



# **Roadmaps for improved Harmonised Energy Savings Calculations**

**A report produced for the IEA DSM  
Agreement,  
Task 21 Harmonisation of Energy Savings  
Calculations**

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In the IEA DSM Agreement, Task 21 Harmonisation of Energy Savings Calculations (ESC), the following countries are participating:

France  
Republic of Korea  
Netherlands  
Norway  
Spain  
Switzerland  
USA

The report contains an overview on the developments in recent years related to harmonisation of energy savings calculations in Europe, the USA and worldwide. In Europe the Energy Service Directive has stimulated common efforts: the EMEEES project providing detailed information on unitary energy savings and the European standardisation organisation CEN for lifetime of savings and a standard on energy savings calculations. The USA, in addition to the work in California, has increased regional co-operation by e.g. NEEP and SEE Action and the DOE (USA Department of Energy) Uniform Methods Projects are the driving force for more harmonisation. The International Standardisation Organisation (ISO) is preparing a global standard on energy savings calculations.

In Europe, it currently comprises more or less a time-out situation: CEN is waiting for new mandates and finances and the Energy Efficiency Directive (EED) will result in more understanding on future needs for energy savings calculations early 2013. In the USA the Uniform Methods Project in combination with more regional co-operations continues to produce more harmonisation. ISO is in the process of creating general standards on energy savings and energy savings calculations to be finalised by early 2014. Task 21 produced several case applications for a number of countries and a template to document information on six key elements. This template contains a number of elements comparable to those suggested in USA reports. Additional work within Task 21 could be conducted based on the USA regional experiences and the energy saving calculation methods provided by EU countries by the end of 2013: to produce more comparable case applications and to develop a 'tier' approach, in line with the levelled approach in different energy reports.

The report is available at [www.ieadsm.org](http://www.ieadsm.org)

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April 2013

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## Summary

In this report on Roadmaps on the basis of which Energy Savings Calculations (ESC) standards could be further developed, it is concluded that the European Standardisation Organisation CEN completed, for the time being, the development of a standard whilst the International Standardisation Organisation (ISO) is in the process of creating general standards on energy savings and energy savings calculations. In Europe the new EED results in uncertainty on future needs for energy savings calculations, but some work continues within the Concerted Action project. In the USA the Uniform Methods Project has started: DOE aims to establish easy-to-follow protocols based on commonly accepted engineering and statistical methods for savings for energy efficiency measures. In combination with the different levels of energy savings calculations in the EED this could be extended within Task 21 in order to develop a 'tier' approach (a levelled approach; from simple to more sophisticated) and thus provide more and more harmonised case applications.

The reports present the developments in recent years related to harmonisation of energy savings calculations in Europe, the USA and worldwide. In Europe the Energy Service Directive has been stimulating common efforts and the European standardisation organisation CEN has been enhancing work in energy savings, whilst in the USA has increased regional co-operation by e.g. NEEP and SEE Action and the DOE Uniform Methods Projects are the main drivers. Worldwide, the International Standardisation Organisation is the driving force as it is preparing a standard on energy savings calculations, whilst there are some actions by the IEA, EVO (International Performance Measurement and Verification Protocol; IPMVP) and IPEEC.



## 1. Introduction

The overall aim of Task 21 is to identify basic concepts, calculation rules and systems for Energy Savings Calculations standards. Both energy savings and emissions avoidance calculation methods and standards will be evaluated for efficiency activities. In addition, a methodology should be developed to nominate and describe the several Demand Response products.

The Task (or project) also explores how and by what type of organisations these draft standards could be used (and improved) to enhance international comparable evaluation of policies and measures.

The three primary objectives of this Task were to:

1. Summarise and compare the current methods and standards used for determining energy use, energy demand and energy and emissions savings from energy efficiency actions and policies;
2. Identify the organisations that are and could be responsible for use and maintenance of such methods and standards;
3. Recommend how existing methods, standards and resources can be expanded and/or used for comparing different countries' policies and actions as well as international efficiency policies and actions.

This has resulted in country reports and two research reports that are available on the website of the IEA Demand Side Management Agreement, [www.ieadsm.org](http://www.ieadsm.org) :

- Harmonised Energy Savings Calculations for selected end-use technologies, key elements and practical formulas (2012), and
- Guidelines for Harmonised Energy Savings Calculations (2013).

This report deals with the second objective and deals with future developments or roadmaps for improved harmonised energy savings calculations.

Section two to four present the developments in recent years related to harmonisation of energy savings calculations in Europe, the USA and worldwide. In Europe the Energy Service Directive has stimulated common efforts and the European standardisation organisation CEN has enhanced work in energy savings, whilst in the USA has increased regional co-operation by e.g. NEEP and SEE Action and the DOE Uniform Methods Projects are the main driving force. Worldwide, the International Standardisation Organisation is the driving force with some actions by the IEA, EVO (IPMVP) and IPEEC.

The main conclusions (section 5) are that in Europe the CEN has completed more or less its work for the time being and that the new Energy Efficiency Directive results at the moment in uncertainty on future needs for energy savings calculations. In the USA the Uniform Methods Project in combination with more regional co-operations continue to produce more harmonisation. Globally, ISO is still in the process of creating general standards on energy savings and energy savings calculations, whilst EVO will continue to maintain the IPMVP; no targeted action from the IEA or IPEEC are expected in the near future. Task 21 has produced case applications for a small number of case applications and a template to document information on six key elements. This template contains a number of elements comparable to those suggested in USA reports. Additional work could be conducted as follow-up within Task 21 using at least the USA experiences and the energy saving calculation methods that the EU Member states will provide in 2013/2014 to the European Commission and produces more comparable case applications. Additionally a 'tier' approach – conventional in the climate world (IPCC and UNFCCC) - could be developed in line with the levelled approach in the energy world.

## 2. Harmonisation of energy savings calculations in Europe

Whilst the report “Guidelines for Harmonised Energy Savings Calculations” contains information on existing evaluation practices and use and the development of standards related to energy savings calculations for France, Norway, Republic of Korea, The Netherlands, Spain and the USA, we restrict ourselves in this report to:

- the impact of EU regulation, the Energy Service Directive (ESD) and the Energy Efficiency Directive (EED)
- the European standardisation organisation CEN.

As of 2006, the **Energy Service Directive** (ESD) in Europe has been stimulating common efforts to improve energy savings calculations and has initiated a regular (every three years) reporting by the Member States on their energy efficiency activities and achievements in the National Energy Efficiency Action Plans (NEEAPs) to the European Commission. Two rounds have already been issued (2007 and 2011). This Directive also stimulates the work at CEN in order to enhance work in energy savings including energy savings calculations.

From November 2006 to April 2009, the IEE project “Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services” (*EMEEES*) worked on a set of calculation methods and case applications, with 21 organisations. In one of the final reports, “Measuring and reporting energy savings for the Energy Services Directive – how it can be done. Results and recommendations from the EMEEES project” which is available at [http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES\\_Final\\_Report.pdf](http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_Final_Report.pdf), the four steps in bottom-up evaluation and the five general bottom-up methods are presented. It also contains 20 bottom-up case applications for which this methodology was used. These steps were further developed in the work CEN conducted in the preparation of the European standard. More details on this methodology will be presented later on in this chapter when the CEN standard is elaborated. The five general methods for measuring or estimating energy savings are:

1. direct measurement;
2. analysis of energy bills or energy sales data;
3. enhanced engineering estimates for individual units;
4. mixed deemed and ex-post estimate;
5. deemed estimate.

Table 1 comprises information on the data collections, corrections etc. for each of these five methods.

Table 1. General bottom-up evaluation methods for energy savings

| Methods for measuring or estimating unitary gross annual energy savings   | Methods for collecting number of units or participants                             | Methods for estimating gross-to-net correction factors   | Applicable if unit is:                               | Characterisation of costs and data collection   |
|---|--|--|--|---|
| <b>1 direct measurement</b><br>a) without normalisation<br>b) with normalisation  | A) monitoring of participants and savings per participant                          | I) and II)   | participant (usually)                                | can be costly; suitable for large buildings or sites, or as a basis for deemed estimates                              |
| <b>2 analysis of energy bills or energy sales data</b> (sample or all participants)<br>a) without normalisation<br>b) with normalisation        | A) monitoring of participants and savings per participant                          | I) and c) comparison with control group; or d) discrete choice modelling and other in-depth billing analysis | participant (usually)                                | can be very costly to collect and analyse, particularly d); may be the only way for information campaigns             |
| <b>3 enhanced engineering estimates for individual units</b><br>(e.g., calibrated simulation)   | A) monitoring of participants/number of actions and savings per participant/action | I) and II)   | participant or specific end-use EEI action/equipment | can be costly; however, if an energy audit is done anyway, small extra cost of monitoring results                     |
| <b>4 Mixed deemed and ex-post estimate</b> , e.g. based on sales data, inspection of samples, monitoring of equipment purchased by participants | A) monitoring of number of actions and savings per action                          | I) and II)   | specific end-use EEI action/equipment (usually)      | costs depend on level of accuracy and gross-to-net correction required; monitoring usually straightforward            |
| <b>5 Deemed estimate</b> , e.g. based on sales data, inspection of samples before implementation of the EEI promotion measure being evaluated   | A) monitoring of number of actions and savings per action                          | maybe II; always simplified; maybe inclusion of correction factors in deemed savings per unit                | specific end-use EEI action/equipment (usually)      | costs can be quite low, monitoring of number of actions and savings per action may be combined with "anyway" contacts |

I) surveys of participants (and control group and other market actors) to find out reasons for implementing end use EEI actions

II) monitoring of participants and end-use EEI actions for different promotion measures to avoid double-counting

Source: EMEES, 2009

EMEES suggested three levels of harmonisation with respect to impacts

- default or harmonised values;
- harmonised rules;
- harmonised supporting resources.

For the first level it has prepared a number of proposals for default values for unitary gross annual energy savings in bottom-up calculations, or for some input parameters for these. However, these default values are often rather conservative in order to reflect uncertainties and differences between Member States. Therefore, they are a tool to allow calculation in Member States that haven't got their own data yet and stimulate creation

of own data, rather than being a tool for harmonisation. The second level of harmonisation in methods and results can be achieved by harmonised rules for a) definition of formulas, parameters, monitoring, and calculation procedures in bottom-up calculations, and b) harmonised reporting of results. EMEES has presented proposals for the definition of formulas, parameters, monitoring, and calculation procedures in the calculations in the 20 bottom-up case applications. However, there is still quite some flexibility possible for the Member States, making these proposals currently belong to the third level of harmonisation, which has the status of supporting resources. It needs further analysis and discussion, to which extend such supporting resources can be moved on to the second level, the harmonised rules. This is certainly also an area, in which more experience needs to be accumulated in the next round of NEEAPs in 2011 (holding the first ex-post calculations of energy savings).

By the end of 2009 the European Commissions concluded that the methods in place for energy savings calculations at national level are very different in nature, with some Member States having very elaborate and well-tested measurement methods, while others have less-developed systems and are hampered by a basic lack of data and of sound monitoring systems. This complicated the issue of harmonisation. In order to move forward on energy saving measurement, the additional guidance was restricted to the minimum required by the ESD, i.e. only the bottom-up calculation methods covering 20 – 30% of final inland energy consumption. The harmonised bottom-up calculation model set out was restricted to residential (households) and tertiary (public and private organisations in the service sector) buildings and appliances in those buildings and consists of guiding principles, a set of formulas, baselines and default values for measuring final energy savings achieved through the implementation of energy efficiency improvement measures or programmes. Additionally, a preliminary list of harmonised average lifetimes of energy efficiency improvement measures and programmes for bottom-up calculations was agreed on.

At the end of 2008 the Concerted Action for the ESD (CA ESD) started to organise a series of seven 'meetings' for EU Member States and their representatives over the years in order to discuss and exchange experiences on five topic areas, most related to the National Energy Efficiency Action Plans. By 2013 this project added additional topics, relevant for the new EU Energy Efficiency Directive amongst others the implementation of Energy Efficiency obligation schemes and other policy measures. During the CA ESD energy savings calculations were not discussed in detail, as the EMEES project was ongoing. By 2014 the energy savings calculations might become a topic within the CA EED, when Member States will present their methods on calculating energy savings for the EED.

By November 2012 a new EU **Energy Efficiency Directive (EED)** came into force and this Directive will drive future development in harmonisation of energy savings calculations as the EED holds a cumulative end-use energy savings target for new savings each year - from January 1<sup>st</sup>, 2014 up to December 31<sup>st</sup>, 2020 - of 1.5% of the annual energy sales to final customers and provides more rules on energy savings calculations.

For the energy savings to be reported, this Directive holds a framework for calculating the impact of energy savings caused by individual actions and states that authorities may use one or more of the following methods for calculating energy savings:

- (a) deemed savings, by reference to the results of previous independently monitored energy improvements in similar installations. The generic approach is termed '*ex-ante*';
- (b) metered savings, whereby the savings from the installation of a measure, or package of measures, is determined by recording the actual reduction in energy use, taking due account of what may affect consumption. The generic approach is termed '*ex-post*';
- (c) scaled savings, whereby engineering estimates of savings are used. This approach may only be used where establishing robust measured data for a specific installation is difficult or disproportionately expensive, or where they are carried out on the basis of nationally established methodologies and benchmarks by qualified or accredited experts that are independent of the obligated, participating or entrusted parties involved;
- (d) surveyed savings, where consumers' response to advice, information campaigns, labelling or certification schemes, or smart metering is determined. This approach may only be used for savings resulting from changes in consumer behaviour. It may not be used for savings resulting from the installation of physical measures.

By the end of 2013 the Member States will have to inform the European Commission in detail on the methods - within this framework- they will use to calculate the energy savings.

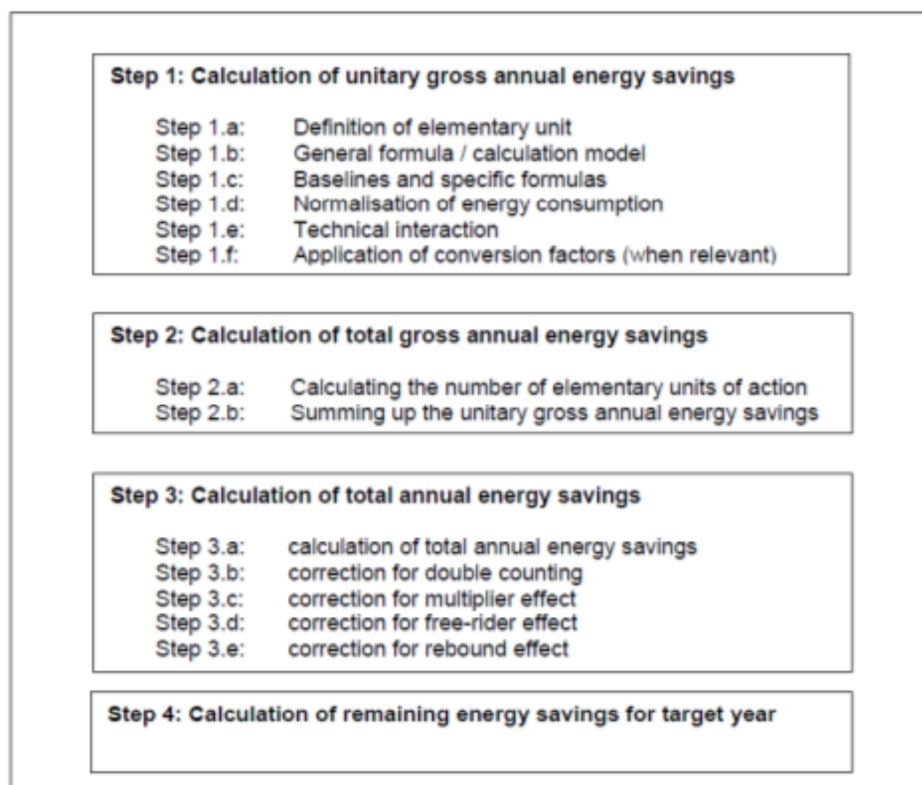
As the target is a cumulative one, the calculation of energy savings has to take into account the lifetime of savings. The Directive states that this may be done by counting the savings each individual action will achieve between its implementation date and December 31<sup>st</sup>, 2020. Alternatively, Member States may adopt another method that is estimated to achieve at least the same total quantity of savings, and Member States must describe in detail in the National Energy Efficiency Action Plan 2014, which other methods they have used and which provisions have been made to ensure this binding calculation requirement.

Since 2007 the **European standardisation organisation CEN** conducted work on standards for common methods of calculation of energy consumption, energy efficiencies and energy savings and for a common measurement and verification of protocol and methodology for energy use indicators. Since then experts have participated in two Working Groups – one for Top-Down calculations and one for Bottom-Up calculations. By September 2012 the standard “Introductory element, Energy Efficiency and Savings Calculation, Top-down and Bottom-up Methods Complementary element” had become officially available at CEN as a standard **EN16212:2012**.

This European standard provides a general framework for calculating energy savings and is organised as follows:

- the methodology and general rules of calculation;
- terminology and definitions;
- the characteristics of the top-down and bottom-up methods;
- the top-down calculation method;
- the bottom-up calculation methods;
- Annex A example for top-down indicators;
- Annex B the level of detail at which bottom-up methods can be applied;
- Annex C a bottom-up example for the building sector (boiler exchange).

Figure 1: Steps and sub-steps in the calculation of bottom-up energy savings as included in Standard EN16212:2012



For the bottom-up energy savings calculations the standards used the approach of unitary savings and contain a figure presenting steps in the calculation process. These steps are shown in figure 1. The standard organises elements for calculating unitary savings in four steps. It starts with the savings per unit (unitary savings); those are summed up to total gross saving and then corrected to get the (net) savings. The savings are annual savings and in step 4 one can count the savings for a period (up to a target year).

At the end of 2011 it was concluded in the meeting of the responsible working group (JWG4) that after the formal vote and the publication of the standard the CEN/CLC/JWG 4 would only continue its work if there would be an evident need expressed to undertake the work. At the moment such a need is not (yet) expressed and therefore, CEN is not continuing the work on the energy savings calculation.



### 3. Harmonisation of energy savings calculations in the USA

The report Guidelines for Harmonised Energy Savings Calculations also holds information on existing evaluation practices and use and the development of standards related to energy savings calculations in the USA. Here we restrict ourselves to three projects that are relevant for future (global) harmonisation of energy savings calculations:

1. the Uniform Methods Project (UMP)
2. Northeast Energy Efficiency Partnerships (NEEP)
3. State and Local Energy Efficiency Action Network (SEE).

Under the **Uniform Methods Project** (UMP), the USA Department of Energy (DOE) is developing a framework and a set of protocols for determining the energy savings from energy efficiency measures and programmes. The protocols provide a straightforward method for evaluating gross energy savings for the most common residential and commercial measures offered in ratepayer-funded initiatives in the United States. DOE aims to establish easy-to-follow protocols based on commonly accepted engineering and statistical method for savings for energy efficiency measures.

Current energy efficiency Evaluation, Measurement, and Verification (EM&V) practices in the United States use multiple methods for calculating energy savings. These methods were initially developed to meet the needs of individual energy efficiency programme administrators and regulators. Whilst the methods served their original objectives well, they have resulted in differing and incomparable savings results—even for identical measures.

Through the UMP, DOE aims to establish easy-to-follow protocols based on commonly accepted engineering and statistical methods for determining gross savings for a core set of commonly deployed energy efficiency measures. The protocols also include:

- A description of measure and application conditions
- An algorithm for estimating savings
- An example of a typical programme offering and alternative delivery strategies
- Considerations for the measurement and verification process, including an International Performance Verification and Measurement Protocol (IPMVP) option
- Data requirements for verification and recommended data collection methods
- Recommended programme evaluation elements
- Fall-back options for lower-cost EM&V approaches.

The protocols provide guidance on energy savings determinations, which will be available as a reference to improve EM&V practices. The protocols include the most common residential and commercial energy efficiency measures found in utility-sponsored energy efficiency programmes in the United States. In January 2013 DOE published the first set of (seven) draft protocols at [http://www1.eere.energy.gov/office\\_eere/de\\_ump.html](http://www1.eere.energy.gov/office_eere/de_ump.html) In the second phase, the number of protocols will be expanded, so the final set of measures covered is expected to represent a significant share of the available technical and economic energy efficiency potential in most jurisdictions.

The methods described in the protocols are approaches that are (or are amongst) the most commonly used in the US energy efficiency industry for certain measures or programmes. As such, they draw from the existing body of research and best practices for energy efficiency evaluation, measurement, and verification (EM&V). They provide a structure for deciding on and applying such criteria consistently and for reporting the uncertainty associated with the indicated savings estimates.

The first set of seven protocols is primarily applicable to residential and commercial facilities and deals with:

- Refrigerator recycling
- Commercial lighting
- Commercial lighting controls
- Residential lighting
- Residential furnaces and boilers
- Residential and small commercial unitary and split system air-conditioning equipment
- Whole-building retrofit.

For each energy efficiency measure, the protocol explains the underlying technology, the end uses affected by the measure, the method for calculating the measure's savings, and the data requirements. Also, each protocol attempts to provide a sufficient level of detail. In Annex B we include the structure for the US Uniform Methods Project Protocols.

The **Northeast Energy Efficiency Partnerships** (NEEP) has been facilitating regional partnerships to advance the efficient use of energy in homes, buildings and industry in the Northeast and Mid-Atlantic States of the USA. This partnership increased regional co-operation in the field of harmonisation or common understanding of MRV and default values etc. The EM&RV Forum, established in 2008, is a regional project facilitated and managed by NEEP that represents states in New England (Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont), New York, New Jersey, Maryland, Delaware, and the District of Columbia. In 2010 and 2011 this forum published several reports at their site <http://neep.org/emv-forum> :

- Common state-wide energy efficiency reporting guidelines and Regional EM&V methods and savings assumptions guidelines, December 2010;
- Regional EM&V Methods and savings assumptions guidelines, May 2010;
- Glossary of terms, version 2.1, July 2011.

The scope of the Common state wide energy efficiency reporting guidelines focuses on electric and gas energy efficiency savings, impacts and programme expenditures, where such investments are funded by gas and electric service ratepayers. The guidelines recommend common reporting templates that provide basic information in a format that makes it straightforward to support energy and environmental planning or analyses for:

- Electric and gas energy efficiency programme energy and demand savings (3 tables);
- Electric and gas energy efficiency programme expenditures, and cost of saved energy (3 tables);
- Air Emission Data from electric and gas energy efficiency programme impacts, and associated process recommendations for improved data exchange between key stakeholders (1 table); and,
- Job Impacts Data from electric and gas energy efficiency programme impacts (1 table).

Each table is followed by a list of supporting definitions, consistent with the Forum Glossary. To encourage increasing consistency in reported elements over time and to inform readers of specifically what each reporting element represents, each jurisdiction should indicate or include a clear definition for each reported element. Ideally, the definitions used by jurisdictions will be consistent with the definitions in the Regional EM&V Forum - Glossary of Terms and Acronyms ("Forum Glossary") which is a living document that is updated annually. Table 1.0 dealing with the description of reported Energy Efficiency Savings is included in Annex C.

The gas energy efficiency programme data for 8 states (Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont) collected using the Forum's Common State-wide Energy Efficiency Reporting Guidelines became available in the *Regional Energy Efficiency Database (REED)* database by February 2013, whilst updating and enlarging is foreseen for fall 2013. This database at [www.neep-reed.org](http://www.neep-reed.org) provide directions for use, a glossary of terms and a series of reports based on 2011 energy efficiency programme data. Throughout 2013, NEEP will be working with the states and programme administrators to identify key similarities and differences in EE programme impacts, and plans to issue reports outlining these findings on a periodic basis.

**The State and Local Energy Efficiency (SEE) Action Network** is a state- and local-led effort facilitated by DOE and the U.S. Environmental

Protection Agency (EPA) to take energy efficiency to scale that builds on the foundation of the National Action Plan for Energy Efficiency. SEE Action is composed of more than 200 leaders from state and local governments, associations, businesses, non-government organisations, and their partners working toward a goal of achieving all cost-effective energy efficiency by 2020. SEE Action offers knowledge resources and technical assistance to state and local decision makers in general and to transform Evaluation, Measurement, and Verification (EM&V) to yield more accurate, credible, and timely results that accelerate deployment and to improve management of energy efficiency. The EM&V Working group conducted among others

- An Energy Efficiency Programme Impact Evaluation Guide (December 2012);
- A Scoping Study of Issues and Implementation Requirements for National Energy Efficiency Evaluation, Measurement and Verification Standard (June 2011);
- A Scoping Study to Evaluate Feasibility of National Databases for EM&V Documents and Measure Savings (June 2011).

The 2012 Energy Efficiency Programme Impact Evaluation Guide is an update to the 2007 National Action Plan for Energy Efficiency Model Energy Efficiency Programme Impact Evaluation Guide. It focuses on bottom-up evaluations of the impacts (primarily energy, demand, and emissions savings) of energy efficiency programmes implemented in facilities, and for which energy and demand savings are the primary objectives. It clearly links the evaluation practices with the IPMVP options and presents the three generic classifications of savings determination approaches: measurement and verification, deemed savings, and large-scale consumption data analysis (using control groups). It also raised the question: "How good is good enough?" This question is a short version of asking (1) what level of certainty is required for energy savings estimates resulting from evaluation activities, and (2) is that level of certainty properly balanced against the amount of effort (e.g. resources, time, and money) used to obtain that level of certainty? This is also a basic question for (the level of) harmonisation of energy savings calculations, and as such also raised in the scoping study for a nation EM&V standard together with the additional one "as compared to what". In the scoping study report, the authors identify four high-level issues that need to be considered and addressed as part of developing a new national EM&V standard for energy efficiency resources:

1. What level of detail will be provided in the EM&V standard and how much flexibility will be left to professional discretion?
2. Will requirements be performance-based (i.e. a requirement for a level of certainty) or prescriptive (i.e. requiring certain EM&V approaches for any given efficiency activity)?
3. Who is responsible for documenting EM&V savings from energy efficiency resources that have been met as part of a national clean

energy resource standard - a state agency, administrators of ratepayer-funded energy efficiency programmes (e.g. utilities), or independent, third-party EM&V professionals?

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

To address these four high-level issues, the following nine issue topic categories were addressed as these were seen the most critical one for an entity designated in any future federal energy legislation to develop a national EM&V standard for energy efficiency:

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

The scoping study also suggests a draft outline for a national evaluation, measurement & verification standard, which is included in Annex D.

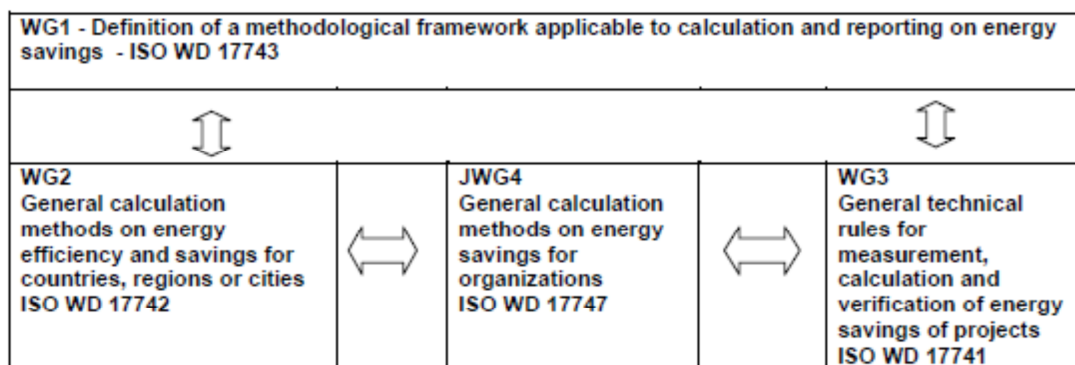
The Scoping Study to Evaluate Feasibility of National Databases for EM&V Documents and Measure Savings reports a widespread recognition of the usefulness of national, or at least regional, databases of deemed savings and algorithms. However many barriers would need to be overcome before developing such a resource that meets the needs of states. In general, the notion of creating a national resource was not considered readily possible, largely due to vast regional variations in baselines, weather, economics, demographics, equipment stocks, measure costs, programme structures, evaluation needs and, in particular, regulatory requirements. However, developing several regional databases is possible and in total could represent a national deemed savings and algorithms. Transparency in measure assumptions is required to gain acceptance, and a consistent methodology for collecting measure data is necessary, as well. To create a resource that could be used to compare savings across programmes or states, a high level of detail and guidance would be required for each measure to ensure transparency and reduce the likelihood of human errors. Another substantial challenge would be the constant updates required to adjust measure savings values based on ongoing research, changes in baselines, and new data.

## 4. Global harmonisation of energy savings calculations

Several organisations are working directly or related to other work streams on improving comparable energy savings calculations and/or energy data and figures. For the global harmonisation of energy savings calculation the ongoing work within the ISO is an important development, especially the work on general technical rules for determination of energy savings. Also the IMVP is a worldwide used method on project/company level, while also the IEA give attention to energy efficiency developments.

In 2011 the **International Organisation for Standardisation (ISO)** started follow-up work on energy savings and installed a Task Committee, **ISO/TC 257** dealing with “General technical rules for determination of energy savings in renovation projects, industrial enterprises and regions”. Workgroups are preparing draft documents to be discussed in meetings. After official voting, standards will become available by the end of 2013 or early 2014. Figure 2 presents an overview of the work programme of this Task Committee.

Figure 2: Work plan and working groups (WG) for ISA/TC 257



Early 2013 the draft standard “Measurement and Verification of Organisational Energy Performance — General Principles and Guidelines” became available for review and comment. This draft hold the same stepwise approach as presented ahead for the CEN Standard EN16212:2012. Like that standard it also presents a preferred order for the selection of the parameters and the formula to calculate unitary energy savings:

- 1) internationally accepted formula;
- 2) national accepted formula;
- 3) literature sources;
- 4) self-developed and documented.

Technical Committee **ISO/TC 242**, Energy Management deals with topics that are related to energy savings. Draft standards are under preparation for among others M&V (measurement and verification) of organisational

Energy Performance and for Measuring Energy Performance using Energy Baselines and Energy Performance Indicators.

The purpose of the first standard is to establish a common set of principles and guidelines to be used for M&V of Organisational energy performance. These principles and guidelines are considered universal and are applicable irrespective of the M&V methodology used. This International Standard does not specify calculation methods or methodologies; rather, it establishes a common understanding of M&V and outlines how M&V could be applied to different calculation methods and methodologies. The second draft standard provides guidance to organisations on how to meet the requirements of ISO 50001 related to the establishment, use and maintenance of energy performance indicators (EnPIs) and energy baselines (EnBs) as part of the process of measuring energy performance and energy performance changes. It is foreseen that both draft standards will be circulated for voting by mid-2013 and for publication by mid-2014.

The **International Performance Measurement and Verification Protocol (IPMVP)**, developed by the Efficiency Valuation Organisation (EVO), is a worldwide organisation exclusively dedicated to the development of measurement and verification standards and the evaluation of projects allowing energy efficiency as a resource. IPMVP "Concepts and Options for Determining Energy and Water Savings" Volume 1 (2012) is a guidance document describing common practice in measuring, computing and reporting savings achieved by energy or water efficiency projects at end user facilities. The IPMVP presents a framework and four measurement and verification (M&V) options for transparently, reliably and consistently reporting a project's saving. The report and additional one (on new constructions and renewable energy technologies) are available in different languages like French, German and Spanish at <http://www.evo-world.org>

EVO continues to update the IPMVP. For example, the 2012 updated edition of the 2010 IPMVP Volume 1 continues to make the protocol more useful to an international audience by responding to comments from all around the world. Highlights of changes in the 2010 edition include addition of new terms: "operational verification", "owners project requirements for M&V", "monitoring and targeting", and a Catalonian section to the Spain section. Additionally, EVO organises trainings for the understanding and use of the IPMVP.

The **International Energy Agency (IEA)** secretariat produces since many years a series of energy indicators in order to study energy use developments and analyse factors behind changes in energy use and CO<sub>2</sub> emissions. In 2005 the IEA, in co-operation with the Statistical Office of the European Communities (Eurostat), published the *Energy Statistics Manual*. This manual will help newcomers in the energy statistics field to have a better grasp of definitions, units and methodology. Most of the text



relates to general energy statistics concepts, but does not provide guidance on energy savings calculations. The IEA also organises workshops on energy efficiency and sometimes also focused on monitoring and evaluation; for example: "Meeting energy efficiency goals: enhancing compliance, monitoring & evaluation" (2008) and "Energy Efficiency Indicators Workshop" (2012). It is foreseen that in 2013 two new IEA publications will become available: *Manual on Statistics for Energy Efficiency Indicators* and *Manual on Analysis of Energy Efficiency Indicators*.

The IEA Implementing Agreement on Demand Side Management (IEA DSM) conducted some project related to energy savings: the International Database on Energy Efficient Programmes (INDEEP) and the IEA DSM Evaluation guidebook (2005). This Guidebook provides guidance for the evaluation of a broad range of energy efficiency programmes and is focused on providing guidance in matching research questions and methodological approaches on the one hand and to programme type and level of ambition on the other hand. Volume I deals with evaluation theory and recommends how evaluations for five types of policy measures and programmes should be conducted. This approach involves organising evaluations into seven key analytic elements:

- Policy measure theory used;
- Specification of indicators for the success of a measure;
- The baselines for the selected indicators;
- Assessment of outputs and outcomes;
- Assessment of energy savings and emissions reductions and other relevant impacts;
- The calculation of cost, cost-efficiency and cost-effectiveness;
- The level of evaluation effort.

Founded in May 2009, the **International Partnership for Energy Efficiency Cooperation (IPEEC)** is a voluntary, high-level forum of developed and developing countries that represent the major economies of the world. As of March 2011, IPEEC members include Australia, Brazil, Canada, China, The European Union, France, Germany, India, Italy, Japan, Mexico, Russia, South Korea, United Kingdom and USA.

In the IPEEC scope one of the areas is: methodologies of energy measurement, auditing and verification procedures, certification protocols and other tool to achieve optimal energy efficiency performance over the lifetime of building and industrial processes, relevant products, appliances and equipment. In practise the Tasks like Assessment of Energy Efficiency Financing Mechanism (AEEFM), Policies for Energy Provider Delivery of Energy Efficiency (PEPDEE), Superior Energy Performance Partnership (GSEP) and Policies through Energy Efficiency Indicators (IPEEI) concentrate more on workshops and general reports than (detailed) energy savings calculation. More information is available at <http://www.ipeec.org/TASKGROUPS.aspx>



## 5. Conclusion for future harmonisation for energy savings

At the end of 2012, after the publication of the CEN standard on energy savings calculations, there was no work within the foreseeable future for the European standardisation body. The CEN Taskforce has been discussing to develop more examples, but the funds to be able to start this work seem to be missing.

In Europe the new Energy Efficiency Directive (EED) provides a framework for calculating the impact of energy savings caused by individual actions. It also puts priority on energy providers' obligations while countries may also use other, alternative, policy and measures. The methods used for these policy and measures have to be reported by the end of 2013. In this manner, the Directive forces European countries to report in a transparent way as to how to conduct the Energy Savings Calculations (ESC) for individual actions; however it is unknown at this stage how these will turn out to be. The EED might stimulate work on lifetime of savings, as the target is a cumulative one, but countries may also continue to use the lifetimes as included in the CEN Workshop Agreement.

The EED might also stimulate the development of default values for energy savings calculations, especially for the energy providers' obligations, but at this moment no new action is progressing.

Therefore, for the moment the EED results in uncertainty on future needs for harmonisation on energy savings calculations, but some work will continue within the Concerted Action project and by early 2014 it will become more clear which actions will be needed and which will be supported.

In the USA, DOE aims to establish easy-to-follow protocols based on commonly accepted engineering and statistical method for savings for energy efficiency measures and implemented the Uniform Methods Project. In combination with more regional co-operations this DOE action continues to produce more harmonisation. For example, if the NEEP EMR&V forum states collectively are to implement the suggested Guidelines successfully, the region would benefit from a common "currency" of reported energy efficiency data to support multiple state and regional energy and environmental policies/objectives. Additionally, a discussion has started (in California) on the role of regulators and their rules on evaluation (including energy savings calculation) that might also stimulate more simple and more harmonised energy savings calculations.

ISO will continue to work on four different areas in order to provide very general standards including the one on energy savings calculations (for actions/projects) and it might *complete* the work within a year. However,

practical case examples are lacking but necessary for further development of such a standard. EVO will continue to maintain the IPMVP, but no major improvement for energy savings calculation is anticipated. Neither are targeted actions from the IEA or IPEEC expected in the near future.

This project, Task 21 within the IEA DSM Agreement, produced case applications for a small number of case applications all over the world and a template to document information on six key elements. This template contains a number of common elements with those suggested in USA reports. The appendices hold these structures. Additional work could be carried out as a follow-up within Task 21 using these USA national and regional proposals and experiences in application, the energy saving calculation methods provided by EU countries to the European Commission and produce more and more comparable case applications. Additional a 'tier' approach, as in use in the climate world (IPCC and UNFCCC) could be developed in line with the levelled approach in the energy world. With such an approach the use of different types of savings (measured, deemed, calculated, technical etc.) would be better combined with the different levels of calculation rules and efforts for data collection. While the harmonisation of energy savings calculations now concentrates on individual actions and individual programmes, policy developers become more interested in combinations/packages policies to get the desired changes in energy use. There might be a need to research how energy savings calculations for packages of policies and measures could be conducted in a (cost) efficient way ensuring no double counting.

The work conducted within Task 21 fitted well within the developments for harmonisation on energy savings calculations and provided input for e.g. CEN and ISO work. Its template could be combined with others, recently developed, to have a more harmonised one for collecting more case applications. This work will not be conducted by a standardisation body, because these will need more case applications to continue developments of standards.

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## **Annexes**

Annex A: Key elements for ESC; used in case applications of the IEA DSM Task 21

Annex B: International evaluation and energy savings calculation reports and guidelines

Annex C: National evaluation and energy savings calculation reports and guidelines (based on country reports)

Annex D: SEE Action Network, Draft Outline for Evaluation, Measurement & Verification National Standard

## **Annex A: Template energy savings calculation for case examples in IEA-DSM Task 21**

### **1 Summary of the programme**

- 1.1 Short description of the programme
  - 1.1.1 Purpose or goal of the programme
  - 1.1.2 Type of instrument(s) used
- 1.2 General and specific user category
- 1.3 Technology(ies) involved
- 1.4 Status of the evaluation and energy savings calculations
- 1.5 Relevant as a Demand Response measure

### **2 Formula for calculation of Annual Energy Savings**

- 2.1 Formula used for the calculation of annual energy savings
- 2.2 Specification of the parameters in the calculation
- 2.3 Specification of the unit for the calculation
- 2.4 Baseline issues
- 2.5 Normalisation
- 2.6 Energy savings corrections
  - 2.6.1 Gross-net corrections
  - 2.6.2 Corrections due to data collection problem

### **3 Input data and calculations**

- 3.1 Parameter operationalisation
- 3.2 Calculation of the annual savings as applied
- 3.3 Total savings over lifetime
  - 3.3.1 Savings lifetime of the measure or technique selected
  - 3.3.2 Lifetime savings calculation of the measure or technique

### **4 GHG savings**

- 4.1 Annual GHG-savings
  - 4.1.1 Emission factor for energy source
  - 4.1.2 Annual GHG-savings calculation as applied
- 4.2 GHG lifetime savings
  - 4.2.1 Emission factor
  - 4.2.2 GHG lifetime savings as applied

## **Annex B: Structure for the US Uniform Methods Project Protocols**

1. Measure Description—a brief description of the measure or measures covered by the protocol
2. Application Conditions of Protocol—details on what types of delivery channels or programme structure are or are not covered by the protocol
3. Savings Calculations—the prevailing algorithm(s) needed to estimate energy savings with explanation of parameters included
4. Measurement and Verification Plan—the recommended approach, including the IPMVP option, for determining values for the parameters required in the savings calculation
5. Sample Design—overview of considerations on how to segment the population in order to provide a representative sample for evaluation; in some protocols, this is discussed in conjunction with the M&V plan
6. Other Evaluation Issues—any additional information deemed pertinent by the author and/or reviewers, including brief discussions of persistence or NTG considerations; often this information is supplemented by the crosscutting protocols.

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

# Annex C: NEEP, Common State wide Energy Efficiency Reporting Guidelines, Table 1.0: Description of Reported Energy Efficiency Savings

|   |   |  |
|---|---|--|
| Jurisdiction/State: XXXXX   |   | Program Year: 20YY   |
| <b>1. General Information on Reported Data</b>  |   |  |
| 1.1 Final annual savings data reported in what quarter of the following program year.   | <input type="checkbox"/> 1st Qtr. <input type="checkbox"/> 2nd Qtr. <input type="checkbox"/> 3rd Qtr. <input type="checkbox"/> 4th Qtr.   |  |
| 1.2 Link(s) to supporting Program Administrator or State Annual Reports   | <a href="http://www.providelink.com">www.providelink.com</a>  |  |
| 1.3 Reported data can be characterized as: <ul style="list-style-type: none"> <li><input type="checkbox"/> <b>Tracking Estimates.</b> Where reported savings are based on year-end tracking data that incorporate impact factors from previous year evaluation studies, but where impact factors are the same ones used to project savings in the program year Energy Efficiency Plan filings.</li> <li><input type="checkbox"/> <b>Savings Estimates Informed by Program Year Evaluation.</b> Where adjustments are made to Tracking Estimates based on program year evaluation activities (e.g., third party review such as verification of installations, impact evaluations, etc. Please generally describe types of EM&amp;V activities:<br/>_____</li> </ul> <p><b>Are evaluation results systematically incorporated into following year Savings Tracking Estimates?</b></p> <input type="checkbox"/> Yes or <input type="checkbox"/> No |   |  |
| <b>2. Gross Savings</b>   |   | <b>Applied to Some or All Programs?</b>  |
| <b>2.1 Adjusted Gross Energy Savings</b><br><br>Please indicate types of adjustments made to Gross Energy Savings (or that are included in Realization Rate). Indicate if adjustments are made to some or all programs/measures. (Check all that apply)   | Adjustments include: <ul style="list-style-type: none"> <li><input type="checkbox"/> Data Errors</li> <li><input type="checkbox"/> Measure Persistence Factor</li> <li><input type="checkbox"/> Savings Persistence Factor</li> <li><input type="checkbox"/> In-Service Rate</li> <li><input type="checkbox"/> Interactive Effects</li> <li><input type="checkbox"/> Other _____</li> <li><input type="checkbox"/> Other _____</li> </ul> | <input type="checkbox"/> Some or <input type="checkbox"/> All Programs<br><input type="checkbox"/> Some or <input type="checkbox"/> All Programs<br><input type="checkbox"/> Some or <input type="checkbox"/> All Programs<br><input type="checkbox"/> Some or <input type="checkbox"/> All Programs<br><input type="checkbox"/> Some or <input type="checkbox"/> All Programs<br><input type="checkbox"/> Some or <input type="checkbox"/> All Programs<br><input type="checkbox"/> Some or <input type="checkbox"/> All Programs |
| <b>3. Net Savings</b>   |   | <b>Applied to Some or All Programs?</b>  |
| <b>3.1 Net Savings</b><br><br>Indicate types of adjustment incorporated in reported net savings. (Check all that apply.)  | Adjustments include: <ul style="list-style-type: none"> <li><input type="checkbox"/> Free Ridership</li> <li><input type="checkbox"/> Participant Spillover</li> <li><input type="checkbox"/> Non-Participant Spillover</li> <li><input type="checkbox"/> Other _____</li> </ul>  | <input type="checkbox"/> Some or <input type="checkbox"/> All Programs<br><input type="checkbox"/> Some or <input type="checkbox"/> All Programs<br><input type="checkbox"/> Some or <input type="checkbox"/> All Programs<br><input type="checkbox"/> Some or <input type="checkbox"/> All Programs   |



| 4. Generation and Meter Level Savings   |   |
|---|---|
| <p><b>4.1 Generation Level Savings</b><br/> <b>Definition:</b> Meter or premise level savings adjusted upward for T&amp;D line losses. Generation level savings are also known as wholesale level savings.</p> <p><b>4.2 Meter Level Savings</b><br/> <b>Definition:</b> Savings at the customer meter or premise level. Indicate types of adjustments to Generation Level Savings</p>  | <p>If reported definition differs from definition to the left, please describe:<br/>         _____</p> <p>Adjustments include:<br/> <input type="checkbox"/> T&amp;D Adjustments - Utility specific values (or weighted avg): _____<br/> <input type="checkbox"/> T&amp;D Adjustments - Other source(s), please describe: _____</p> |
| 5. Supporting State Energy Savings Assumptions and EM&V Process Information   |   |
| <p><b>5.1 Supporting Savings Data and Assumptions.</b> For more detailed information regarding supporting data, refer to:</p> <p>a) [STATE] Program savings documents (or technical reference manuals): <a href="http://www.providelink.com">www.providelink.com</a><br/>         b) [STATE] or [PA] Energy efficiency program plans: <a href="http://www.providelink.com">www.providelink.com</a><br/>         c) Program administrator annual reported data, where applicable: <a href="http://www.providelink.com">www.providelink.com</a><br/>         d) [STATE] achievable potential studies: <a href="http://www.providelink.com">www.providelink.com</a><br/>         e) Other _____</p> <p><b>5.2 Review and Approval of Reported Data.</b> The savings and cost information reported have been reviewed and/or approved by (check those that apply):</p> <p><input type="checkbox"/> [STATE PUC]<br/> <input type="checkbox"/> [STATE ENERGY OFFICE]<br/> <input type="checkbox"/> Other _____</p> <p><b>5.3 Evaluation, Measurement and Verification (EM&amp;V) Protocols/Methods.</b> The EM&amp;V protocols or methods used to support the reported savings are based on and/or include (check those that apply):</p> <p><input type="checkbox"/> State PUC prescribed guidelines/methods: <a href="http://www.providelink.com">www.providelink.com</a><br/> <input type="checkbox"/> Energy Efficiency M&amp;V standards required by regional system operator [ISO New England] OR [PJM] for demand resources participating in the wholesale electricity forward capacity markets: <a href="http://www.providelink.com">www.providelink.com</a><br/> <input type="checkbox"/> The Regional EM&amp;V Forum Methods and Savings Assumptions Guidelines: <a href="http://www.providelink.com">www.providelink.com</a><br/> <input type="checkbox"/> Other (Describe) _____</p> |   |
| 6. Sources of Funding For Reported Energy Efficiency Activities (check all that apply):   |   |
| <p><input type="checkbox"/> Electric Ratepayer Funded Programs<br/> <input type="checkbox"/> Natural Gas Ratepayer Funded Programs<br/> <input type="checkbox"/> Regional Greenhouse Gas Initiative (RGGI) Allowance Proceeds<br/> <input type="checkbox"/> Wholesale capacity market revenues (ISO NE Forward Capacity Market/PJM Reliability Pricing Model)<br/> <input type="checkbox"/> Weatherization Assistance Programs (WAP)<br/> <input type="checkbox"/> American Recovery and Reinvestment Act (ARRA) Funds<br/> <input type="checkbox"/> Other (Describe): _____</p>  |   |

## **Annex D: SEE Action Network, Draft Outline for Evaluation, Measurement & Verification National Standard**

### Table of Contents

#### Acronyms

1. Executive Summary
  - a. Brief introduction to process and document
  - b. Purpose of document
  - c. Summarise key requirements
2. Introduction and Background
  - a. Purpose of this document - summarise appropriate Commission/DOE regulations and enabling legislation
  - b. Describe the period of time covered by this standard
  - c. Indicate contents
3. Energy Efficiency Activities covered by the Framework
  - a. Define the energy efficiency activities covered
4. Evaluation Principles, Objectives and Metrics
  - a. Evaluation principles that drive the effort - high level items
  - b. High level evaluation objectives
  - c. Key portfolio metrics
    - i. Energy numbers (include annual and/or life cycle, and per hour, month, year, etc.)
      1. kW (net/gross) (First year/Lifecycle) (recommend both)
      2. kWh (net/gross) (First year/Lifecycle) (recommend both)
      3. Therms (net/gross) (First year/Lifecycle) (recommend both)
    - ii. Costs and other benefit data
    - iii. Market transformation metrics
    - iv. Other
5. Evaluation Cycle
  - a. Describe the evaluation cycle with respect to the EM&V activities and reporting
  - b. Hierarchy of planning steps for each cycle
    - i. EM&V Standard (this document)
    - ii. Per Cycle Portfolio-level EM&V Plan
    - iii. Detailed research plans; these will be prepared for each EM&V effort (market and per programme or portfolio process and impact evaluations)
6. Scale and Certainty
  - a. Expectations for savings determination certainty
    - i. Best practices
    - ii. Control for systematic error via documentation and best practices, trained experts, etc.

- iii. Control for random sampling error by defining a confidence and precision level of at least 80/20 for any sampling to be done
- 7. Transparency and Reporting
  - a. High level statement about transparency and reporting of analyses subject to customer confidentiality
  - b. Overall schedule for reporting during each cycle; high level discussion of what will be covered in the EM&V reports and when they will be delivered
  - c. Report expected contents
  - d. How is impact evaluation savings applied? – looking back/going forward
- 8. Evaluation Methods and Key Assumptions
  - a. What impact evaluation approaches will be used and how will they be selected?
  - b. Baselines against which savings are judged (existing standards, codes and standards, dynamic baselines)?
  - c. Deemed savings and deemed calculated savings “values”
  - d. How and when will this source of values be updated?
  - e. Performance will be reported on basis of net or gross savings? What is included in net savings (free riders, spillover, etc.)?
  - f. Whether (and if so, at which point in the reporting process) T&D savings considerations included
  - g. How ‘granular’ will the results be?
- 9. Who Will Conduct The Evaluations?
  - a. How is independent evaluation defined?
  - b. Process for 3rd party consultant selection
- 10. Data Management Strategies
  - a. Tracking system requirements to be used
  - b. How this system will be used for QA/QC and reporting
- 11. What is data submittal process and dispute resolution process?

Attachments:

Definitions of key terms

High level content outlines of required documents and reports