes in behavior due to program activities. Such programs typically involve information, education, marketing, promotion, and outreach efforts that do not have specific energy saving goals but still can create energy impacts. The Market Effects Evaluation Protocols includes three levels of rigor (I, II, III) where Level I is the lowest (for programs that cannot be linked to energy savings but where net behavior changes need to be estimated), while Level III is the highest level of rigor.

Examples of the different levels of rigors assigned by the Joint Staff can be seen in Tables 1-2 in Attachment E.

The M&V Protocol. The M&V protocol is a subset of the impact evaluations. The impact evaluation will initiate the M&V protocols, however, not every evaluation requires M&V. This M&V protocol is intended to set guidelines for conducting and reporting field data collection activities in support of energy efficiency program evaluations. All of the M&V projects conducted under the California Protocol must adhere to the IPMVP. Sampling that occurs under the M&V protocol must also follow the Sampling and Uncertainty Protocol and also follow the Reporting Protocol.

Similar to the IPMVP, the California M&V Protocols requires the submittal of an M&V plan for each field measurement project that sets forth what procedures will be conducted and the rationale for choosing those procedures, and how to manage uncertainty of the data. The process for determining the level of rigor is the same as in the Impact Protocols. The Joint Staff sets a level of rigor for the Program and their components that the M&V contractor must follow. The varying levels of rigor, and examples of these, are summarized in Tables 3-4 of Attachment E.

Finally, it is expected that the CEEEP will be updated from time to time, and that new protocols may need to be added as the need for different types of information evolves. For example, California is currently addressing the need to establish protocols for crediting greenhouse gas reductions resulting from the energy efficiency program portfolios, and possibly for addressing demand response programs that are currently outside the scope of these protocols.

B. The Northwest Regional Technical Forum

1. Background

In 1995, the Bonneville Power Administration (Bonneville) began to shift responsibility for financing and acquiring conservation savings over to its utility customers. This shift in responsibility was intended to reduce Bonneville's costs and permit utilities to better tailor their programs to local situations. Congress recognized that one implication of this shift would likely be a more diversified approach to conservation acquisition across the region. Consequently, in 1996 it directed Bonneville and the Northwest Power Planning Council (Council) to convene a Regional Technical Forum (RTF) to develop standardized protocols for verifying and evaluating conservation savings. Congress further recommended that the RTF's membership include individuals with technical expertise in conservation program planning, implementation, and evaluation and that its services be made available to all utilities in the Northwest.

The Comprehensive Review of the Northwest Energy System (Comprehensive Review) supported the Congressional directives and recommended that the RTF should, in addition, track conservation and renewable resource goals and provide feedback and suggestions for improving the effectiveness of conservation and renewable resource development programs in the region. The Comprehensive Review also recommended that the RTF conduct periodic reviews of the region's progress toward meeting its conservation and renewable resource goals at least every five years and communicate recommended changes to appropriate decision-makers. These periodic reviews are to acknowledge changes in the market and adjust targets appropriately.

In 1999 the Council voted to form the RTF to facilitate the development of the conservation and renewable resources identified in the Council's Plan. Specifically, the four goals adopted by the Council for the RTF corresponding to its original charge from Congress and the Comprehensive Review are to:

- Develop standardized protocols for verification and evaluation of energy savings and the performance of renewable resources.
- Track regional progress toward the achievement of the region's conservation and renewable resource goals.
- Provide feedback and suggestions for improving the effectiveness of the conservation and renewable resource development programs and activities in the region.
- Conduct periodic reviews of the region's progress toward meeting its conservation and renewable resource goals at least every 5 years, acknowledging changes in the market for energy services and the potential availability of cost-effective conservation opportunities.

Consistent with these goals, the RTF was called upon to make recommendations to Bonneville to facilitate the operation of its conservation and renewable resources acquisition programs. These recommendations include:

- A list of eligible conservation measures and programs, the estimated savings associated with those measures and programs, and the estimated regional power system value associated with those savings.
- A process for updating the list as technology and standard practices change and an appeals process through which customers can demonstrate that different savings and value estimates should apply.
- A set of protocols by which the savings and system value of measures/programs not on the list could be estimated. These would include complex commercial or industrial projects.
- Criteria for eligible renewable resource projects.
- Recommended protocols for measurement and evaluation of savings or production.

2. Key Components of the NW RTF

The key components of the NW RTF are:

a) RTF Protocols
b) Evaluation Process and Reporting Requirements
c) RTF Software – Development, Maintenance and Cost
d) RTF as a Tracking Tool
e) RTF Developments

a) RTF Protocols

The RTF provides gross "deemed" energy savings estimates[48], standardized calculation procedures and M&V protocols that must be used by any utility participating in any of the all Bonneville EE programs. The RTF also provides default deemed savings values, inputs and formulas and M&V guidelines to measure energy efficiency program savings, including guidelines for addressing custom projects for use by other jurisdictions (investor-owned utilities,

[48] NWPCC's use of the term "gross" savings refers to total savings including spillover effect plus free-ridership, as it does not limit savings to what is attributable to EE programs. Rather, it projects the total amount of energy and demand savings beyond those savings "embedded" in its regional forecast (e.g., savings anticipated from known building energy codes and appliance standards).

commissions, public benefits charge administrators). These deemed energy savings, standardized calculation procedure and M&V protocols may be modified by these entities to fit their specific programmatic needs.

The RTF's deemed savings estimates are developed and adopted by the RTF based on a combination of engineering estimates and ex ante estimates from prior utility evaluations. The RTF has established minimum criteria that must be met before a measure's savings can be "deemed" such reliability and predictability of savings estimates, the load shape of the savings and program delivery consistent with those from which ex ante savings estimates were derived.

The RTF has both developed its own standardized calculation procedures ("deemed calculators") for measures where the specific conditions of application are variable (e.g. hours of operation for efficient lighting or loading of a specific motor) as well as adopted or adapted existing public domain engineering models (e.g. MotorMaster, AirMaster, etc.).

The RTF recommends that custom projects follow the IPMVP for evaluation. Utilities are free to select the IPMVP option appropriate to their project. However, the RTF provides guidance by directing the utilities to specific "protocols" depending on the measure they select from its online database. While some utilities and all public benefits charge administrators may select which IPMVP option they use, utilities participating in Bonneville program must submit their M&V plans for all custom projects to Bonneville for review and acceptance. For examples of the RTF on-line forum, see the website at http://www.nwcouncil.org/energy/rtf/Default.htm.

Most of the Northwest's larger utilities apply RTF recommended protocols to their own evaluation processes. The region's smaller utilities primarily use "deemed" or "deemed calculated" measures using the RTF online database and standardized calculation tools.

Energy efficiency savings using the RTF are reported at both the customer and the generation (busbar) level. However, for the purposes of NWPCC planning and forecasting, only generation level savings are used, and adjusted for line losses using regional average values.

While the states in the region apply different adjustments to report net to gross savings (e.g., some count free-ridership, others do not based on their respective regulatory requirements), this is irrelevant to the NWPCC because it relies on the total "gross" savings at the generator level for the purposes of regional power planning.

b) Evaluation Process and Reporting

NWPCC receives frequent requests to modify the RTF data based on updated input assumptions or values from utility impact evaluations. The RTF reviews these requests and determines whether changes to the default assumptions and M&V protocols are warranted. If so, RTF provides a six-month notice to parties about potential updates if the changes are considered major (e.g., change in a deemed savings value). The RTF reviews evaluations filed by program administrators with their state respective regulatory commission. According to the NWPCC staff, the investor-owned utilities typically perform fairly rigorous evaluations because of commission oversight in their respective states. If, however, evaluated numbers submitted by utilities are drastically different from the default assumptions set forth in the RTF database, the RTF will conduct an investigation.

The RTF does occasionally facilitate or manage joint program or technology evaluations. In the case of program evaluations, the RTF identifies measures that it believes should be the subject of evaluation. In some cases, it prepares a scope of work for the evaluation. It then works with entities that have sponsored programs that installed the measure to secure joint funding for the evaluation. Those entities that wish to co-sponsor the evaluation can and those that do not are not even under any obligation to do their own. In the case of specific "technology" evaluation, these are done only in response to utility/SBC administrator requests. The RTF contracts with independent third-parties that have expertise to do the work and to develop the testing protocols and observed the test.

Utilities and public benefits charge program administrators are requested to report their savings data to the RTF in April.[49] The RTF reviews the data and publishes an annual report on regional program savings by July. Where estimated savings data is provided (i.e., not yet verified), retrospective adjustments can be made. The last reporting year filed with NWPCC is always preliminary data, as is the case in most Northeast states.

c) RTF Software – Development, Maintenance and Cost

The RTF online planning, tracking and reporting software was development by Synergy, Inc.[50] The software is a flexible tool that can be easily and regularly updated, allowing for frequent adjustments based on users' petitions to update input assumptions etc. It serves as a centralized function for updating deemed savings values and evaluation protocols in the region.

There are two major cost centers associated with the RTF's regional planning, tracking and reporting system. First, there is the cost of developing and maintaining the database, calculation tools, supporting the RTF's analysis and technology reviews, etc. The second cost center is the development and maintenance of the Internet-based planning, tracking and reporting system. The approximate cost of each of these components is as follows:

- initial deemed savings, standardized calculation tools and M&V protocols data base development cost was $300,000 - $400,000. This includes NWPCC staff time and an estimate of the "in-kind" contributions of time from RTF members.
- initial Internet site and software data base planning, tracking and reporting system development cost was $300,000.
- annual maintenance costs for software averages about $125,000 to $150,000 to support changes and updates to the software[51].
- technical support and training, including a toll free technical assistance number and on-line/email assistance, is $30,000 per year

[49] While program administrators file their data with the RTF in the timeframe required by NWPCC, the state regulatory filing schedules vary.
[50] See http://www.synergyhq.com/solutions.html
[51] A significant portion of the maintenance cost is associated with changes in Bonneville program "business rules" which require alternations in utility reporting requirements.

- On-going operation of the RTF requires a part-time (½ to ¾) position at an annual cost of $40,000 - $60,000.
- NWPCC staff and contractor support, which includes review of evaluations and petitions to change RTF data is about $250,000 per year.
- Currently, the majority of RTF member travel and time spent on RTF activities is covered by the respective parties. A limited number of RTF members who would not otherwise be able to participate receive "honoria" for their work on the RTF. The NWPCC is in the process of developing a business plan to develop a funding source that will provide the ability to reimburse members for their time spent on the RTF so that the group can maintain independence from parties that have a financial interest in its findings and recommendations.

Based on the above, the total annual costs to maintain, operate and update the RTF is about $500,000 per year.

According to NWPCC, the RTF supporting software could be modified to meet the needs of the Northeast states if common protocols are developed[52].

The benefits of the RTF, relative to its costs, are largely due to economies of scale. For example, utilities in the region that use the RTF tracking system do not have to develop and maintain their own program specifications or create their own "calculators", run "cost-effectiveness" models, or stay abreast of changes in baseline performance (e.g. new federal standards). The RTF allows the utilities to focus on delivery rather than the analytics behind the savings values.

d) RTF as a Tracking Tool

Importantly, the RTF is used as a tracking tool to gage the region's progress towards its energy conservation and renewables resource goals. The NWPCC conducts periodic reviews of the region's progress toward its goals at least every five years. These periodic reviews acknowledge changes in the market, and any recommended changes for improving the effectiveness of conservation and renewable resource programs are communicated to the appropriate decision-makers.[53]

e) RTF Developments

Currently, the Bonneville Power Administration is contracting with Synergy, Inc. to enhance the RTF software to include a module that can calculate carbon offsets associated with the energy efficiency program savings in the region. This module will forecast the carbon offset from efficiency programs over the lifetime of the measures installed, reflecting both the shape of savings over the lifetime and the carbon emissions (depending on variables such as season, resource portfolio, etc.). The new module was recently completed in Fall of 2005.

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[52] NWPCC staff note that modification of the existing RTF Internet-based system for use in other areas would be significantly lower than the cost of its initial development.

[53] For more information on how conservation goals are tracked and reported, see the NWPCC's Fifth Electric Power and Conservation Plan (June 2004) at http://www.nwcouncil.org/energy/powerplan/plan/Default.htm.

C. Findings and Recommendations

NEEP's key findings with regard to M&V protocols used in other states or regions in the country are:

- The International Performance and Measurement Verification Protocol (IPMVP) is widely used elsewhere and can help inform the development of common protocols in the Northeast. The IPMVP is a flexible M&V guideline that offers varying levels of rigor and cost. It is the accepted industry standard used by energy service companies (ESCOs) for performance contracting projects, largely for government EE projects (e.g., municipal buildings, schools, etc.), and is recommended by EPA as the protocol to use to support the NOx SIP Call program. While initially developed to support financial contract terms between ESCOs and their clients, it is increasingly being used or recommended in a number of states as the M&V guideline for EE savings to support system planning needs, portfolio standards and carbon reduction programs.

- The Northwest Regional Technical Forum (RTF) is a model for common regional M&V protocols where consistent savings data informs system planning in the region, and tracks progress towards EE goals. Developed and informed by a working group representing four states in the Northwest, the RTF provides a web-based forum for reporting EE savings using default protocols (including IPMVP for C&I custom projects). The RTF functions within the individual state regulatory rules, requirements and reporting schedules, and is informed and updated by utility specific evaluation efforts. It also provides a cost-effectiveness framework for calculating program benefits and costs.

Based on its findings, NEEP recommends that:

- The Northeast consider using IPMVP options as a way to increase the transparency of the M&V methods used to estimate EE program energy savings, in particular for C&I and residential retrofit projects. This does not necessarily mean adopting a new set of M&V methodologies. Rather, it would involve identifying how existing M&V methodologies fit into the IPMVP Option A-D framework, as presented in Attachment C. Whether regulators or system planners require different levels of rigor relative to what program administrators currently use in order to meet their needs, will depend on further research and discussion among key stakeholders.

- The Northeast leverage experience from the Northwest Regional Technical Forum in developing common M&V and reporting protocols, and also consider adopting and modifying the online planning, tracking and reporting software. This should not necessarily duplicate, but rather build upon program administrator evaluation efforts.

IV. Conclusions and Recommendations

Conclusions

To date, individual state EE savings data have been reliable for the purposes they were developed. However, NEEP's research pointed to several modifications necessary to more fully support an evolving set of needs related to regional energy system planning and environmental policies. These changes include improvements to consistency, documentation and comparability.

As the region prepares to increase investments in energy efficiency along with other clean energy resources, it is in the states' interest to establish common protocols for measuring, verifying, and reporting energy and capacity savings in a consistent and transparent manner that meets minimum requirements for rigor. Lacking this, system planners and policy makers would find it difficult to reliably incorporate energy efficiency into power system planning or reliably assess the impacts of energy efficiency policies and programs to meet energy, economic or environmental goals.

Recommendations

Based on its findings and conclusions, NEEP recommends that the New England states, New York and New Jersey:

1. **Commit to developing common M&V protocols and reporting formats for EE program/project savings to support:**
    a. The inclusion of energy efficiency as a valued and reliable resource in regional power system planning and reporting; and
    b. The use of energy efficiency as a priority strategy to meet state and regional greenhouse gas reduction goals, and to track progress toward these goals.

2. **Establish a Regional Protocols Working Group represented by state air regulators, utility regulators, electric and gas efficiency program administrators, and electric power system planners to develop common regional protocols and reporting formats. NEEP further recommends that the Working Group consider:**
    a. Establishing common definitions and consistent requirements for the measurement and verification of energy efficiency policies, programs and projects;
    b. Establishing the level of rigor needed for specific applications, whether resource acquisition, system planning, carbon reduction efforts, etc.;
    c. Exploring IPMVP as the M&V guideline for EE programs, especially for C&I and residential retrofit markets where the largest energy savings potential exists in the region.
    d. Building upon existing M&V protocols and state practices in the Northeast to guide the development of common protocols for non-retrofit programs and projects.

e. The Northwest Regional Technical Forum as a model from which the Northeast can leverage resources and experience using existing capacities to provide technical analysis and modeling for regional energy and environmental policies.
f. Working with existing resources to develop regional M&V protocols, and ensuring that the development of common regional protocols will be designed to fill a full range of utility and state needs so as to not require program administrators to keep multiple sets of books to document their program costs or savings.
g. Establishing a process to address evolving needs for M&V protocols (e.g., new measures and applications).
h. Assessing annual resource needs to provide needed services to maintain regional M&V protocols and reporting;
i. Ensuring public access to forum activities and recommendations.

3. **Develop and implement common protocols within the context of one or more ongoing regional efforts, such as:**

   a. The regional implementation of a carbon cap and trade system, in which establishing common protocols for EE savings will be critical to ensuring that EE plays an effective role in helping the region reduce its greenhouse gas emissions. This effort covers most states in the Northeast, includes a funding mechanism to support EE investments through the initial sale of carbon allowances, and identifies EE as a complementary energy policy that states agree to maintain or expand to decrease the use of less efficient or relatively higher polluting power plants.

   b. Common protocols could also be developed through existing regional forums that address energy policies, including efforts through the Coalition of Northeast Governors, the New England Conference of Public Utility Commissioners, or the New England Governors Conference, in coordination with regional system planning efforts to address system reliability and resource adequacy issues.[54]

[54] ISO-NE has identified conservation and demand response as one of the "four pillars of a balance and reliable power system," and the need for comprehensive planning to provide a roadmap to achieve the four pillars. See ISO-NE presentation by CEO Gordon van Welie at http://www.raabassociates.org/main/roundtable.asp?sel=64.

Attachment A: Acronyms and Definitions

ACRONYMS

EE – Energy Efficiency
kWh – Kilowatt-hour
KW – Kilowatt
M&V – Measurement and Verification
NYSERDA – The New York State Energy Research and Development Authority
IPMVP – International Measurement, Performance and Verification Protocol
C&I – Commercial and Industrial
CFL – Compact Fluorescent light bulb
T&D - Transmission and Distribution
NOx – Nitrogen Oxide
NOx SIP Call – The U.S. EPA's State Implementation Plan for a NOx trading program
RTF – Regional Technical Forum
NESCAUM – Northeast States Coordinated Air Use Management
GHG – Greenhouse Gas
DSM – Demand Side Management
SBC – Systems Benefit Charge
EEPS – Energy Efficiency Portfolio Standard
TRM – Technical Reference Manual
CIPP – Commercial/Industrial Performance Program
PUC – Public Utility Commission
AEPS – Alternative Energy Portfolio Standard
FEMP – Federal Energy Management Program
ECM – Energy Conservation Measure
ESCO – Energy Service Company
CVP – Conservation Protocols
CEEEP – California Energy Efficiency Evaluation Protocols
NWPCC – Northwest Power and Conservation Council
FERC – Federal Energy Regulation Commission
ISO-NE – New England's Independent System Operator or Regional Transmission Organization (RTO), serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.
PJM – PJM Regional Transmission Organization serving all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.
NY-ISO – New York Independent System Operator

DEFINITIONS

ADMINISTRATOR (or PROGRAM ADMINISTRATOR) - A company or other entity receives funding for and implements energy efficiency programs pursuant to state legislative law or commission order.

ASHRAE - Acronym for American Society of Heating, Refrigerating and Air- Conditioning Engineers.

AVERAGE DEMAND - The energy demand in a given geographical area over a period of time. For example, the number of kilowatt-hours used in a 24-hour period, divided by 24, tells the average demand for that period.

AVOIDED COST - The amount of money that an electric utility would need to spend for the next increment of electric generation to produce or purchase elsewhere the power that it instead buys from the wholesale energy market.

BASE LOAD - The lowest level of power production needs during a season or year.

BASELINE DATA - The measurements and facts describing facility operations and design during the baseline period. This will include energy use or demand and parameters of facility operation that govern energy use or demand.

BASELINE MODEL - The set of arithmetic factors, equations, or data used to describe the relationship between energy use or demand and other baseline data. A model may also be a simulation process involving a specified simulation engine and set of input data.

BILLING DATA - Has multiple meanings. Metered data obtained from the electric or gas meter used to bill the customer for energy used in a particular billing period. Such meters typically conform to regulatory standards established for each customer class. Also used to describe the data representing the bills customers receive from the energy provider and also used to describe the customer billing and payment streams associated with customer accounts. This term is used to describe both consumption, demand, and account billing and payment information.

BILLING DEMAND - The demand used to calculate the demand charge cost. This is very often the monthly peak demand of the customer, but it may have a floor of some percentage of the highest monthly peak of the previous several months (a demand "ratchet"). May have other meanings associated with customer account billing practices.

CAPACITY - The amount of electric power for which a generating unit, generating station, or other electrical apparatus is rated either by the user or manufacturer. The term is also used for the total volume of natural gas that can flow through a pipeline over a given amount of time, considering such factors as compression and pipeline size.

CAPACITY FACTOR - A percentage that tells how much of a power plant's capacity is used over time. For example, typical plant capacity factors range as high as 80 percent for geothermal and 70 percent for cogeneration.

COEFFICIENT OF PERFORMANCE (COP) COOLING - The ratio of the rate of heat removal to the rate of energy input in consistent units, for a complete cooling system or factory assembled equipment, as tested under a nationally recognized standard or designated operating conditions.

COEFFICIENT OF PERFORMANCE (COP) HEATING & HEAT PUMPS - The ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system under designated operating conditions. Supplemental heat shall not be considered when checking compliance with the heat pump equipment COPs.

COINCIDENT DEMAND - The metered demand of a device, circuit, or building that occurs at the same time as the peak demand of the building or facility or at the same time as some other peak of interest, such as a utility's system load. This should properly be expressed so as to indicate the peak of interest, e.g., "demand coincident with the building peak."

COINCIDENCE FACTOR (CF) - Coincidence factors represent the fraction of connected load expected to be coincident with a particular system peak period, on a diversified basis. Coincidence factors are provided for summer, winter and spring/fall peak periods.

CONSERVATION - Steps taken to cause less energy to be used than would otherwise be the case. These steps may involve improved efficiency, avoidance of waste, reduced consumption, etc. They may involve installing equipment (such as a computer to ensure efficient energy use), modifying equipment (such as making a boiler more efficient), adding insulation, changing behavior patterns, etc.

COOLING DEGREE DAYS - The cumulative number of degrees in a month or year by which the mean temperature is above 18.3°C/65°F.

COOLING LOAD - The rate at which heat must be extracted from a space in order to maintain the desired temperature within the space.

COST-EFFECTIVENESS - An indicator of the relative performance or economic attractiveness of any energy efficiency investment or practice when compared to the costs of energy produced and delivered in the absence of such an investment. In the energy efficiency field, the present value of the estimated benefits produced by an energy efficiency program as compared to the estimated total program's costs, from the perspective of either society as a whole or of individual customers, to determine if the proposed investment or measure is desirable from a variety of perspectives, e.g., whether the estimated benefits exceed the estimated costs.

CUSTOM PROJECT – Energy Efficiency projects that are tailored to meet customer-specific needs.

DEFAULT ASSUMPTION - The value of an input used in a calculation procedure when a value is not entered by the designer.

DEMAND - The time rate of energy flow. Demand usually refers to electric power and is measured in kW (equals kWh/h) but can also refer to natural gas, usually as Btu/hr, kBtu/hr, therms/day or ccf/day.

DEMAND BILLING - The electric capacity requirement for which a large user pays. It may be based on the customer's peak demand during the contract year, on a previous maximum or on an agreed minimum. Measured in kilowatts.

DEMAND RESPONSIVENESS - Also sometimes referred to as load shifting. Activities or equipment that induce consumers to use energy at different (lower cost) times of day or to interrupt energy use for certain equipment temporarily, usually in direct response to a price signal. Examples: interruptible rates, doing laundry after 7 p.m., air conditioner recycling programs.

DEMAND SAVINGS - The reduction in the demand from the pre-retrofit baseline to the post-retrofit demand, once independent variables (such as weather or occupancy) have been adjusted for. This term is usually applied to billing demand, to calculate cost savings, or to peak demand, for equipment sizing purposes.

DEMAND SIDE MANAGEMENT (DSM) - The methods used to manage energy demand including energy efficiency, load management, fuel substitution and load building. See LOAD MANAGEMENT.

END USE (MEASURES/GROUPS) - Refers to a broad or sometimes narrower category that the program is concentrating efforts upon. Examples of end uses include: refrigeration, food service, HVAC, appliances, envelope and lighting.

ENERGY CONSUMPTION - The amount of energy consumed in the form in which it is acquired by the user. The term excludes electrical generation and distribution losses.

ENERGY EFFICIENCY - Using less energy/electricity to perform the same function. Programs designed to use electricity more efficiently - doing the same with less. For the purpose of this paper, energy efficiency is distinguished from DSM programs in that the latter are utility sponsored and financed, while the former is a broader term not limited to any particular sponsor or funding source. "Energy conservation" is a term that has also been used but it has the connotation of doing without in order to save energy rather than using less energy to do the same thing and so is not used as much today. Many people use these terms interchangeably.

ENERGY EFFICIENCY OF A MEASURE - A measure of the energy used to provide a specific service or to accomplish a specific amount of work (e.g., kWh per cubic foot of a refrigerator, therms per gallon of hot water).

ENERGY EFFICIENCY RATIO (EER) - The ratio of cooling capacity of an air conditioning unit in Btus per hour to the total electrical input in watts under specified test conditions.

ENERGY PERFORMANCE CONTRACT – A contract between two or more parties where payment is based on achieving specified results; typically, guaranteed reductions in energy consumption and/or operating costs.

ENERGY SAVINGS - The reduction in use of energy from the pre-retrofit baseline to the post-retrofit energy use, once independent variables (such as weather or occupancy) have been adjusted for.

ENGINEERING APPROACHES - Methods using engineering algorithms or models to estimate energy and/or demand use.

ESCO or ENERGY SERVICES COMPANY – A firm which provides a range of energy efficiency and financing services and guarantees that the specified results will be achieve under an energy performance contract.

EVALUATION - The performance of studies and activities aimed at determining the effects of a program, or any of a wide range of assessment activities associated with understanding or documenting program performance or potential performance, assessing program or program-related markets and market operations, or any of a wide range of evaluative efforts including assessing program-induced changes in energy efficiency markets, levels of demand or energy savings, and program cost-effectiveness.

FREE RIDER - A non-participant who adopted a particular efficiency measure or practice as a result of an energy efficiency program.

FREE RIDERSHIP - The fraction of gross program savings that would have occurred despite the program.

GIGAWATT (GW) - One thousand megawatts (1,000 MW), one million kilowatts (1,000,000 kW), or one billion watts (1,000,000,000 watts) of electricity. One gigawatt is enough to supply the electric demand of about one million average California homes.

GIGAWATT-HOUR (GWH) - One million kilowatt-hours of electric power.

GROSS SAVINGS - The change in energy consumption and/or demand that results directly from program-related actions taken by participants in the DSM program, regardless of why they participated.

HEATING DEGREE DAYS - The cumulative number of degrees in a month or year by which the mean temperature falls below 18.3°C/65°F.

IMPACT EVALUATION - Used to measure the change in energy and/or demand usage (such kWh, kW and therms) attributed to energy efficiency and demand response programs.

IMPACT YEAR - Depending on the context, impact year means either (a) the twelve months subsequent to participation used to represent program costs or load impacts occurring in that year, or (b) any calendar year after the program year in which load impacts may occur.

KILOWATT (kW) - One thousand (1,000) watts. A unit of measure of the amount of electricity needed to operate given equipment. On a hot summer afternoon a typical home with central air conditioning and other equipment in use might have a demand of four kW each hour.

KILOWATT-HOUR (kWh) - The most commonly used unit of measure telling the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour.

LOAD - An end use device or an end use customer that consumes power. The amount of electric power supplied to meet one or more end user's needs. Load should not be confused with demand, which is the measure of power that a load receives or requires.

LOAD FACTOR - A percent telling the difference between the amount of electricity a consumer used during a given time span and the amount that would have been used if the usage had stayed at the consumer's highest demand level during the whole time. The term also is used to mean the percentage of capacity of an energy facility - such as a power plant or gas pipeline - that is utilized in a given period of time.

LOAD IMPACT - Changes in electric energy use, electric peak demand, or natural gas use.

LOAD MANAGEMENT - Steps taken to reduce power demand at peak load times or to shift some of it to off-peak times. This may be with reference to peak hours, peak days or peak seasons. The main thing affecting electric peaks is air conditioning usage, which is therefore a prime target for load management efforts. Load management may be pursued by persuading consumers to modify behavior or by using equipment that regulates some electric consumption.

LOAD SHAPE - The time-of-use pattern of customer or equipment energy use. This pattern can be over 24 hours or over a year (8760 hours).

LOST OPPORTUNITIES - Energy efficiency measures that offer long-lived, cost-effective savings that are fleeting in nature. A lost opportunity occurs when a customer does not install an energy efficiency measure that is cost-effective at the time, but whose installation is unlikely to be cost-effective (or is less cost-effective) later.

MARGINAL COST - The sum that has to be paid for the next increment of product or service. The marginal cost of electricity is the price to be paid for kilowatt-hours above and beyond those supplied by presently available generating capacity.

MARKET ASSESSMENT - A characterization or description of a specific market or market segments, including a description of the types and number of buyers and sellers in the market, the key actors that influence the market, the type and number of transactions that occur on an annual basis, and the extent to which energy efficiency is considered an important part of these transactions by market participants. One particular kind of market assessment effort is a baseline study, or the characterization of a market before the commencement of a specific intervention in the market, for the purpose of guiding the intervention and/or assessing its effectiveness later.

MARKET BARRIER - Any characteristic of the market for an energy-related product, service, or practice that helps to explain the gap between the actual level of investment in, or practice of, energy efficiency and an increased level that would appear to be cost-beneficial to the consumer.

MARKET EFFECT - A change in the structure or functioning of a market or the behavior of participants in a market that result from one or more program efforts. Typically these efforts are designed to increase in the adoption of energy efficient products, services, or practices and are causally related to market interventions.

MARKET PARTICIPANTS - The individuals and organizations participating in transactions with one another within an energy efficiency market or markets, including customers and market actors.

MEASURE (noun) - A product whose installation and operation at a customer's premises results in a reduction in the customer's on-site energy use, compared to what would have happened otherwise. See also ENERGY EFFICIENCY MEASURE.

MEASURE (verb) - Use of an instrument to assess a physical quantity, or use of a computer simulation to estimate a physical quantity.

MEASURE RETENTION STUDY - An assessment of (a) the length of time the measure(s) installed during the program year are maintained in operating condition; and (b) the extent to which there has been a significant reduction in the effectiveness of the measure(s).

MEASURED SAVINGS - Savings or reductions in billing determinants, which are determined using engineering analysis in combination with measured data or through billing analysis.

MEASUREMENT AND VERIFICATION (M&V) – In the context of performance-based energy efficiency contracts/projects, M&V works as a risk management tool where financial payments are tied with the performance of the project (energy savings) and by developing a cost-effective M&V strategy, can reduce their respective risks. The energy service provider and prove with the help of M&V that the savings are real and the energy service receiver can hold the provider accountable if there is a shortfall in energy savings.

MEGAWATT (MW) - One thousand kilowatts (1,000 kW) or one million (1,000,000) watts. One megawatt is enough energy to power 1,000 average California homes.

MEGAWATT HOUR (MWh) - One thousand kilowatt-hours, or an amount of electricity that would supply the monthly power needs of 1,000 typical homes in the Western U.S. (This is a rounding up to 8,760 kWh/year per home based on an average of 8,549 kWh used per household per year. (U.S. DOE EIA, 1997 annual per capita electricity consumption figures.))

METERED DATA - Data collected at a customer's premises over time through a meter for a specific end use, or energy-using system (e.g., lighting and HVAC), or location (e.g., floors of a building or a whole premise). Metered data may be collected over a variety of time intervals. Usually refers to electricity or gas data.

METERED DEMAND - The average time rate of energy flow over a period of time recorded by a utility meter.

METERING - The collection of energy consumption data over time at a customer's premises through the use of meters. These meters may collect information about kWh, kW or therms, with respect to an end use, a circuit, a piece or equipment or a whole building (or facility). Short-term metering generally refers to data collection for no more than a few weeks. End use metering refers specifically to separate data collection for one or more end uses in a building, such as lighting, air conditioning or refrigeration. What is called "spot metering" is not metering in this sense, but is an instantaneous measurement (rather than over time) of volts, amps, watts or power factor to determine equipment size and/or power draw.

MODEL - A mathematical representation or calculation procedure that is used to predict the energy use and demand in a building or facility or to estimate efficiency program savings estimates. Models may be based on equations that specifically represent the physical processes or may be the result of statistical analysis of energy use data.

MONITORING (equipment or system) - Gathering of relevant measurement data over time to evaluate equipment or system performance, e.g., chiller electric demand, inlet evaporator temperature and flow, outlet evaporator temperature, condenser inlet temperature, and ambient dry-bulb temperature and relative humidity or wet-bulb temperature, for use in developing a chiller performance map (e.g., kW/ton vs. cooling load and vs. condenser inlet temperature).

NET SAVINGS - The total change in load that is attributable to the utility DSM program. This change in load may include, implicitly or explicitly, the effects of spillover, free riders, energy efficiency standards, and natural market effects.

NET-TO-GROSS RATIO - A factor representing net program load impacts divided by gross program load impacts that is applied to gross program load impacts to convert them into net program load impacts. This factor is also sometimes used to convert gross measure costs to net measure costs.

NEW CONSTRUCTION - Residential and non-residential buildings that have been newly built or have added major additions subject to state building codes.

NON-ENERGY BENEFITS (NEBS) – The effects of an energy efficiency programs that are other than energy saved, and are identifiable and sometimes quantifiable. Examples include: reduced emissions & environmental benefits, productivity improvements, jobs created, reduced utility debt and disconnects, and higher comfort and convenience level of participant.

NON-PARTICIPANT - Any customer who was eligible but did not participate in the utility program under consideration in a given program year.

NOx - Oxides of nitrogen that are a chief component of air pollution that can be produced by the burning of fossil fuels. Also called nitrogen oxides.

PARTICIPANT - An individual, household, business, or other utility customer that received the service or financial assistance offered through a particular utility DSM program, set of utility programs, or particular aspect of a utility program in a given program year.

PARTICIPANT TEST - A cost-effectiveness test intended to measure the cost-effectiveness of energy efficiency programs from the perspective of electric and/or gas customers (individuals or organizations) participating in them.

PEAK DEMAND - The maximum level of metered demand during a specified period, such as a billing month, or during a specified peak demand period.

PEAK DEMAND PERIOD – Varies from state to state or even by utility (e.g., Noon to 7 p.m. Monday through Friday, June, July, August, and September).

PEAK LOAD - The highest electrical demand within a particular period of time. Daily electric peaks on weekdays occur in late afternoon and early evening. Annual peaks occur on hot summer days.

PERFORMANCE CONTRACTS - A binding agreement between two parties prescribing the range and magnitude of achievement required of equipment, subsystem, or system, which is provided by one party for the benefit and use of the other.

PERSISTENCE STUDY - A study to assess changes in net program impacts over time (i.e., includes retention and technical degradation).

PERSISTENCE FACTOR - The fraction of gross measure savings obtained over the measure life based on a persistence study.

PRACTICE RETENTION STUDY - An assessment of the length of time a customer continues the energy conservation behavioral changes after adoption of these changes.

PROCESS EVALUATION - A systematic assessment of an energy efficiency program for the purposes of (a) documenting program operations at the time of the examination, and (b) to identify and recommend improvements that can be made to the program to increase the program's efficiency or effectiveness for acquiring energy resources while maintaining high levels of participant satisfaction.

PROGRAM - An activity, strategy, or course of action undertaken by an implementer or administrator using SBC funds. Each program is defined by a unique combination of program strategy, market segment, marketing approach, and energy efficiency measure(s) included.

PROJECT - An activity or course of action undertaken by an implementer involving one or multiple energy efficiency measures, usually at a single site.

PROTOCOL – a document that describes the objective(s), design, methodology, statistical considerations, and organization for calculating and reporting energy savings. The protocol usually also gives the background and rationale for calculations, but these could be provided in other protocol reference documents.

REALIZATION RATE – Ratio of energy or demand performance of installed equipment relative to initial estimates of performance. They are usually based on engineering or billing analyses.

REGRESSION MODEL - A mathematical model based on statistical analysis where the dependent variable is regressed on the independent variables which are said to determine its value. In so doing, the relationship between the variables is estimated statistically from the data used.

REPLACEMENT - Refers to the changing of equipment either due to failure, move to more efficient equipment or other reasons near the end of product life or earlier.

RETENTION (MEASURE) - The degree to which measures are retained in use after they are installed.

RETROFIT - Energy efficiency activities undertaken in existing residential or non-residential buildings where existing inefficient equipment is replaced by efficient equipment.

RETROFIT ISOLATION - The savings measurement approach defined in the International Performance Measurement and Verification Protocols (IPMVP) Options A and B, and ASHRAE Guideline 14 that determines energy or demand savings through the use of meters to isolate the energy flows for the system(s) under consideration.

RIGOR - The level of expected reliability. The higher the level of rigor, the more confident we are the results of the evaluation are both accurate *and* precise, i.e., reliable. That is, reliability and rigor are treated as synonymous.

SIMPLIFIED ENGINEERING MODEL - Engineering equations used to calculate energy usage and/or savings. These models are usually based on a quantitative description of physical processes that describe the transformation of delivered energy into useful work such as heat, lighting or motor drive. In practice, these models may be reduced to simple equations that calculate energy usage or savings as a function of measurable attributes of customers, facilities or equipment (e.g., lighting use = watts X hours of use). These models do not incorporate billing data and do not produce estimates of energy savings to which tests of statistical validity can be applied.

SPILLOVER - Savings attributable to the program, but generated by customers not directly participating in the program. These effects could result from: (a) additional energy efficiency actions that program participants take outside the program as a result of having participated; (b) changes in the array of energy-using equipment that manufacturers, dealers, and contractors offer all customers as a result of program availability; and (c) changes in the energy use of non-participants as a result of utility programs, whether direct (e.g., utility program advertising) or indirect (e.g., stocking practices such as (b) above, or changes in consumer buying habits).

STATISTICALLY ADJUSTED ENGINEERING (SAE) MODELS - A category of billing analysis models that incorporate the engineering estimate of savings as a dependent variable. The regression coefficient in these models is the percentage of the engineering estimate of savings observed in changes in energy usage. For example, if the coefficient on the SAE term is 0.8, this means that the customers are on average realizing 80% of the savings from their engineering estimates.

TRANSMISSION & DISTRIBUTION (T&D) LINE LOSS – Electric energy or capacity that is wasted in the normal operation of a power system. LINE LOSSES are kilowatts or kilowatt-hours lost in transmission and distribution lines under certain conditions.

TIME-OF-USE METER - A measuring device that records the times during which a customer uses various amounts of electricity. This type of meter is used for customers who pay time-of-use rates.

WATT - A unit of measure of electric power at a point in time, as capacity or demand.

WATT-HOUR - One watt of power expended for one hour. One thousandth of a kilowatt-hour.

Attachment B: Summary of Northeast State Energy Efficiency M&V and Reporting Protocols

<table>
<tr><th colspan="2">1) Is there a formal M&V protocol (e.g., guideline, order) used in the state?</th></tr>
<tr><td>CT</td><td>Yes – Program Savings Documentation (PSD) submitted as part of 2006 C&LM plan filing October 2005. The PSD includes standard algorithms, practices and input assumptions, which are based on generally accepted methodologies and have a history of being used and approved by the CT DPUC.</td></tr>
<tr><td>ME</td><td>No formal protocols or order/guiding document on M&V. There has not been an official evaluation of Efficiency Maine's programs to date as efforts continue to ramp up. Open proceeding currently considers whether to begin 3rd party evaluation, and if so for which programs.</td></tr>
<tr><td>MA</td><td>No formal protocols or guiding document on M&V. Savings estimates are based on evaluation results, algorithms, practices and institutional knowledge that are generally accepted. Evaluations are guided by standards identified by the Dept. of Telecommunications and Energy (DTE) in past orders. Collaborative efforts have led to standardized algorithms for residential product programs, and efforts are underway to coordinate M&V protocols for C&I programs. DTE 98-100 Guidelines set forth economic framework for measuring program cost-effectiveness.</td></tr>
<tr><td>NH</td><td>No formal protocols or guiding document. Utilities rely on NH PUC Order No 23,574 in DR 96-150 to guide evaluation activities, and have a common assumptions document in which each program has estimated savings guides for specific equipment.</td></tr>
<tr><td>NJ</td><td>Yes – Protocols to Measure Resource Savings, New Jersey Clean Energy Program September 2004. Document lays out standardized algorithms program managers must use to measure program savings.</td></tr>
<tr><td>NY
(NYSERDA)</td><td>Yes/no – For commercial performance program, NYSERDA uses the International Performance, Measurement and Verification Protocol (IPMVP). For other programs, there is no formal M&V protocol in place. Savings estimates are based on algorithms, practices and institutional knowledge that are generally accepted and have a history of being used by NYSERDA. Sources of information include ACEEE, Optimal Energy and implementation contractor experience.</td></tr>
<tr><td>RI</td><td>No formal protocols or guiding document on M&V. Savings estimates are based on evaluation results, algorithms, practices and institutional knowledge that are generally accepted and have a history of being used and approved by the RI PUC.</td></tr>
<tr><td>VT</td><td>Yes – Technical Reference Manual (TRM) developed and maintained by Efficiency Vermont implementation contractor (Vermont Energy Investment Corporation or VEIC). The TRM and any updates are reviewed and approved by the VT Department of Public Service.</td></tr>
<tr><th colspan="2">2) How are gross energy savings estimated for deemed (stipulated, default or standard) savings, custom projects, and measured savings?
• Types of savings data collection methods used (e.g., engineering estimates, surveys, modeling, end-use metering, on-site audits, billing data)
• Types of data analysis methods used (engineering methods, basis statistical models, multivariate statistical models, etc.)</th></tr>
<tr><td>CT</td><td>> Standard algorithms used by both UI and CL&P, currently being documented in Technical Reference Manual. Savings estimates to date are based on algorithms, practices and institutional knowledge that are generally accepted and have been used and approved by the DPUC.
> Deemed savings used for some programs/measures based on either engineering estimates or a blend of ex ante data with some site-specific data.
> Standard input values to algorithms are based on engineering estimates for some custom projects, customer-specific reporting also used where measures with widely varying characteristics (e.g., hours of operation).
> Measured savings based on results of impact evaluations, site-specific analyses.</td></tr>
<tr><td>ME</td><td>> No standard algorithms used.
> Deemed savings used, borrowed partly from Efficiency Vermont program experience and "blessed" by the Maine PUC.
> Standard input values to algorithms based on engineering estimates used to calculate savings for custom projects.
> Measured savings estimates not used.</td></tr>
<tr><td>MA
(Nat'l Grid)</td><td>> Standard algorithms used by program administrators to measure residential product measure savings. No standard algorithms used for C&I programs although efforts are in process to compare algorithms and standard input assumptions. For some prescriptive and custom projects, utilities estimate savings at different levels of detail, making standardization a challenge.</td></tr>
</table>

	> Deemed savings are net savings agreed to and approved by DTE and informed by either current or past evaluations. > Standard input values based on accepted engineering calculations (e.g., for custom C&I projects) are used to develop preliminary/tracking savings data. > Measured savings estimates are based on impact evaluations, used prospectively to update standard input values but also used retrospectively to adjust tracking savings numbers
NH	> No standard algorithms used across state, but utilities share a common assumptions document and programs have estimated savings guides for specific equipment > Deemed savings are net savings agreed to and approved by PUC and informed by either current or past evaluations. > Standard input values based on accepted engineering calculations (e.g., for custom C&I projects) are used to develop preliminary/tracking savings data. > Measured savings estimates are based on impact evaluations, used prospectively to update standard input values. Newer technologies are sometimes metered to verify usage before and after.
NJ	> Standard algorithms used to measure prescriptive measures and measures with important variations in one or more input values. > Deemed savings based on standard formulas and standard input values for standard prescriptive measures. > Standard input values based upon best available measured or industry data applicable for the NJ programs. > Measured savings estimates for custom, site-specific measures, or measures in complex comprehensive projects (industrial processes), based on site-specific analysis.
NY (NYSERDA)	> Standard algorithms used but not formally documented. > Deemed savings developed by evaluation contractor based on their evaluations. > Standard input values based on accepted engineering calculations from multiple sources including Optimal Energy, Inc. and ACEEE studies, experience, and implementation contractors. > Measured savings estimates based on impact evaluations, used prospectively to update standard input values. > IPMVP used for large C&I performance contracting program (CIPP)
RI	> Standard algorithms used but not formally documented. > Deemed savings are net savings agreed to and approved by RI PUC and are informed by current or past evaluations. > Standard input values based on accepted engineering calculations (e.g., for custom C&I projects) are used to develop preliminary/tracking savings data. > Measured savings estimates are based on impact evaluations, used prospectively to update standard input values but also used retrospectively to adjust tracking savings numbers.
VT	> Standard algorithms used to measure prescriptive measures and measures with important variations in one or more input values. > Deemed savings based on standard formulas and standard input values for standard prescriptive measures. > Standard input values based on engineering estimates and results from statewide or regional evaluations are used for prescriptive savings (eg. retail lighting and appliances, commercial lighting) > Measured savings estimates are based on impact evaluations, used prospectively to update standard input values but also used retrospectively to adjust tracking savings numbers.
3) How are baselines developed and maintained? Do protocols require stipulated baselines or development of baselines? If so, how frequently?	
CT	Baselines are developed as part of evaluations and updated on an as-needed basis: They are informed by market assessments, market studies, vendor/field rep input, on-site measurement, and changes in building energy codes, etc.
ME	Baselines currently based on shelf space inventory for residential product program, and through trade ally network and use questionnaires to assess C&I program baselines.
MA (Nat'l Grid)	Baselines are developed as part of evaluations and updated on an as-needed basis: They are informed by market assessments, market studies, vendor/field rep input, on-site measurement, and changes in building energy codes, etc.

NH	Baselines are developed as part of evaluations and updated on an as-needed basis: They are informed by market assessments, market studies, vendor/field rep input, on-site measurement, and changes in building energy codes, etc.
NJ	Baseline estimates used in protocols must be documented in the baseline studies or other market information. Protocol requires that baselines be updated to reflect changing codes, practices and market transformation effects. Updated baselines currently being developed.
NY (NYSERDA)	No static baselines used – rather, NYSERDA relies on market characterization studies to determine naturally occurring energy efficiency investments over time. Market characterizations based on contractor surveys, interviews with customers, and surveys of builders.
RI	Baselines are developed as part of evaluations and updated on an as-needed basis: They are informed by market assessments, market studies, vendor/field rep input, on-site measurement, and changes in building energy codes, etc.
VT	Baselines are developed as part of evaluations and updated on an as-needed basis as identified through stakeholder negotiation and consensus. They are informed by in-depth surveys of vendor and contractors, on-site surveys, and changes in building energy codes.
4) How are savings estimates verified?	
CT	Current and past evaluations are used to verify savings by adjusting realization rates applied to preliminary savings data. Because of filing schedule in CT, energy savings are typically reported at the tracking system level and are updated prospectively (not used for retrospective true up) based upon evaluations results. Evaluations are performed on an as-needed basis, identified by the utilities and the Energy Conservation Management Board.
ME	Maine PUC in process of considering program evaluation and address independent 3rd party verification. To date, savings are verified largely based on shelf inventories and trade ally surveys/questionnaires on changes in inventory.
MA (Nat'l Grid)	Current and past evaluations are used to verify savings by adjusting realization rates applied to preliminary savings data. Evaluations are performed on an as-needed basis, as determined by the utility with input from the non-utility parties involved in a collaborative process. Final evaluated savings results are reported to MA DTE and Division of Energy Resources in utility's Energy Efficiency Annual Report.
NH	For some utilities, current and past evaluations are always used to verify savings by adjusting realization rates applied to preliminary savings data. In some cases, vendors or customers sometimes calculate savings, and program administrators calculate or verify savings and analyze the data at year end.
NJ	Verification involves testing the algorithms by doing some end use metering. Quality assurance process also requires checking for proper installation of measures in a sample of applications. Impact evaluations used to update input values to algorithms but not to retrospectively true-up savings. Evaluations are prospective only. None have been performed in several years, but new evaluations are expected in 2006.
NY (NYSERDA)	For C&I performance contracting program (CIPP), savings verified using the IPMVP (Option B level). For other non-performance programs, evaluations are used to update initial savings estimates on a revolving basis. The frequency and level of rigor of evaluation depends on internal priorities. M&V for other programs based on a 3-tiered approach of: file review (consists of examining databases, accuracy check); examining algorithms and input assumptions; and on-site M&V. In any given year, one level of review is performed, depending on the evaluation emphasis. NYSERDA's evaluation contractor comes up with realization rates and deemed savings based on any one of the 3 Tiers where Tier 3 is considered best approach. NYSERDA uses a 3rd party verification process through a contractor. The evaluation planning process involves looking at budgets, anticipated savings, and portfolio of programs relevance and create an evaluation plan for 2 year periods. Nexant provides reporting to NYSERDA in the spring which is a combination of all the #1, 2 and 3 tier evaluations conducted. The report comes out in May and only reports cumulative savings. Every program will get evaluated by 3-tier approach over a three year period.
RI	Utility performs evaluations on an as-needed basis in consultation with the collaborative. No formal PUC process or protocol for performing evaluations.
VT	The DPS receives savings data from VEIC (Efficiency Vermont contractor) once a year. The DPS then conducts an evaluation in the late summer. The evaluation includes an in-depth review of tracking system data and electronic and hard copy project files by staff and contractors. An independent engineering firm reviews certain large and/or complex C&I projects. Since VEIC has a performance-based contract, if assumptions are off they will make adjustments in the next evaluation as they do not want to penalize VEIC if their reported savings are off.
5) How are savings estimates converted from end-use/customer level savings to generator/system level savings (i.e., line loss adjustments)? How are adjustments for losses associated with distribution and transmission?	

CT	Rely on Joint Avoided Energy Supply Cost study, which includes methodology for calculating T&D line losses. Utilities use own numbers, but same methodology. Savings are reported at customer level.
ME	Savings are reported at customer level.
MA	Rely on Joint Avoided Energy Supply Cost study, which includes methodology for calculating T&D line losses. Utilities use own numbers, but same methodology. Savings are reported at customer level but the value attributed to savings takes into account T&D.
NH	Rely on Joint Avoided Energy Supply Cost study, and utilities use a weighted average value for T&D line losses. Savings are reported at customer level but the value attributed to savings takes into account T&D.
NJ	Savings are report at the generator level – the T&D loss factor for both energy and demand is 11%
NY (NYSERDA)	NYSERDA reports savings at the generation and end-use level, and uses a 9% T&D loss factor to adjust customer-level savings to generator level.
RI	Rely on Avoided Energy Supply Cost study (update forthcoming Fall 2005), which includes methodology for calculating T&D line losses. Utilities use own numbers, but same methodology. Savings are reported at customer level but the value attributed to savings takes into account T&D.
VT	Savings are reported at 3 different levels: 1) Net generation; 2) Net customer meter; 3) Gross customer meter (what customer reads on their meter). This is the level that the DPS verifies and sends to the PSB. DPS also includes T&D line loss for each costing period.
6) Are savings estimates approved, and if so by whom and how frequently?	
CT	Utilities file energy efficiency plans in October, DPUC approves plans in March/April of following year. Energy Conservation Management Board (ECMB) reviews quarterly savings reports from utilities, including 4th quarter report due the second week of February. In March, utilities file compliance report with DPUE with tracking (and/or trued up). DPUC reviews, but does not formally approve savings. Savings reported to DPUC are also submitted in annual report to CT Legislature.
ME	Maine PUC approves savings. Maine fiscal year is July 1 –June 30, savings summary from this period are reported to legislature by December 1.
MA	Massachusetts DTE approves savings.
NH	New Hampshire PUC approves savings
NJ	New Jersey Board of Public Utilities approves protocols
NY (NYSERDA)	NYSERDA compiles summary reports in May of each year – but there is no official approval required from Public Service Commission.
RI	RI PUC approves savings.
VT	The DPS decides when and what programs will be evaluated. EVT gives a report to the DPS by April 1st of each year.
7) What adjustments are made to calculate net savings, and how are these developed and maintained?	
CT	Free-ridership and spillover. Free-ridership studies periodically undertaken (e.g., custom C&I and small business program spillover study underway).
ME	Net to gross adjustments not yet applied. Free-ridership and spillover assumed to net to zero.
MA	Total spillover (participant and non-participant), free-ridership, realization rates and persistence factors. Adjustments based on evaluation findings. Spillover and free-ridership studies periodically undertaken, most recently a joint study for C&I programs.
NH	Total spillover (participant and non-participant), no free-ridership. Other impact factors are calculated to account for impact evaluation findings.
NJ	Spillover and free-ridership assumed to net to zero. Realization rates, measure retention and persistence rates.
NY (NYSERDA)	Spillover and free-ridership assumed to net to zero. Other adjustments include realization rates and persistence rates.
RI	Like-measure participant spillover, no free-ridership. Other impact factors are calculated to account for impact evaluation findings.
VT	Spillover and free-ridership.

Attachment C: Examples of Protocols Used for Select Measures in Sample States

State	Type of Protocol Used				IPMVP Option Equivalent (A-D)
	Algorithms	**Stipulated/ Deemed Savings**	**Baseline Method**	**Evaluation/Verification Methods Used**	
1) Standard Prescriptive (e.g., Residential Lighting For CFL)					
CT	**Energy Savings:** ΔkWh = Watts x Hours x 365/1000 **Demand Savings:** ΔkW = ΔkWh x peak kW/kWh factor	ΔkWh = 45.5 ΔkW = 0.0035 (20 watt CFL)	Baseline is existing measure.		Option B or C in year of evaluation, Option A in non-evaluation years, but informed by prior year evaluations
MA	**Energy Savings:** ΔkWh = Gross Watts x Average annual hours of use **Demand Savings:** ΔkW = watts displaced	ΔkWh = 68	Baseline is existing measure.	Customer surveys, long-term metering with lighting loggers, in-home visits, in-store intercepts, retailer survey.	Option B
NJ	**Energy Savings:** Electricity Impact (kWh) = ((Average Watts Replaced for a CFL Installation) × (Average Daily Burn Time for CFL Installation × 365)/1000 **Demand Savings:** Peak Demand Impact (KW) = (Average Watts Replaced for a CFL Installation) × (Summer Demand Coincidence Factor for all lighting measures)	Δ kWh = 38 ΔkW = 0.0021	Baseline is existing measure	Direct observation or measurement	Option A (variables based upon measured savings from a sample of projects)
NY	**Energy Savings:** Electricity Savings (kWh) = ((Average Watts Replaced for a CFL Installation) × (Average Daily Burn Time for CFL Installation × 365)/1000 **Demand Savings:** Peak Demand Savings (KW) = (Average Watts Replaced for a CFL Installation) × (Summer Demand Coincidence Factor for all lighting measures)	ΔkWh = 94.7 ΔkW = 0.006	Baseline is existing measure	Home energy audit reviews, program participant home visits, database reviews, customer telephone calls, retailer surveys, manufacturer surveys, mystery shopping, partner in-store surveys, non-partner in-store surveys.	Option A
VT	**Energy Savings:** ΔkWh = ΔkW × Average Hours of Use × Waste Heat Factor for energy/Waste Heat Factor for demand **Demand Savings:** ΔkW = ((Baseline Connected KW – Energy Efficient Connected KW) /1000) × In Service Rate × Waste Heat Factor for demand	ΔkWh = 63.4 ΔkW = 0.0511	Baseline is existing measure	Lighting floor inventory data collected, retailer survey, in-home surveys, interviews with program staff, contractors, and retailers; review of program records and materials; pre-EVT program analysis	Option A

	Type of Protocol Used				IPMVP Option Equivalent (A-D)
State	**Algorithms**	**Stipulated/ Deemed Savings**	**Baseline Method**	**Evaluation/Verification Methods Used**	
2) Prescriptive measures with variations in one or more input values (e.g., C&I Lighting – retrofit and/or new construction)					
CT	**Energy Savings:** ΔkWh = (total power usage of the lighting fixtures that are being replaced, kW - total power usage of the new lighting fixtures that are being installed, kW) × number of hours during which the lighting is used at the facility, hours/year. **Demand Savings:** ΔkW = 0.9 × (total power usage of the lighting fixtures that are being replaced, kW - total power usage of the new lighting fixtures that are being installed, kW)		If a retrofit project, baseline is existing measure. For lost opportunity or new construction projects, baseline is technology that is standard practice, generally building energy code. For early replacement, baseline is a blend of existing technology and current standard practice/code.	On-site engineering assessments conducted on statistically selected sample of participants, including verification of measure quantity, technology, hours of operation, and subsequent engineering reanalysis.	Option B or C in measured years (evaluation is performed) and Option A in non-measured years, but informed by prior year evaluations.
MA	**Energy Savings:** Gross kWh = Gross KW ×Annual Hours of Use **Demand Savings:** KW of installed fixtures = Quantity of fixtures installed × Wattage per fixture KW of baseline fixtures = Quantity of existing fixtures × Wattage per fixture		If a retrofit project, baseline is existing measure. For lost opportunity or new construction projects, baseline is technology that is standard practice or building energy code, whichever is stricter.	On-site engineering assessments conducted on statistically selected sample of participants, verification of measure quantity, technology, hours of operation, and subsequent engineering reanalysis. Billing data analysis, lighting logger studies.	Options A, B and C have been used.
NJ	**Energy Savings:** = Change in Connected Load from Baseline to Efficient Lighting Level × Equivalent Full Load Hours × (1+ Interactive Factor) **Demand Savings:** = Change in Connected Load from Baseline to Efficient Lighting Level × Coincidence Factor × (1+ Interactive Factor)		Small C&I: Most efficient T-12 lamp and magnetic ballast. Large C&I: Market driven assumptions for new construction, renovation, remodeling or equipment replacement that presumes a decision to upgrade the lighting equipment	Measurement of key variables through end use metering data accumulated from a large sample of participating facilities from 1995 through 1999	Option A (variables based upon measured savings from a sample of projects)
NY	**Energy Savings:** ΔkWh = Average Kilowatt Reduction × Average Hours of Use per Year **Demand Savings:** ΔkW = Change in Connected Load from Baseline to Efficient Lighting Level × Coincidence Factor **Stipulated/Deemed Savings:** LED exit lighting – 0.015 kW, 131 kWh; Pulse start metal halide (exterior) –0.08 kW, 438 kWh; Pulse metal halide (interior) – 0.119 kW, 688 kWh; Fluorescent fixtures (4 ft, 2 lamp T8) – 0.008 kW, 49 kWh Fluorescent fixtures (4 ft. 2 lamp T5) – 0.006 kW, 34 kWh	See “Algorithms”	Baseline fixture type selected based on lumen output of retrofit fixture (i.e., baseline is existing measure).	On-site engineering assessments conducted on statistically selected sample of participants, including verification of measure quantity, technology, hours of operation, and subsequent engineering reanalysis.	Option A
VT	**Energy Savings:** ΔkWh = Average Kilowattage Reduction × Average Hours of Use per Year × Waste Heat Factor for Energy **Demand Savings:** ΔkW = Average Kilowattage Reduction × Waste Heat Factor for Demand		If a retrofit project, baseline is existing measure. For lost opportunity or new construction projects, baseline is technology that is standard practice	On-site engineering assessments conducted on statistically selected sample of participants	Option A

	Type of Protocol Used				IPMVP Option Equivalent (A-D)
State	Algorithms	Stipulated/ Deemed Savings	Baseline Method	Evaluation/Verification Methods Used	
3) Custom/site specific measures (e.g., industrial process, comprehensive/complex projects)					
CT	Site or measure specific algorithms used with site specific data	N/A	If a retrofit project, baseline is existing measure. For lost opportunity or new construction projects, baseline is technology that is standard practice, generally building energy code. For early replacement, baseline is a blend of existing technology and current standard practice/code.	Site specific analysis including on site visits and specific input values and/or engineering algorithms. Also supplemented with spot or end-use metering from some facilities.	Option B or C
MA		N/A	Site specific analysis including on site visits and specific input values and/or engineering algorithms. Also supplemented with spot or end-use metering from some facilities.	On -site specific metering, simulation and/or engineering analysis.	Option B, C or D
NJ		N/A	Energy savings are calculated from the energy use of the existing lighting to the energy use of the higher efficiency replacements	Site specific analysis either in number of site-specific input values or in use of special engineering algorithms	Option A or B
NY		N/A	Energy savings are calculated from the energy use of the existing lighting to the energy use of the higher efficiency replacements	On-site visits, database reviews, participant surveys, reviewing technical assistance studies for accuracy.	Option B
VT		N/A	Energy savings are calculated from the energy use of the existing lighting to the energy use of the higher efficiency replacements	Site specific analysis either in number of site-specific input values or in use of special engineering algorithms	Option A or B

Sources:

Connecticut
UI and CL&P Program Savings Documentation For 2006 Program Year. Docket 05-10-02 - Revised 9/30/2005
Jeff Schlegel – CT Energy Conservation Management Board consultant

Massachusetts
2004 Energy Efficiency Annual Report for Massachusetts Electric Company and Nantucket Electric Company. October 2005, and National Grid staff

New Jersey
New Jersey Clean Energy Program Protocols to Measure Resource Savings. September 2004.
Mike Ambrosio - NJ Board of Public Utilities consultant

New York
M&V Evaluation: ENERGY STAR® Products and Residential ENERGY STAR® Marketing Programs.
Final Report. Prepared for The New York State Energy Research and Development Authority by Nexant, Inc. May 2005.
New York State Energy Research and Development Authority staff

Vermont
Efficiency Vermont Technical Reference User Manual (TRM) No. 2005-37. November 2005
Vermont Energy Investment Corporation staff and Optimal Energy Inc.

Attachment D: Summary of Savings Data Collection/Analysis Methods

Methods	Application	Advantages	Disadvantages
Engineering Methods	Individual buildings and groups of buildings	Relatively quick and inexpensive for simple engineering methods. Most useful as a complement to other methods. Methods are improving. Useful for baseline development.	Relatively expensive for more sophisticated engineering models. Need to be calibrated with onsite data. By themselves, not good for evaluation of spillover.
Basic Statistical Models	Primarily for groups of buildings	Relatively inexpensive and easy to explain	Assumptions need to be confirmed with survey data and other measured data. Limited applicability. Cannot evaluate peak impacts. Large sample sizes needed.
Multivariate Statistical Models	Primarily for groups of buildings	Can isolate project impacts better than basic statistical models.	Same disadvantages as for basic statistical models. Relatively more complex expensive, and harder to explain than basic statistical models.
End-use Metering	Individual buildings and groups of buildings	Most accurate method for measuring energy use. Most useful for data collection, not analysis.	Can be very costly. Small samples only. Requires specialized equipment and expertise. Possible sample biases. Difficult to generalize to other projects. Does not, by itself, calculate energy savings. Difficult to obtain pre-installation consumption.
Short-term Monitoring	Individual buildings and groups of buildings	Useful for measures with relatively stable and predictable operating characteristics. Relatively accurate method. Most useful for data collection, not analysis.	Limited applicability. Using this method alone, energy savings cannot be calculated.
Integrative Methods	Primarily for groups of buildings	Relatively accurate.	Relatively more complex, inexpensive, and harder to explain than some of the other models.

Source: USAID/Office of Energy, Environment and Technology Best Practices Manual

Attachment E: Northeast State Energy Code Status

As of December 2005			
	RESIDENTIAL	COMMERCIAL	COMMENT
DOE Northeast Region			
CONNECTICUT	2003 IECC	2003 IECC / ASHRAE 90.1 2001	
MAINE	2003 IECC with State amendments and ASHRAE 62.2 – 2003 Ventilation Standard	2003 IECC / ASHRAE 90.1 2001 ASHRAE 62.2 – 2003 Ventilation Standard	Voluntary Residential code adopted.
MASSACHUSSETTS	MA State Building Code, based on 1995 MEC with state-specific amendments	ASHRAE 90.1 1999 (w/amendments)	(NOTE: mechanical and lighting is 90.1 1999, envelope is 2000 IECC) (BASELINE CODE) Code update planned in 2005
NEW HAMPSHIRE	2000 IECC (w/amendments) Sunroom Additions based on 2003 IECC	ASHRAE 90.1 1999 (w/amendments)	Express Package available that tracks 2004 IECC Supplement
NEW YORK	State-developed code based on the 2000 IECC w/2001 supplements	2000 IECC w/2001 supplements, including ASHRAE/IESNA 90.1-1999	Update to IECC 2004 Supplement is under formal consideration.
RHODE ISLAND	2003 IECC	2003 IECC amended to include ASHRAE/IESNA 90.1-2001	
VERMONT	Vermont Residential Building Energy Standards (RBES) based on (and exceed) IECC 2000 with amendments	2005 Vermont Guidelines for Energy Efficient Commercial Construction based on 2004 IECC Supplement with amendments to incorporate and exceed ASHRAE/IESNA 90.1-2004	VT's commercial code is voluntary state-wide as a minimum performance standard
DOE Mid Atlantic Region			
DELAWARE	2000 IECC	ASHRAE 90.1-1999	
DISTRICT OF COLUMBIA	2000 IECC	ASHRAE 90.1-1989	Update in progress to IECC 2003.
MARYLAND	2003 IECC	ASHRAE/IESNA 90.1-2001	
NEW JERSEY	1995 MEC	ASHRAE/IESNA 90.1-1999	
PENNSYLVANIA	2003 IECC	2003 IECC	

Attachment F: IPMPV Summary of M&V Options

Option A: Partially Measured Retrofit Isolation
In this option energy savings are determined by measuring the capacity, efficiency, or operation of a system before and after a retrofit and by multiplying the difference by a stipulated factor. The stipulated factor is based on assumptions, analysis of historical data, or manufacturer's data. This option does not involve long-term measurement and is limited to only well-documented, non-weather sensitive measures. Option A is typically only accepted if the savings are predictable and reliable and is only to be used for independent actions or upgrades, not full building retrofit.[55]

Option B: Retrofit Isolation:
This option builds upon Option A through the use of short-term or continuous metering during the performance period to determine energy consumption. Option B more correctly estimates operational factors such as hours of use by taking measurements at the device or system level.[56]

Option C: Whole Facility
Option C like Option B involves the use of long-term metering data but techniques outlined in Option C determine savings by examining overall energy use in a facility and identifying the impact of ECMs on total building or facility energy use. Option C requires the comparison of monthly billing data recorded for the whole building or project site by a utility meter or sub-meters, before and after project installation. In addition, an analysis of variables including weather and occupancy is conducted. Energy savings can be determined once the variables are recognized and adjusted to match pre-installation conditions.[57]

Option D: Calibrated Simulation
Unlike the previous options, Option D involves the use of software to create a simulated model of a building and its components and can be used to examine individual ECMs or entire facility savings. In order to assure accuracy the model is calibrated through comparing it with billing or end-use monitored data. Typical models run in Option D are for the existing base case, a base case complying with minimum standards, and a case with the energy measures installed. Option D is most commonly used when baseyear or post-retrofit energy use data unavailable or unreliable; expected energy savings aren't large enough to be separated from utility meter as in Option C; or when Options A or B are too difficult or costly. Option D is typically the best choice in verifying savings in new construction or for savings associated with building operator training.[58]

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[55] Pacific Northwest Laboratory: FEMP M&V Guidelines. Available at: http://metering.pnl.gov/femp_2.2/FEMP22_seci.htm and *The International Performance Measurement & Verification Protocol: Concepts and Options for Determining Energy and Water Savings Volume 1.* Revised March 2002. Available at http://www.ipmvp.org

[56] NYSERDA guidelines: http://www.nyserda.org/funding/855PON.html

[57] Pacific Northwest Laboratory: FEMP M&V Guidelines. Available at: http://metering.pnl.gov/femp_2.2/FEMP22_seci.htm and *The International Performance Measurement & Verification Protocol: Concepts and Options for Determining Energy and Water Savings Volume 1.* Revised March 2002. Available at http://www.ipmvp.org

[58] Pacific Northwest Laboratory: FEMP M&V Guidelines. Available at: http://metering.pnl.gov/femp_2.2/FEMP22_seci.htm and *The International Performance Measurement & Verification Protocol: Concepts and Options for Determining Energy and Water Savings Volume 1.* Revised March 2002. Available at http://www.ipmvp.org

Attachment G: California Energy Efficiency Evaluation Protocols

Table 1: Required Protocols for Evaluations of Gross Energy Savings

Rigor Level	Gross Energy Evaluation Allowable Methods
Basic	1. Simple Engineering Model (SEM) with M&V equal to Option A of the IPMVP and meeting all requirements in the M&V Protocol for this method. Sampling according to the Sampling and Uncertainty Protocol. For comprehensive measure packages with interactions must use energy simulation modeling under IPMVP Option D. 2. Normalized Annual Consumption (NAC) using pre- and post-program participation consumption from utility bills from the appropriate meters related to the measures undertaken, normalized for weather, using identified weather data to normalize for heating and/or cooling as is appropriate to measures included. Twelve (12) months pre-retrofit and twelve (12) months post-retrofit consumption data is required. Sampling must be according to the Sampling and Uncertainty Protocol.
Enhanced	1. A fully specified regression analysis of consumption information from utility bills with inclusion/adjustment for changes and background variables over the time period of analysis that could potentially be correlated with the gross energy savings being measured. Twelve (12) months post-retrofit consumption data are required. Twelve (12) months pre-retrofit consumption data are required, unless program design does not allow pre-retrofit billing data, such as in new construction. In these cases, well-matched control groups and post-retrofit consumption analysis is allowable.[59] Sampling must be according to the Sampling and Uncertainty Protocol utilizing power analysis. 2. Building energy simulation models that are calibrated as described in IPMVP Option D requirements in the M&V Protocols. If appropriate, could alternatively use a process engineering model (e.g., AirMaster+) with calibration as described in the M&V Protocols. Sampling according to the Sampling and Uncertainty Protocol. 3. Retrofit Isolation engineering models as described in IPMPV Option B requirements in the M&V Protocols. Sampling according to the Sampling and Uncertainty Protocol. 4. Experimental design established within the program implementation process, designed to obtain reliable net energy savings based upon differences between energy consumption between treatment and non-treatment groups from consumption data.[60] Sampling must be according to the Sampling and Uncertainty Protocol.

[59] Post-retrofit only billing collapses the analysis from cross-sectional time-series to cross-sectional. Given this, even more care and examination is expected with regard to controlling for cross-sectional issues that could potentially bias the savings estimate.

[60] The overall goal of the Impact Protocols is to obtain reliable net energy and demand savings estimates. If the methodology directly estimates net savings at the same or better rigor than the required level of rigor, then a gross savings and participant net impact analysis is not required to be shown separately.

Table 2: Required Protocols for Market Effects Evaluation

Rigor Level	Effects Evaluation Method Options
I	An evaluation to estimate the program's net changes on the behavior of the participants is required.
II	A two-stage analysis is required that will produce energy and demand savings. The first stage is to conduct an evaluation to estimate the program's net changes on the behavior of the participants/targeted-customers. The second is to link the behaviors identified to estimates of energy and demand savings based upon prior studies (as approved through the evaluation planning or evaluation review process).
III	A three-stage analysis is required that will produce energy and demand savings. The first stage is to conduct an evaluation to estimate the program's net effects on the behavior changes of the participants. The second stage is to link the behavioral changes to estimates of energy and demand savings based upon prior studies (as approved through the evaluation planning or evaluation review process). The third stage is to conduct field observation/testing to *verify* that the occurrence of the level of net behavioral changes.

Table 3. Required M&V Protocols

Standard Level of Rigor:	
Provision	**Requirement**
Verification	Physical inspection of installation to verify correct measure installation and installation quality
IPMVP Option	Option A[61].
Source of stipulated data	DEER assumptions, program workpapers, engineering references, manufacturers catalog data, onsite survey data
Baseline definition	Consistent with program baseline definition. May include Federal or Title 20 Appliance standards effective at date of equipment manufacture, Title 24 building standards in effect at time of building permit; existing equipment conditions, or common replacement or design practices as defined by the program.
Monitoring strategy and duration	Spot or short-term measurements depending on measure type
Weather adjustments	Weather dependent measures: normalize to long-term average weather data for CTZ in which site is located.
Calibration Criteria	Not applicable
Additional Provisions	None

[61] Exceptions to this provision are programs offering comprehensive measure packages with significant measure interactions; commissioning, and retrocommissioning programs; and new construction programs. Evaluations of these programs conducted using engineering methods must follow the enhanced M&V protocol, and use building energy simulation modeling under IPMVP Option D.

Enhanced Level of Rigor:	**Table 3 Continued…**
Provision	**Requirement**
Verification	Physical inspection of installation to verify correct measure installation and installation quality. Review of commissioning reports or functional performance testing to verify correct operation
IPMVP Option	Option B or Option D
Source of stipulated data	DEER assumptions, program workpapers, engineering references, manufacturers catalog data, onsite survey data
Baseline definition	Consistent with program baseline definition. May include Federal or Title 20 Appliance standards effective at date of equipment manufacture, Title 24 building standards in effect at time of building permit; existing equipment conditions, or common replacement or design practices as defined by the program.
Monitoring duration	Sufficient to capture all operational modes and seasons
Weather adjustments	Weather dependent measures: normalize to long-term average weather data for CTZ in which site is located.
Calibration Criteria	Option D building energy simulation models calibrated to monthly billing or interval demand data. Optional calibration to end-use metered data.
Additional Provisions	Hourly building energy simulation program compliant with ASHRAE Standard 140-2001

Table 4. Examples of Typical Rigor Levels for Different Measure Types

Measure Type	Basic Rigor Level	Enhanced Rigor Level
Appliances	A	B
Commissioning and O&M programs	D	D
Comprehensive	D	D
Envelope	D	D
Food service	A	B
HVAC Controls	D	D
HVAC Equipment Efficiency	A	D
Lighting controls	A	B
Lighting efficiency	A	B
New construction	D	D
Non-HVAC Motor controls	A	B
Non-HVAC Motor efficiency	A	B
Process	A	B
Refrigeration	A	D
Water heating	A	B
Water pumping/treatment	A	B