Northwest Power and Conservation Council

June 29, 2011

MEMORANDUM

TO: Power Committee

FROM: Charlie Grist

SUBJECT: Transmittal of RTF Guidelines for the Development and Maintenance of RTF Savings Estimation Methods

Staff will brief the Committee on the purpose of the Guidelines and their transmittal to the Council.

The Guidelines describe how the RTF selects, develops and maintains approved methods for estimating savings from the delivery of energy efficiency measures. The Guidelines are a major step forward for the RTF. They embody a significant update to decision criteria which were originally adopted more than a decade ago.

Ultimately, the energy savings estimates of the RTF should provide an appropriate level of quality and reliability for the region's stakeholders. The process and decision rules used by the RTF should be clear and transparent. The RTF seeks the Council's determination on whether these Guidelines achieve those goals. The RTF anticipates that the Council will seek advice from its RTF Policy Advisory Committee and other regional stakeholders on the Guidelines, their application, and implications.

Attachments:
Transmittal letter from RTF
Power Point Presentation
Guidelines (Release 6-1-11)

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Steve Crow
Executive Director

503-222-5161
800-452-5161
Fax: 503-820-2370

Transmittal of RTF Guidelines

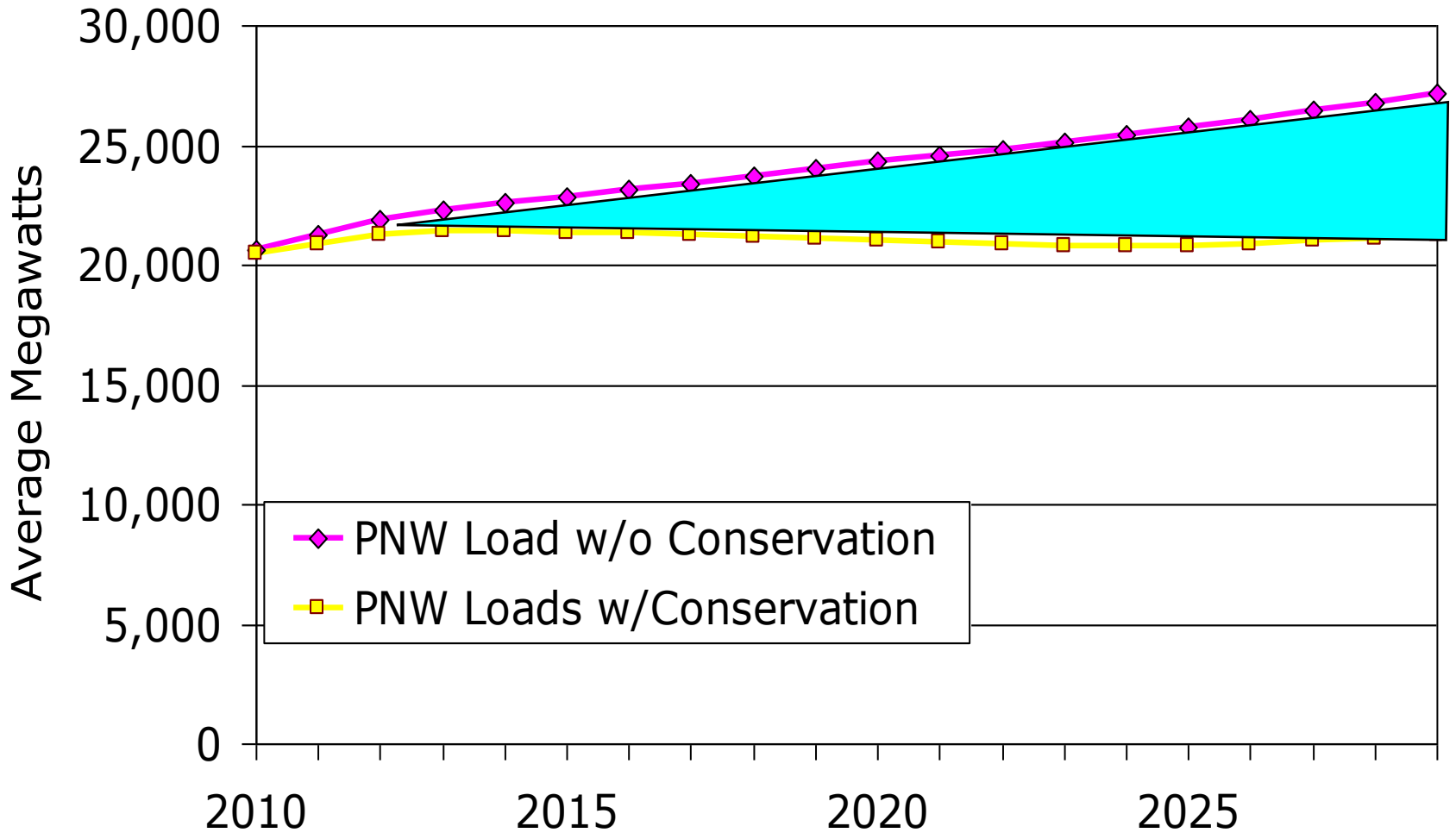
POWER COMMITTEE

JULY 12, 2011

RTF Develops Savings Estimates and Methods that Utilities & Regulators Can Rely On

- Increasing Need for Reliable Estimates of Savings
- Provides Centralized & Unbiased Technical Review
  - Energy Savings Data & Assumptions
  - Cost-Effectiveness Methodology & Assumptions
  - Standard Protocols & Guidelines for Savings Estimation
- Builds on Empirical Data & Historic Experience
- Provides Peer Review in an Open Public Forum
  - Vetting Claims, Identifying Uncertainties
  - Keeping Up with Changes
  - Establish Standards of Proof

RTF Plays a Pivotal Role in the Council's 6th Power Plan by Measuring the Savings



Development of the RTF *Guidelines*?

- RTF operated for 10 years transparently but its "rule book" evolved with experience
- *Guidelines* development began in the fall of 2010 to codify 10 years of experience
- Scope of *Guidelines* grew to encompass all the RTF methods for estimating savings
- Developed over 8 months of intensive engagement by the full RTF (utilities, regulators, staff and consultants)
- Now forwarding *Guidelines* to be examined by the Power Council and the RTF Policy Advisory Committee

Guidelines Scope and Intent

- "..describe how the RTF … selects, develops and maintains approved methods for estimating savings from the delivery of energy efficiency measures."
- "Four savings estimation methods … unit energy savings (UES), standard protocol, custom protocol and program impact evaluation."
- "..intention that each method will produce savings estimates of comparable reliability .." at the lowest reasonable cost

RTF's Responsibilities Under the *Guidelines*

- Two responsibilities
  - Approval
    - Unit Energy Savings (UES) values – Stable savings per unit
      - Example: kWh per CFL delivered by retail sales
    - Standard Protocol: Development of "Simplest Reliable Estimation Method" – Prescriptive methods to calculate variable savings
      - Example: Calculator for savings from Variable Speed Fan
  - Advice
    - Custom Protocols: Guidance on good practices and documentation standards
    - Program Impact Evaluation: Guidance on good practices and peer review of research designs

Why Council Input in Guidelines?

- Guidelines set forth the process, data quality, and reliability standards used by the RTF
- Standards rely on research & evaluation conducted outside the RTF
  - Utilities, Bonneville, the Energy Trust of Oregon, NEEA, and others
- Implementation of the Guidelines will likely require increased regional investments in research and program impact evaluation
  - Significant financial and resource implications for utilities, Bonneville, the Energy Trust of Oregon, NEEA, and regulators, as well as the RTF itself
- Seek advice from its RTF Policy Advisory Committee on the Guidelines, their application, and implications
  - Four policy issues identified during formulation of Guidelines

Regional Technical Forum

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
503-222-5161 fax 820-2370
www.nwcouncil.org/rtf

June 1, 2011

MEMORANDUM

TO: **Bruce Measure, Council Chair**

FROM: **Tom Eckman, RTF Chair**

SUBJECT: **RTF Guidelines for the Development and Maintenance of RTF Savings Estimation Methods**

I am pleased to forward to the Council the Regional Technical Forum's (RTF) Guidelines for the Development and Maintenance of RTF Savings Estimation Methods (Guidelines). The Guidelines set forth a proposed process and criteria to be employed by the RTF to select, develop, and maintain methods for estimating savings from energy efficiency measures. The Guidelines describe how the RTF will judge whether the quality of the data and/or analytical methods is sufficient to produce reliable savings estimates. The process, data quality, and reliability standards set forth in the Guidelines rely on research and evaluation conducted outside the RTF by utilities, Bonneville, the Energy Trust of Oregon, the Northwest Energy Efficiency Alliance (NEEA), and others.

In the judgment of the RTF, the implementation of the Guidelines will require increased regional investments in research and program impact evaluation. Consequently, the adoption and use of the Guidelines by the RTF could have significant financial and resource implications for utilities, Bonneville, the Energy Trust of Oregon, NEEA, and regulators, as well as the RTF itself. The RTF anticipates that the Council will seek advice from its RTF Policy Advisory Committee and other regional stakeholders on the Guidelines, their application, and implications.

Background

The RTF is directed by its Council charter to:

- Develop standardized protocols for verification and evaluation of energy savings from efficiency measures;
- Track regional progress toward the achievement of the regional conservation targets embodied in the Council's power plan; and
- Provide analysis and advice on potential efficiency measures for the Council's power planning.

The Guidelines embody the key elements of what is needed to accomplish the first two objectives. The RTF embarked on the task of developing the Guidelines to clarify and increase the transparency

of the process and standards by which it makes its recommendations on energy savings for efficiency measures. The development and codification of the Guidelines was driven by four factors.

First, the increasing regional magnitude of investments in and reliance on energy efficiency as an energy resource is a key driver. Over the past three decades the region has met half of its load growth through the development of energy efficiency resources. The Council's Sixth Power Plan envisions that the region could meet over 85 percent of future load growth with efficiency resources. The increased reliance on energy efficiency necessitates that greater attention be paid to determining the actual impact of investments in energy efficiency. Utility demand for the reliable savings from efficiency programs is more critical than ever.

Second, the RTF has not formally updated its decision criteria and processes since they were originally adopted in the late summer of 2000. Over the past decade, the RTF has grown and matured and the demands for its services have rapidly expanded. During this period, the RTF informally adopted processes and decision criteria that either expanded on or amended its original rules of engagement. Consequently, the specific criteria and processes used by the RTF to arrive at its decision are neither clear nor transparent to many of the region's stakeholders. Therefore, the RTF determined that a formal update and codification of its process and criteria was needed.

The third force driving the revision and codification of the Guidelines was the recognition that experience from the last decade demonstrated the high value of measuring performance of efficiency measures and practices. Findings from field research and impact evaluations have provided invaluable insights which have lead to significant adjustments, both up and down, to savings estimates, revised program approaches, and the addition of significant new measures to the regional portfolio. Direct measurement of efficiency savings was the foundation of the RTF's original decision criteria and they underpin the quality standards embedded in the Guidelines. Unfortunately, research and impact evaluation efforts have not kept pace with the expansion of efficiency programs nor the sheer number of new and/or unique measures delivered via these programs. The Guidelines imply expansion of research efforts and also present the opportunity for significant economies of scale through cooperative approaches targeting and conducting research.

Finally, the RTF is tasked with tracking progress toward the achievement of the regional conservation targets embodied in the Council's power plans. As the RTF has conducted its work it has become apparent that there are different methods to measure and report savings being used by utilities, Bonneville, regulators, and independent evaluators across the region. These Guidelines are specifically intended to control only RTF actions by specifying how the RTF selects, develops, and maintains its savings estimates. However, the Guidelines also set forth standards that could inform and influence approaches used by others or which could be used to bring more consistency to regional measurement and reporting of energy savings if they were adopted by other parties in the region.

Guideline Deployment and Evolution

The Guidelines are a work in progress. The RTF developed the Guidelines over the last eight months with significant engagement of the region's utilities, the Energy Trust of Oregon, Bonneville, and regulatory commission staff. The RTF believes the Guidelines have been vetted sufficiently to begin using them. Therefore, the RTF intends to use the Guidelines to review its existing library of savings estimates and protocols for estimating savings as well as to review prospective new measures. This process will allow the RTF to test the pragmatic workability of the

Guidelines. The RTF fully anticipates that this will lead to revisions and refinements. Consequently, the RTF seeks the Council's and other stakeholders' views on the following questions/issues:

- Transparency. The Guidelines were created in part to clarify the RTF's decision-making process and allow for its consistent application across the body of RTF-approved savings estimation methods. Are the criteria and processes used by the RTF clear and transparent in the Guidelines?

- Quality and Reliability Standards. Are the quality and reliability standards for savings estimation appropriate and consistent with the region's policy direction for efficiency programs?

- Resource Requirements. The quality and reliability standards in the Guidelines will likely require increased regional investments in research and program impact evaluation. If the resources required to satisfy the quality and reliability standards in the Guidelines are appropriate, is the region prepared to increase its investments in research and evaluation to meet these needs? Application of the guidelines will also present opportunities for cost savings through cooperative efforts. What role should the RTF play in any such coordination?

Policy Issues Identified During the Formulation of the Guidelines

The RTF is also keenly aware that these Guidelines have implications for the research and evaluation activities performed by utilities, Bonneville, the Energy Trust of Oregon, and NEEA. The development of the Guidelines has identified several policy level issues that warrant input from the Council and regional stakeholders. The RTF has deliberately deferred work on these topics because it was determined that policy guidance was necessary prior to addressing their associated technical issues. A brief summary of these issues appears below.

- Regional Savings Reporting Standards. Foremost among the policy issues identified by the RTF is whether there should be regional reporting standards and if so, should the RTF be charged with their development. One of the RTF's duties is to report regional progress towards energy savings goals. This is accomplished through a survey of all regional utilities, Bonneville, and the Energy Trust of Oregon. But reported savings are not necessarily derived through the use of consistent methods and criteria. Thus reported savings are not necessarily comparable between utilities, or to Council power plan targets. Should the RTF Guidelines eventually establish regional reporting standards for savings? In particular, can consistent and reliable reporting of efficiency savings be defined in a way that is practical for public, private, and federal entities and provide comparability to the Council's power plan efficiency targets? If so, what elements of this task should the RTF be charged with?

- RTF Role in Research Funding. As drafted, the Guidelines assume that utilities, the Energy Trust of Oregon, Bonneville, NEEA, and others will be funding and conducting the primary research required by the RTF to support the quality standards. At this time, the RTF does not envision that it would carry out significant primary research. What role should the RTF play in identifying, developing, coordinating, and managing regional research?

- RTF Review of Impact Evaluation. As drafted, program impact evaluation plans may be brought to the RTF for review and the RTF may advise utilities on those plans if asked. Impact evaluation results may be considered by the RTF for use in developing RTF estimates of savings. However, the Guidelines do not envision the RTF reviewing impact evaluation results to opine on their validity in regulatory proceedings. Should the RTF be called on to review others' impact evaluations?

- Process for Addressing Measures found out of Compliance with the Guidelines. The RTF is planning to review its entire current library of 90+ Unit Energy Savings measures under the Guidelines over the next 12 months. It is anticipated that some measures will be found to be out-of-compliance with the proposed quality standards or reliability standards. The Guidelines specify a process and timeline for bringing these measures into compliance. Is this process and timeline appropriate?

Council Advice

The Guidelines are a major step forward for the RTF. They embody a significant update to decision criteria which were originally adopted more than a decade ago. Ultimately, the energy savings estimates of the RTF should provide an appropriate level of quality and reliability for the region's stakeholders. The process and decision rules used by the RTF should be clear and transparent. We look forward to the Council's advice on whether these Guidelines achieve those goals.

GUIDELINES FOR THE DEVELOPMENT AND MAINTENANCE OF RTF SAVINGS ESTIMATION METHODS

REGIONAL TECHNICAL FORUM

Release Date: June 1, 2011

TABLE OF CONTENTS

1. Scope and Purpose

The purpose of this document is to describe how the Regional Technical Forum (RTF) selects, develops and maintains methods for estimating savings from the delivery of energy efficiency measures. Four savings estimation methods are defined: unit energy savings (UES), standard protocol, custom protocol and program impact evaluation. It is the RTF's intention that each method will produce savings estimates of comparable reliability sufficient to meet the needs of regional energy planners. These methods are also expected to support regulatory processes related to the adoption and planning of energy efficiency initiatives.

The RTF plays two roles in implementing these savings estimation methods. For the UES and standard protocol methods it approves detailed estimation procedures that can be directly applied to estimating savings for specific instances of delivered measures. For the custom protocol and program impact evaluation methods, the RTF provides more general guidance and relies on programs operated by individual utilities, Bonneville Power Administration (BPA), the Energy Trust of Oregon (ETO) and Northwest Energy Efficiency Alliance (NEEA) to implement this guidance in estimating savings.

1.1. Key Terms

The following key terms are used throughout this document. Their definitions are critical to the correct interpretation of the RTF's intent for each of the savings estimation methods.

1.1.1. Measure

A measure is one or more changes in system configuration, equipment specifications or operating practices that reduces electric power consumption as a result of increases in the efficiency of energy use, production, or distribution. Measures may be further defined by their specific application. Specific measure applications may be defined by characteristics of the affected building, end use, system, equipment or location. For example, wall insulation may be applied to single family residences, with basements, located in the climate zone west of the Cascade Mountains. Specific measure applications may be further distinguished by the method of a measure's delivery. For example, efficient showerheads for single family residences may be delivered via mail-by-request, retail outlets or direct installation.

1.1.2. Commissioning

Commissioning is the process of testing and adjustment required to ensure that the measure is operating according to its design intent.

1.1.3. Savings

Savings is defined as the difference in energy use between the baseline (prior to measure delivery) and post (after measure delivery) periods which is caused by the delivery of a measure.

1.1.4. Sunset Criteria

Sunset criteria specify the conditions under which an RTF-approved method for estimating the savings of a measure (see section 1.2) can be used. In many instances a criterion will be a date beyond which the savings estimation method is no longer RTF-approved. Many other factors can reduce the reliability of an RTF-approved savings estimation method for a specific measure, e.g., passage of revised energy codes, adoption of new federal standards or shifts in current practices of consumers. All important factors are considered in forming the sunset criteria for a measure's savings estimation method.

1.1.5. Provisional

Provision savings estimation methods are those which the RTF approves with special conditions requiring the collection of data from all or a sample of specific measure applications. These data are used by the RTF to improve the reliability of the savings estimation method.

1.2. Savings Estimation Methods

Four savings estimation methods are defined by these guidelines. For the first two methods –Unit Energy Savings and Standard Protocol –, the RTF approves detailed estimation procedures. For the third and fourth methods – Custom Protocol and Program Impact Evaluation – the RTF provides more general guidance.

1.2.1. Unit Energy Savings (UES)

The UES method is appropriate for measures whose unitized savings, e.g., savings per lamp or motor, is stable (both the mean and variance) and can be reliably forecast through the period defined by the measure's sunset criteria. In addition the data available on key estimation parameters and the estimation procedure used in establishing the unit energy savings meet the minimum quality requirements described in section 3.2. The UES method reduces program delivery cost by simplifying the data that must be collected. Programs are only required to collect a verified count of delivered units, plus the information needed to assign a specific application of the measure, e.g., single family residence with forced air furnace west of the Cascade Mountains, to the correct UES. Delivery is defined by the specification of each measure and its specific applications. Total savings is the UES multiplied by the number of delivered units.

1.2.2. Standard Protocol

A standard protocol method is appropriate when savings from a measure are widely varying but can be determined by a standardized procedure for data collection and analysis that is applicable to many different end use sites. Quality standards and other guidance related to standard protocols are found in section 4. Standardization of data collection reduces cost by eliminating or minimizing the need for site-specific measurement planning. Standardization of the analysis procedure also reduces the planning burden and ensures uniform quality in the analysis product. In addition, standardization reduces the skill level needed to reliably estimate savings and too perform quality assurance activities.

1.2.3. Custom Protocol

Custom protocols are appropriate for measures that require site-specific data collection and analysis in order to develop a reliable estimate of savings. Guidance concerning skill and documentation requirements for custom protocols is found in section 5. Highly skilled and experienced practitioners are required to design and implement custom protocols. Custom protocols require site-specific documentation of the data collected and how that data are used in estimating savings.

1.2.4. Program Impact Evaluation

The program impact evaluation method involves the analysis of randomly sampled program participants (and possibly non-participants) to determine the savings achieved during a period of program delivery. Guidance concerning research designs for program impact evaluations is presented in section 6. The research designs for impact evaluations vary widely and yield program-level savings estimates covering the delivery of a group of measures during a period of program operation.

1.3. Development Process for Savings Estimation Methods

There are many steps in the development process for savings estimation methods, starting with the specification of a measure and concluding with a reliable method for estimating savings for that measure. The process begins (see Figure 1) when regional research and development and program design activities supply information on feasible measures. Each measure is classified and prioritized as shown in Figure 1 and then travel one of four paths, corresponding to each of the four savings estimation methods.

As shown, UES measures have two pathways, one of which allows legacy measures (those approved prior to the adoption of these guidelines) special treatment. National and regional studies contribute information about UES measures; leading to a determination of whether it is practical to develop reliable UES values. If not, the measure can be reclassified as needing a standard protocol. Also shown in the figure is the role played by provisional status in the development of UES values.

Figure 1 illustrates the development steps for standard protocol measures. As shown, the development path is determined by the availability of adequate data to prove the reliability of the protocol. As with UES measures, provisional status and the associated data collection effort play an important part in establishing reliable standard protocols.

Measures associated with custom protocols and program impact evaluation travel on similar paths. In both cases, the RTF develops and approves general guidelines, but relies on programs operated by individual utilities, BPA, the ETO and NEEA to implement this guidance in estimating savings.

As shown in the figure there are relationships between program impact evaluation and the other RTF savings estimation methods:

- **Impact Evaluation of UES Measures**. RTF-approved UES values provide reliable estimates of savings. Only simple forms of program impact evaluation (limited to claim and delivery verification described in section 6) are required for these measures.
- **Impact Evaluation of Standard Protocol Measures**. If program implementers faithfully apply RTF approved standard protocols for all or a sample of delivered measures the savings estimates for these measures can be treated as reliable estimates. Impact evaluation need only confirm that the standard protocol has been followed.
- **Creation and Updates of UES Values and Standard Protocols**. Studies utilizing program impact evaluations techniques such as sampling, performance measurement, statistical estimation, and engineering modeling, are used to estimate savings for UES measures and to support the development of standard protocols.

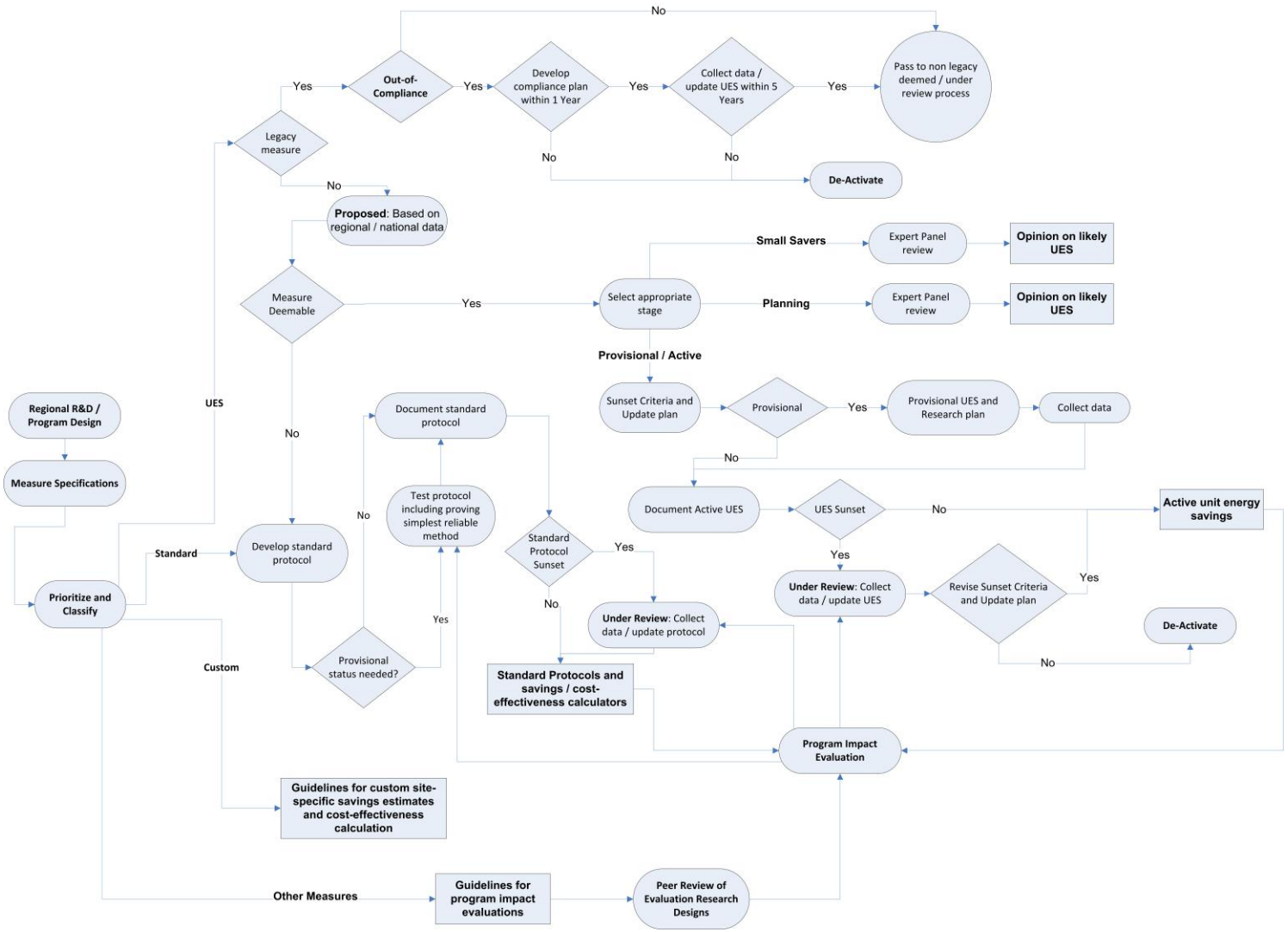


Figure 1: Development of Savings Estimation Methods

2. MEASURE SPECIFICATION

Before a measure can be considered by the RTF, the following specifications must be provided so that an informed decision can be made about the most appropriate savings estimation method. This information also helps the RTF select the best strategies for developing the information required for savings estimation.

2.1. Measure Identifiers

Measure identifiers are the characteristics that uniquely identify each separate savings value. Measure identifiers must be clearly described and limited to those characteristics data that can be reliably obtained by the programs so that the correct savings are estimated for each delivered measure. Separate savings values may be estimated for specific applications of a measure. For example, a single family weatherization measure may have separate UES for attic and floor insulation (measure types). In addition, the specific applications may be identified by end user, equipment, and program design characteristics. These include, but are not limited to, heating or cooling climate zones, heating and cooling system types, delivery method, size range, and efficiency category.

2.2. Savings Baseline

Measure savings must be determined against clearly defined baseline conditions. Each unique savings value must be associated with one of the following definitions of baseline conditions:

2.2.1. Current Practice

A current practice baseline is used for measures delivering new equipment or practices, e.g., ENERGY STAR® specifications for new homes. When using this baseline, any equipment or practices serving the same end use function are assumed to have no remaining useful life. For these measures the baseline is defined by the recent typical choices of eligible end users in purchasing new equipment and services. These choices may be inferred from data on shipments, purchases (equipment or services) or selected design / construction features. For example, the baseline for more efficient televisions is the average efficiency of recent television shipments. The RTF may also determine that current state and local building codes or federal standards provide a reliable definition of the baseline for these measures. As a general rule the RTF will use a baseline that is characterized by current market practice or the minimum requirements of applicable codes or standards, whichever is more efficient. Major renovations that are covered by codes and standards use this baseline. Incremental measure cost is used in determining cost-effectiveness of current practice measures. Current practice incremental cost is defined as the difference between the average cost of current practice and the average cost of the measure.

2.2.2. Pre-Conditions

A pre-conditions baseline is used when the measure-affected equipment or practice still has remaining useful life. The baseline is defined by typical existing conditions found among eligible end users. For example, the baseline for agricultural motor replacements is defined by the average efficiency and operating hours of in-service agricultural motors. If savings are based on existing conditions then the full cost of the measure is used in determining cost-effectiveness. Before using a pre-conditions baseline, the RTF must have evidence that a significant portion of measure applications will only occur if incentives offsetting the full cost are provided as opposed to incentives adequate to offset the incremental costs associated with a current practice baseline. The use of the terms upgrade, replacement and conversion in describing a measure all indicate that savings for the measure are estimated using a pre-conditions baseline.

2.3. Implementation Standards

Measures may involve equipment, practices or both. Whatever the nature of the measure, there must be standards that govern its implementation. These standards must specify procedures for measure design, installation and commissioning and may also include provisions for independent third party quality assurance. In addition, training required for staff that performs each of these functions should be specified. These standards must be clearly documented so that they can be correctly accounted for in the estimation of savings.

2.4. Product Standards

Some measures involve equipment or building components that must meet or exceed certain performance specifications. These performance specifications may be substantiated by standardized test procedures. These specifications must be clearly documented so that they can be correctly accounted for in the estimation of savings. Some measures may encompass a range of specifications, such as the seasonal energy efficiency rating (SEER) for cooling equipment, with each level of the rating defining a specific measure application. Separate savings values may be required for each variation on the specification.

2.5. Savings Estimation Method

Measure savings may be determined by one of the four methods described in section 1.2. Appendix A provides a checklist of criteria that can be applied in determining the appropriate savings estimation method. It can also be used to track the status the measure during the UES development process.

3. UNIT ENERGY SAVINGS (UES)

This section describes the requirements for obtaining RTF approval of UES values. This method is appropriate for measures whose unitized savings, e.g., savings per lamp or motor, is stable (both the mean and variance) and can be reliably forecast through the period defined by the measure's sunset criteria. In addition the data available on key estimation parameters and the estimation procedure used in establishing the unitized savings meets the minimum quality requirements described in section 3.2. The UES method reduces program delivery cost by simplifying the data that must be collected. Programs are only required to collect a verified count of delivered units, plus the information needed to assign a specific application of the measure, e.g., single family residence with forced air furnace west of the Cascade Mountains, to the correct UES. Delivery is defined by the specification of each measure and its specific applications. Total savings is the UES multiplied by the number of delivered units.

3.1. UES Estimation Procedures

A UES estimation procedure for each measure must be fully described (section 3.4). The description must include the methods used to derive all key input parameters and model(s) used to derive the UES values. Three types of estimation procedures are allowed:

3.1.1. Statistical

The UES estimate may be derived from statistical analysis of baseline and efficient case energy use for reliable random samples of relevant customers or end uses. Such measurements of energy use can be used to estimate typical savings for a population that are representative of the likely future participants. Statistical designs can include comparison of randomly selected treatment and control groups or pre/post measurements for a treatment group. The quality of these estimates is judged primarily by the relative error of the mean savings estimate. It is also critical to determine whether there are systematic errors (biases) associated with sampling or measurement procedures that reduce or increase savings for all or a portion of the sample studied.

Statistical estimation procedures are not recommended for UES measures whose savings significantly interact with other measures, e.g., concurrent lighting wattage reductions and lighting control measures or electronic thermostats and ductless heat pumps. This is because the cost of studies large enough to estimate savings for all combinations of interactive measures is likely to be prohibitive. However, statistical estimation may be appropriate for a highly interactive measure if the measure has a short effective useful life, during which the interactions with other measures are likely to be insignificant.

3.1.2. Meta-Statistical

In some cases, relatively small statistical studies are conducted by a number of different agencies. None of these studies alone provide sufficient confidence in the UES estimate. However, the RTF may determine that a value in the range of savings demonstrated by these studies constitutes a sufficiently reliable estimate. Meta-statistical estimation is not recommended for measures whose savings significantly interact with other measures.

3.1.3. Calibrated Engineering

There are many instances where statistical or meta-statistical procedures are not practical or where they are not the best choice. In those instances, UES may be estimated with calibrated engineering procedures. These procedures rely on unbiased measurements to establish input values for key parameters of an engineering model. The model may be a simple equation, such as multiplying a change in efficiency rating by average capacity by average hours of operation. In other cases, more complex bin, regression or simulation models may be used. Models may be calibrated to individual cases or to the average characteristics and consumption of groups. In some cases, the estimation may be carried out via a series of models. For example, a meta-statistical result for percent savings from single family electronic thermostats is multiplied by typical heating consumption for such homes with the heating consumption derived from calibrated hourly simulation of typical homes.

Calibrated engineering estimates may be based on measurement and modeling of savings for randomly selected end users. Alternatively, they may be any group of program participants, if the RTF determines that the group is sufficiently representative of likely future participants.

For savings estimates derived from calibrated engineering procedures there are five factors that must be considered in judging the quality of the procedure:

3.1.3.1 Input Parameters

The data supporting each baseline and efficient case input parameter must be documented and determined to be reliable. A key consideration is whether the values are expected to be different for the RTF region based on factors such as existing building stock characteristics, demographics, climate, and energy prices. In some cases, appropriate normalization of national or other-regional data may overcome the need for region-specific estimates. This may require that critical normalization parameters, e.g., efficiency rating of televisions, be gathered during program delivery. If normalization of national or other-regional data is not possible, or not sufficient, then region-specific data sources are required. The RTF may consider the relative importance of each parameter in determining what data collection is needed to establish reliable values. For some parameters, which are not primary determinants of measure savings, the RTF may rely on consensus opinion from a panel of experts in lieu of primary data collection.

3.1.3.2 Model Calibration

In most cases, calibrated engineering procedures will involve at least one stage of modeling in which baseline and efficient case energy consumption are estimated for the measure-affected end use. For example, the heating load for single family homes is estimated as part of the derivation of UES for ductless heat pump conversion. A simulation model is used to derive the heating end use for typical homes in different climate zones. Ideally, the model would be calibrated to measured heating end use for a sample of homes. If end use data are not available, the model should at least be calibrated to metered total use for the sample. Calibration should also be performed for samples that have adopted the measure, i.e., the efficient case. For measures that affect new buildings the calibration may be limited to the efficient case or to comparable buildings of recent vintage.

3.1.3.3 UES Components

Often savings are estimated for separate UES components. For example, this is common for measures that reduce water and energy use. One portion of the estimation procedure will derive the UES component associated with energy savings at the site where the measure is delivered. Another UES component will be separately estimated based on the reduction in energy used to deliver water to the end use site. A reliable modeling procedure for each UES component must be separately described.

3.1.3.4 Interactions between Measures

In many cases the savings of one measure depends on whether another measure is already implemented. For example, savings from high performance windows depends, in part, on whether increased wall insulation is already implemented. Another example is the interaction between electronic thermostats and ductless heat pumps. The UES for each measure should be computed under the assumption that all other measures it interacts with are already implemented. The other measures assumed to be present should be consistent with expected typical conditions at the end of the measure's effective useful life. This "last-in" requirement may create a downward bias in the short-term savings estimate for a measure. An alternative estimate of UES may be prepared using different assumptions about what other measures have already been implemented. Both UES estimates must be presented to the RTF along with the justification for which should be used. The measure's sunset criteria may include consideration of the rate of implementation for the other interactive measures.

3.1.3.5 Heating/Cooling Interactions

Some measures reduce the waste heat rejected to conditioned spaces or distribution systems. Reduction in waste heat results in increased primary heating consumption and decreased primary cooling consumption. The amount of the interaction varies based on heating/cooling system type, envelope and distribution system characteristics, climatic conditions, and other variables. The

savings estimation procedure must include appropriate adjustments to UES savings to account for these interactions or provide an explanation as to why the interactions are not significant.

3.2. Quality Standards for UES Estimates

The following standards will be applied by the RTF to determine the quality and reliability of UES values.

3.2.1. Planning

The RTF may, if requested, provide expert panel review of planning UES values. The quality standard for a planning UES is reserved for measures that do not meet the requirements of provisional or active quality, but would benefit from a peer review process by the RTF. Planning UES values may be needed by individual utilities, BPA, the ETO and NEEA for planning purposes, such as the operation of pilot programs, setting incentive levels for measures with uncertain savings, initial estimates of cost-effectiveness, or regional coordination. The review will only be provided if:

- There is a reasonable expectation that data are available or can be collected that will ultimately support RTF approval for measure savings, determined by one of the four RTF savings estimation methods addressed by these guidelines.
- The RTF expert panel review has sufficient usefulness and applicability in the region.
- Sound engineering and statistical analyses are performed to develop the planning UES estimate.

3.2.2. Provisional

Provisional UES values may be approved if the following criteria are met. For statistical or meta-statistical estimation procedures

- The statistical findings are determined to be sufficiently reliable, even if the level of reliability is less than that required for active UES values.
- The programs delivering the measure commit to collecting data according to the study design.

For calibrated engineering estimation procedures:

- Reliable data are available to characterize the baseline[1] consumption for measure-affected end uses.

[1] As defined in section 2.2.1, baseline for new construction is defined by current practices (construction and operation) for the affected end use that would have been implemented in the absence of the efficiency measure. As these conditions cannot be directly observed, reliable data is developed by engineering modeling or measurement of control groups that implement similar practices.

- Any models used in the estimation procedure have been calibrated, at a minimum, to baseline energy consumption.
- Sound engineering and statistical analyses are performed to develop the UES estimate.
- A study design has been developed that is likely to result in data on efficient-case energy consumption that will support RTF approval for active UES values.
- The programs delivering the measure commit to collecting data according to the study design.

3.2.3. Active

Active UES values may be approved if the following criteria are met. For statistical or meta-statistical estimation procedures:

- The statistical findings are determined to be sufficiently reliable.

For calibrated engineering estimation procedures:

- Reliable data are available to characterize both the baseline[2] and efficient-case energy consumption for measure-affected end uses.
- Sound engineering and statistical analyses are performed to develop the UES estimate.
- Any models used in the estimation procedure have been calibrated, at a minimum to both baseline and efficient-case energy consumption.

3.2.4. Standard for Reliability

The RTF, after having been presented with full documentation of the estimation procedure and the supporting data, will determine whether any UES estimate is sufficiently reliable. This determination will be based on many factors, including sample size, sample design, validity of the model specification, model calibration and measurement errors. Measure cost-effectiveness will not be a consideration in determining whether the UES estimate is sufficiently reliable. For example, if a measure had a benefit to cost ratio of 10 there might be a tendency to allow for less reliable primary data by applying a large discount factor to the UES. By resisting this tendency the RTF ensures that both the absolute magnitude of the savings estimate and the estimate of cost-effectiveness are reliable.

3.3. Development Process

This section describes the stages of development for a UES measure. The development process begins with a proposal to develop UES values, incorporating all the specification data required in section 2, and ends with the de-activation of the measure. Between these two points the stages of

[2] See footnote 1.

development are defined by the quality and nature of the primary data available to support the savings estimates and the RTF-assigned sunset criteria.

At various stages in the development process UES estimates are given sunset criteria. The criteria set the conditions under which the UES estimates may be used to calculate savings. In many instances the criteria will be a date beyond which UES values are no longer RTF-approved. For others, the criteria may involve factors such as a maximum delivered quantity. All these factors should be considered in creating appropriate sunset criteria for each measure as defined in section 1.1.4.

The following stages of development are defined by the sunset criteria and the quality and nature of the available primary data.

3.3.1. Proposed

Any party can propose a new UES measure. The proposal must provide the measure specification information described in section 2, a preliminary description of the savings estimation procedure, and an estimate of the total achievable regional savings potential. Estimates of measure effective useful life and cost (incremental or full depending on the baseline, see section 2.2) must also be provided. The proposal may be to establish small saver, planning, provisional or active UES. Appendix A provides a checklist that can be used by the proposer to determine whether all required information has been assembled. This same checklist can also be used in all subsequent development stages.

3.3.2. Small Savers

The RTF may determine that the likely savings from a measure are too small to warrant the resources needed to meet the section 3.2 UES quality criteria for provisional or active status. In making this determination, the RTF will consider the size of the regional end use that is affected by the measure or the magnitude of the likely savings. Measure specifications (section 2) and the information described above for the proposed stage is required for small savers and must be provided before the RTF can designate a measure as a small saver. For small savers, the RTF may choose to convene an expert panel to consider the proposed measure and to formulate a consensus opinion on the likely UES values. This process is intended to promote consistent treatment of these measures throughout the region not to confer RTF-approval on the proposed UES values.

3.3.3. Planning

Upon request, the RTF will convene an expert panel to consider the proposed planning measure and to formulate a consensus opinion on the likely UES values. This process is intended to promote consistent treatment of these measures throughout the region. It does not confer RTF-approval on the planning UES values. The panel will also review and comment on any proposed research design for collecting data needed to support provisional or active UES values. The review will only be

provided if the section 3.2.1 UES quality criteria for planning measures are satisfied. Measure specifications (section 2) and the information described above for the proposed stage must be provided before this review can commence.

3.3.4. Provisional

Measures can obtain provisional approval if the section 3.2.2 UES quality criteria for provisional measures are satisfied. In addition, it must be possible during the provisional period to obtain the data and analyses needed to meet the active quality criteria (3.2.3). The data and analyses may come from programs delivering the measure or from other studies. The plan for completing the necessary data collection and analyses must be approved along with the provisional UES estimates. In addition, sunset criteria must be adopted that are consistent with the plan. For measures that require long periods to collect and analyze baseline and efficient case data, the plan should include staged analyses so that early experience with deployment, baseline conditions, and measure performance can be used to adjust the sunset criteria.

3.3.5. Active

Measures can obtain approval for active status if the section 3.2.3 UES quality criteria for active measures are satisfied. Sunset criteria will be assigned by the RTF along with a plan for data collection and analysis that allows the UES estimate to be reviewed and updated in a timely fashion.

3.3.6. Under Review

At any time prior to the sunset criteria being met, the RTF may decide to place a measure under review. This may be the result of a review of the UES savings estimation procedure or the availability of new sources of information for baseline or efficient-case consumption. The UES values will remain "RTF-Approved" while the measure is under review. As a result of the review, the UES values may be re-estimated and the measure sunset criteria revised.

3.3.7. De-Activated

If the sunset criteria are met, and the new or revised UES estimates have not been approved, the RTF will deactivate the measure. This means that the UES estimates are no longer approved by the RTF. The RTF may decide to deactivate a measure before the sunset criteria is satisfied based on unanticipated factors, such as the adoption of new energy codes or the release of study results with findings that invalidate the UES values or the procedures for estimating those values.

3.3.8. Out-Of-Compliance

The RTF may determine that measures approved prior to the adoption of these guidelines do not comply with one or more requirements of these guidelines. The UES estimates for these measures

will continue to be "RTF-Approved" if a plan for bringing the measure into compliance is approved by the RTF within one year following the RTF determination that the measure is out-of-compliance. If no plan is approved within one year, the measure will be de-activated. The RTF intends that all out-of-compliance measures will be reclassified, i.e., become a standard protocol or be placed in one of the UES measure development stages of small saver, planning, provisional, de-activated or active, as soon as possible, but no later than five years following the adoption of these guidelines.

3.4. Documentation Standard

Throughout the life cycle of a UES measure the primary vehicle for the estimation of measure UES and documentation of the data sources and estimation procedures is a Microsoft Excel® workbook. A primary workbook is created at the time a measure is proposed. The first standardized sheet in the workbook is called Summary. Appendix B provides an example of a summary sheet. As a measure moves through its life cycle it accumulates versions of the Summary sheet.

A Summary sheet consists of four sections

- **Measure Classification and Properties**. This section includes: market sector, market segment, measure category, measure description (including references to important specifications and eligibility requirements), sunset criteria, primary workbook, linked workbooks, and a description of the number of measures and UES components for which UES values are estimated.
- **Measure Identifiers**. This section documents the identifiers of the specific measure applications for which UES values are estimated. The table lists the possible values for each identifier, e.g., heating zones 1, 2 and 3, and provides further explanation and relevant sources that support each identifier. Collectively, these identifiers define the all the possible measure applications. Measure Type is the only required identifier. For some measure categories there is only one measure type, e.g., high efficiency televisions. For others there can be many measure types, such as each type of residential single family weatherization treatment, e.g., wall and ceiling insulation.
- **Constant Parameters**. This section lists all of the key input parameters whose values do not vary between baseline and efficient case for a measure. If these constants have different values across the specific measure applications, the constants for each of those applications are described. The table also contains further explanation and sources for each of these constants.
- **Unit Energy Savings (UES) Estimation Method, Parameters and Sources**. This section documents the analysis used to derive the UES for each of the UES components for each measure type. Primary parameters or adjustment factors are listed for each UES component, along with their baseline and efficient case values. The sources for each of these values are also listed.

When a measure is initially proposed, the Summary sheet can be used to document the expected estimation procedure and data sources. The Summary sheet along with preliminary analysis of

savings would be the basis for an RTF decision on whether to take the measure under consideration. From that point forward, versions of the Summary sheet must be retained and labeled with the RTF adoption date in the primary Excel workbook. This facilitates easy comparisons so that the RTF and others can see what changed between the versions. When a new version of the primary measure workbook is created, the previous version should be stored in an archive folder with a date range (indicating the period the UES values were approved for use) appended to the workbook filename.

4. Standard Protocols for Site-Specific Savings Estimates

This section describes the requirements for RTF approval of a standard protocol for savings estimation and a procedure for developing such protocols. Standard protocols support estimation of savings for a measure at specific end user sites. The extent of data collection and analysis required by the protocol is the minimum level needed for reliable savings estimation. Standardization of data collection reduces cost by eliminating or minimizing the need for site-specific measurement planning. Standardization of the analysis procedure also reduces the planning burden and ensures uniform quality in the analysis product. Standardization reduces the skill level needed to reliably estimate savings.

4.1. Quality Standards for Standard Protocols

4.1.1. Minimum Requirements

All standard protocols approved by the RTF must meet the following requirements:

- Precise specification of the measure including eligibility rules.
- Simplest reliable savings estimation procedure.
- Entirely prescriptive data collection and analysis procedure that will work for all eligible measures.
- Independent of program design and delivery method.
- Skills required are common among the region's program implementation workforce.
- Protocol is cost-effective across a range of measure savings.
- Yield savings estimates that are additive, i.e., independent of the savings from other measures implemented at the same site.
- Protocol documentation that complies with section 4.3.

4.1.2. Transparent and Accessible Savings Calculator

Each protocol must provide a transparent and accessible savings calculator. The calculator must accept exactly the data that are required by the protocol. The calculator must be implemented using computer software that is generally accessible and reasonably priced for all practitioners in the region. The software must either be inherently transparent, such as a Microsoft Excel® workbook that does not rely on extensive macro coding, or it must be fully documented. Fully documented means the exact algorithms for all calculations are completely described in a document accessible to all practitioners or that the analysis method is documented along with the results of a validation process, similar to ASHRAE Standard 140, which demonstrates the comparability of the method to other accepted calculation methods.

4.2. Development Process

This section describes the stages of development for a standard protocol. The development process begins with the definition of a best practice standard for data collection and analysis. Best practice data are assembled, or if necessary collected during a provisional stage for a sample of sites. These best practice data are used to establish the simplest reliable savings procedure.

4.2.1. Definition of Best Practice Reliablity Standard

The development of the protocol for a measure begins by assembling site-specific data that support a best practices savings estimate. Best practice data should include the following:

- Complete descriptions of the measure and the affected systems and equipment.
- Enough information about the site and its operation to support the identification of the primary determinants of consumption for affected systems and equipment.
- True power measurements or reliable methods for estimating true power of affected systems or equipment.
- Measurements of the primary determinants of consumption for the affected systems and equipment, such as flow or outside temperature.
- Measurements of less expensive and less technically challenging surrogates for the primary determinants, such as damper position instead of flow, which will support the development of the simplest reliable savings estimation method.
- Trend logs for baseline and post (after measure delivery) periods that are of sufficient duration to represent most of the variance in energy use and its determinants.

Best practice data are used to estimate savings for each site. This estimate should take full advantage of the measurements of true power and the direct determinants of consumption. This best practice savings estimate provides the benchmark against which the reliability of estimates derived with simpler methods can be tested.

4.2.2. Definition of Simplest Reliable Savings Estimation Method

One of the requirements for a standard protocol (section 4.1.1) is that it be the simplest reliable method for estimating savings for a measure. A precise definition of reliability is difficult to enforce across all standard protocols, but in general, any method that produces savings estimates within +/- 20 percent of the best practice method (across a representative sample of best practice examples) should be considered sufficiently reliable. However, in addition to considering the range of the error, it is necessary to consider whether the simplified procedure is biased. A method that is always 20 percent high or 20 percent low for all tested cases would not be considered reliable.

One or more simplified savings estimation procedures should be developed for each measure and tested against the best practice method. Following are examples of the types of simplifications that should be considered:

- Combining trend logs of current with one time measurements of true power to estimate a trend log for true power.
- Estimating the primary determinants for consumption, such as flow, by measuring a simple surrogate and applying default performance curves.
- Combining one-time measurements of baseline conditions or default performance curves with post-period trend logs of system/equipment utilization to estimate baseline consumption and performance.
- Reducing the duration of either baseline or post-trend log periods.

The standard protocol should be based on the simplest and least expensive method that provides reliable savings estimates.

4.2.3. Provisional Status and Data Requirements

In some cases, the number and quality of best practice examples are not adequate to support the definition of the simplest reliable savings estimation method. In those cases, the protocol can be granted provisional status. This provisional version will require best practice data collection in addition to the data needed for the development of the simplest reliable method. Programs which use this protocol agree to provide the data that are collected to the RTF so that they can be used to complete the development of the protocol. Once a simplified method is proven reliable, the standard protocol documentation and associated calculator will be modified to be consistent with that method. Sunset criteria must be assigned to provisional standard protocols.

4.2.4. Under Review Status

At any time prior to the sunset criteria being met the RTF may decide to place a standard protocol under review. A standard protocol may be placed under review for a number of reasons including: concerns about the reliability of the data collection or savings estimation procedures, proposals to change the definition of the measure, or the availability of new sources of best practice data. The

standard protocol will remain "RTF-Approved" while it is under review. As a result of the review, the RTF may approve changes to the standard protocol and adopt new sunset criteria.

4.3. Documentation Standard

A standard protocol consists of two parts. The first is a Microsoft Word® document that describes the protocol. Appendix C contains an example that demonstrates the structure of this document. The second part is a transparent and accessible calculator that can be used to compute savings for the measure in a fashion that is consistent with the protocol.

The template for the protocol document requires the following information.

- **Purpose**. Defines the measure and key features and objectives of the protocol.
- **Sunset Criteria**. Defines the conditions under which the standard protocol is approved for use. This may be a date beyond which the protocol cannot be used. It may also involve other factors at the discretion of the RTF.
- **Definition of Key Terms**. Definition of terms that aid in making the language of the protocol concise. Terms are not included if they would be commonly known to the practitioners who have sufficient skills to conduct data collection and analysis in accordance with the protocol.
- **Eligible Measures**. Specifies the types of measures that can use this protocol to create an RTF approved estimate of savings. Listing types of measures that are not eligible can be just as important as listing those that are eligible.
- **Required Knowledge and Skills of Practitioner**. Describes the required knowledge and skills for practitioners that will use the protocol to estimate savings.
- **Required Commissioning**. This is not a complete list of all relevant commissioning tasks. It is a short list that if completed allows the practitioner to be confident that a reliable savings estimate can be achieved during the measurement period specified by the protocol.
- **Data Collection Requirements**. Exact description of the data that must be collected during the baseline and post periods. Alternative measurements may be specified that exceed the minimum requirements as in some cases these alternative measurements may be easier to obtain. Data needed to assess life cycle costs and benefits are also described.
- **Savings Estimation Steps**. Describes the computational algorithm that can be found in the accompanying calculator for estimating savings and life cycle costs and benefits.
- **Sampling Procedure**. If applicable, this section describes the allowed method for sampling units. Sampling is applicable when it is common for the measure to be implemented in large quantities of units at a single site. This is not a procedure for sampling sites that implement the same measure.
- **Relationship to Other Protocols and Guidelines**. Discusses compliance with and relevant relationships to other protocols, such as *International Performance Measurement and*

Verification Protocol (Efficiency Valuation Organization - http://www.evo-world.org) and *M&V Guidelines: Measurement and Verification for Federal Energy Projects* (US Department of Energy - http://www1.eere.energy.gov/femp/pdfs/mv_guidelines.pdf), and guidelines such as those maintained by BPA and other regional utilities and agencies.

- **Estimate of Typical Cost**. Provides a listing of the major tasks that must be performed to implement the protocol for a typical measure and estimates the hours and costs (labor and non-labor) associated with this work.
- **Provisional Data Collection**. Describes special data collection that is required during the period of provisional RTF approval for a protocol (see section 4.6). Once the protocol obtains full approval from the RTF, these data collection requirements are no longer in force.
- **User's Guide to Savings Calculator**. A step-by-step guide to using the accompanying calculator.

4.4. Sampling Application of Standard Protocols

The application of standard protocols to a sample of sites may be warranted under two conditions:

- **Collecting Data Needed to Develop the Protocol**. The development of a standard protocol will require new data collection, if insufficient best practice data are available from national or regional sources. Data from a sample of sites, (during the provisional stage as defined in section 4.2.3) will provide sufficient information to develop the simplest reliable estimation procedure.
- **Using the Protocol for Program Impact Evaluation**. Once the simplest reliable estimation procedure has been proven, the standard protocol can be deployed by programs to estimate savings. Standard protocol savings estimates are only required for a sample of sites that is sufficient to reliably estimate total program savings. The treatment of these standard protocol samples for program impact evaluation is further discussed in section 6.2.

5. Custom Protocol for Site-Specific Savings Estimates

Custom protocols are appropriate for measures that require site-specific data collection and analysis in order to develop a reliable estimate of savings.

5.1. Required Knowledge and Skills of Practitioner.

The practitioner with lead responsibility for estimating savings for a custom protocol measure must have a full understanding of the following:

- Factors that determine the energy use of the affected end use system(s) and the proposed measure, e.g., the impact of outside air temperature on the performance of a chiller.
- Appropriate safety procedures relevant to the end use facility, affected system(s) and the required measurement equipment.

- These guidelines and the guidelines enforced by the program delivering the measure.

The practitioner must also be able to successfully perform the following tasks:

- Conduct all required inspections of the affected system(s) and extract necessary data from related documentation and end user records.
- Supervise licensed trades in taking required measurements.
- Install and operate required data collection equipment and obtain necessary trend logs from facility control systems.

5.2. Site-Specific Savings Estimation Plan

A site-specific plan must be formulated for each custom protocol measure that will result in a reliable estimate of savings for the measure. If the plan specifies baseline data collection, that data must represent typical conditions found at the site during the baseline period. Similarly, the plan must represent typical conditions after measure delivery (post-period). The plan must specify the data analysis and modeling to be used to estimate savings and must call for the collection of all data needed to satisfy the input requirements of the savings estimation model.

Frequently, various aspects of the planned data collection and analysis will need to be adjusted as they are implemented. There is no general requirement to formally document either the initial plan or updates to the plan as they occur. Such formal documentation requirements for the plan are left to the discretion of the program delivering the measure. However, the as-implemented data collection and analysis must be documented in the site-specific savings report described in the next section.

5.3. Site-Specific Savings Report

A site-specific savings report must be prepared that contains at least the information listed below. Other reporting requirements may be specified by the utility delivering the measure.

- **Measure Description**. Description of the baseline and post-period conditions of the affected system(s). Includes a summary of the measure and the mechanism by which it changes energy use.
- **Measure Commissioning**. Description of the inspection procedure, testing, and documentation review completed by the practitioner to determine whether the measure was fully operational during the post-period.
- **Data Collection**. Description of the data collected during the baseline and post periods. All measurement points should be enumerated along with the calendar period of data collection, the data logging interval, sensor type and placement, and data logging method. All other data directly relevant to the savings calculation such as equipment performance specifications should be listed along with the source of the information.

- **Sampling Procedure**. If applicable, this section describes the method for sampling units. Sampling is applicable when the measure comprises a large quantity of units at a specific site. The sampling objective should be described, such as estimating the mean unit capacity, along with the information available for the population of units that allows for the relative error of the sample to be tested. The target relative error for any sampling must not exceed +/- 20 percent at a confidence level of 80 percent.
- **Savings Estimation**. Description of the computational procedure used to estimate the change in use for all affected fuels. All input assumptions and the source of each must be documented.

6. Program Impact Evaluation

Program impact evaluations estimate gross and net savings from a period of program operation. Programs vary widely in delivery method, target markets and delivered measures. Programs are operated in this region by a wide variety of agencies: individual utilities, BPA, the ETO and NEEA. Private retail utilities and the ETO operate under the oversight of state regulators and public utilities have a similar relationship to general or special purpose local governmental boards. Impact evaluations should be designed to achieve reliable estimates of savings while accommodating the special requirements of the program's delivery methods, target markets, efficiency measures, operating agency, and regulatory environment.

6.1. Impact Evaluation of Active UES Measures

The evaluation of savings from the delivery of active UES measures involves two steps. The first is to verify the number of units that were delivered. The second is to apply the correct RTF-approved UES value to the delivered units.

6.1.1. Verification of Delivered Units

There are two methods for verification of delivered units for UES measures. These methods only apply to measures with RTF-approved active UES (3.3.5) values. Measures with small savers (3.3.2), planning (3.3.3), or provisional (3.3.4) UES values should be addressed by other program impact evaluation techniques, see section 6.3.

- **Claim Verification**. Program operators track the delivery of measures under each program and claim savings for each period of program operation based on these accomplishments. Each program's design must include methods for proving measure delivery. Such proof varies based on program delivery design and efficiency measure. An upstream program might document shipments of efficient products to distributors or retail outlets, by type of product. At the other extreme, a custom grant program might require documentation from detailed post-period site inspection of the delivered measures. Impact evaluations that verify the savings claim will involve random selection of delivered measures and independent review of the delivery proof.

They also involve verification that the sampled measures are accurately recorded in the tracking systems used to summarize savings for a program period.

- **Delivery Verification**. Unlike the claim verification, which is based entirely on review of paper and electronic records, delivery verification involves physical inspection of delivered measures. In the upstream example, this might involve inspection of distributor inventory to confirm that the efficient products are reaching their intended destinations. At the other extreme, for a custom grant program, this might involve inspection of the end user facility to confirm that equipment or practices funded by the grant are in place and operational. These delivery inspections should be performed for a random sample of delivered measures.

6.1.2. Estimation of UES Measure Savings

The next step in the evaluation process is to associate the correct RTF-approved UES value with each delivered unit. Information is obtained; either from documentation or direct inspection, needed to match the units to the measure specifications (see section 2). A UES value is associated with each delivered unit that is consistent with the latest version of RTF-approved values prior to the program delivery period. Savings for the units delivered during a program period can then be computed as the sum of the delivered count multiplied by the respective UES value for each measure.

6.2. Impact Evaluation of Standard Procotol Measures

The evaluation of savings from the delivery of standard protocol measures involves two steps. The first step is to verify that the measure was delivered by inspecting the documentation provided, which in all cases includes evidence that the measure was commissioned (see section 4.3). The second step is to confirm that the program faithfully applied the RTF-approved standard protocol (latest version approved prior to measure delivery) in estimating savings. Savings are accepted as estimated if faithful application of the protocol is confirmed. Savings for standard protocol measures that do not satisfy this condition would be addressed by other impact evaluation techniques (section 6.3)

6.3. Other Impact Evaluations

Other impact evaluation techniques are needed to estimate savings from delivered measures which are not covered by RTF-approved active UES values or standard protocols. A wide variety of research designs may be deployed to accomplish these estimates. Each of these designs must be adapted to the particular needs of the program operator (individual utilities, BPA, the ETO and NEEA) and its regulatory agency or governing board. These research designs may benefit from regional peer review, which may also foster collaborative research. Those charged with developing these designs should take advantage of the substantial regional and national literature which provides guidelines and protocols for impact evaluation.

6.3.1. Peer Review of Evaluation Research Designs

The RTF will play a clearinghouse role for regional collaboration on impact evaluation. Its particular focus will be research that is needed to support the development of provisional and active UES values and standard protocols, but all relevant and useful research will be considered. Parties may bring proposed research to the RTF for review. The RTF will not directly fund such research, but if it determines the research is important it will facilitate peer review of the research design and regional coordination leading to implementation. The RTF will work closely with NEEA's Northwest Research Group in accomplishing these tasks.

6.3.2. Evaluation Guidance and Protocols

Substantial work has been done by many organizations on the development of guidelines and protocols that aid researchers in designing program impact evaluations. Guidelines and protocols that should be considered in the design of impact evaluations include the following.

- Evaluation Methods for Achieving Diverse Energy-Efficiency Policy Objectives --Webinar (both audio and supporting materials). (http://www.cee1.org/eval/webinar.php3).
- Energy efficiency Guidebook for Public Power Communities (Chapter 14 on evaluation), prepared by Energy Center of Wisconsin. (http://www.ecw.org/publicpowerguidebook/)
- Model Energy Efficiency Program Impact Evaluation Guide, part of the National Action Plan for Energy Efficiency. (http://www.epa.gov/RDEE/documents/evaluation_guide.pdf).
- Scaling-Up Energy Efficiency Programs: The Measurement Challenge, prepared by the Alliance to Save Energy to showcase the critical importance of effective evaluation, measurement and verification (EM&V) of energy savings, especially as the U.S. continues to witness unprecedented growth in investments for energy efficiency. (http://ase.org/uploaded_files/6338/AllianceToSaveEnergy-Measurement_Challenge.pdf).
- California evaluation protocols (http://www.calmac.org/events/EvaluatorsProtocols_Final_AdoptedviaRuling_06-19-2006.pdf).
- California Evaluation Framework (http://www.calmac.org/publications/California_Evaluation_Framework_June_2004.pdf).
- American Evaluation Association's Guiding Principles for Evaluators (http://www.eval.org/Publications/GuidingPrinciplesPrintable.asp).
- Code of standards and ethics set by the Council of American Survey Research Organizations (http://www.casro.org/pdfs/10CodeOfStandards.pdf).

In addition, the RTF has developed additional regionally specific protocols governing the design of program impact evaluations (see Appendix D). These protocols cover sample design, requirements

for program tracking systems, data collection procedures, statistical savings estimation methods, and engineering savings estimation methods.

Appendix A – Guidelines Checklist

Appendix A is found in the file *Appendix A - Guidelines Checklist (6-1-2011).docx*. This file contains a blank version of the checklist.

Appendix B – UES Measure Summary Sheet

Appendix B is found in the file *Appendix B - UES Measure Summary Sheet (6-1-2011).xlsm*. This file contains a blank version of the Summary sheet. It also contains an example of completed Summary sheet for a residential, single-family, weatherization measure.

Appendix C – Standard Protocol Example and Template

Appendix C is found in the file *Appendix C - Standard Protocol Example and Template (6-1-2011).docx*. This file contains an example (Fan VFD) of a standard protocol. The example illustrates the documentation requirements for a standard protocol.

Appendix D – Program Impact Evaluation Protocols

Appendix D will be included in a future release of these guidelines.