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|  | **PENNSYLVANIA**  **PUBLIC UTILITY COMMISSION**  Harrisburg, PA. 17105-3265 |  |

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|  | Public Meeting held August 29, 2013 |
| Commissioners Present: |  |

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| Robert F. Powelson, Chairman | | |  |
| John F. Coleman, Jr., Vice Chairman  Wayne E. Gardner | | |  |
| James H. Cawley | | |  |
| Pamela A. Witmer | | |  |
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| Implementation of the Alternative Energy Portfolio  Standards Act of 2004: Standards for the Participation  of Demand Side Management Resources – Technical  Reference Manual 2014 Update | Docket No. M-2012-2313373  M-00051865 |

**2014 TRM ANNUAL UPDATE Tentative Order**

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**BY THE COMMISSION:**

As explained in our Order, entered June 1, 2009 at Docket No. M-00051865, in implementing the Alternative Energy Portfolio Standards Act (AEPS Act), 73 P.S. §§ 1648.1‑1648.8 and 66 Pa.C.S. § 2814,this Commission had adopted an *Energy‑Efficiency and DSM Rules for Pennsylvania’s Alternative Energy Portfolio Standard, Technical Reference Manual* (TRM).[[1]](#footnote-1) In adopting the original version of the TRM, this Commission directed its Bureau of Conservation, Economics and Energy Planning (CEEP)[[2]](#footnote-2) to oversee the implementation, maintenance and periodic updating of the TRM.[[3]](#footnote-3) Additionally, in the *Energy Efficiency and Conservation Program* Implementation Order for Phase I of Act 129’s Energy Efficiency and Conservation (EE&C) Program,[[4]](#footnote-4) this Commission adopted the TRM as a component of the EE&C Program evaluation process. In that Phase I Implementation Order, this Commission also noted that “as the TRM was initially created to fulfill requirements of the AEPS Act, it will need to be updated and expanded to fulfill the requirements of the EE&C provisions of Act 129.”[[5]](#footnote-5)

Soon after the adoption of the EE&C Program Phase I Implementation Order, Commission staff initiated a collaborative process to review and update the TRM with the purpose of supporting both the AEPS Act and the Act 129 EE&C program that culminated in the adoption of the 2009 TRM at the May 28, 2009 Public Meeting.[[6]](#footnote-6) In adopting the 2009 TRM, the Commission recognized the importance of updating the TRM on an annual basis.[[7]](#footnote-7)

With regard to Phase II of the Act 129 EE&C Program, the Commission again adopted the TRM as a component of the EE&C Program evaluation process.[[8]](#footnote-8) The *Phase II Implementation Order* also recognized the importance of the continued use of an annual updating process for the TRM for Phase II.[[9]](#footnote-9) With this Tentative Order, the Commission advances the fifth annual update of the TRM to be applied beginning with the 2014‑2015 AEPS Act and Act 129 EE&C Program Phase II compliance year.

**BACKGROUND**

Act 129 of 2008, P.L. 1592, specifically directed this Commission to establish an evaluation process that monitors and verifies data collection, quality assurance and the results of each electric distribution company’s (EDC) EE&C plan and the EE&C program as a whole. *See* 66 Pa. C.S. § 2806.1(a)(2). To assist in meeting this obligation, the Commission contracted with GDS Associates, Inc. in August 2009 and again in February 2013, to perform these duties as the Act 129 Statewide Evaluator (SWE). As part of its duties, the SWE is to review the TRM and the Total Resource Cost Test Manual (TRC) and to provide suggestions for possible revisions and additions to these manuals. A program evaluation group (PEG)[[10]](#footnote-10) was formed to, among other things, provide guidance to the SWE in clarifying energy savings measurement protocols and plans by recommending improvements to the existing TRM and other aspects of the EE&C program. In addition, the Commission convened a Technical Working Group (TWG)[[11]](#footnote-11) meeting to discuss the proposed 2014 TRM updates.[[12]](#footnote-12)

As indicated above, the Commission has previously updated the TRM on four other occasions. On each occasion, the Commission used a process, similar to the current process that offers all stakeholders multiple opportunities to provide input, in an open and collaborative way.[[13]](#footnote-13)

The SWE, in collaboration with the PEG and staff from the Commission’s Bureau of Technical Utility Services (TUS), with input from the TWG, reviewed the 2013 TRM and proposes several changes and additions for consideration for inclusion in the 2014 TRM. With the adoption of this Tentative Order, the Commission seeks comments on the proposed 2014 TRM. The proposed 2014 TRM and its associated Appendixes can be found on the Commission’s website at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/technical_reference_manual.aspx>. A notice of the adoption of this Tentative Order and the proposed 2014 TRM will be published in the *Pennsylvania Bulletin* with comments on the proposed 2014 TRM due within 30 days after publication of the notice and reply comments due within 40 days after publication of the notice.

**DISCUSSION**

The proposed improvements to the TRM are based on more recent research, a review of TRMs from other states and the needs and experiences of the EDCs. The EDCs provided, through the SWE evaluation, measurement and verification (EM&V) process, much of the data that forms the basis of these recommended improvements. Specifically, the current proposed improvements were the result of SWE site inspections, and comments from conservation service providers (CSPs) and EDC independent evaluators. The proposed updates mainly focus on improving assumptions for key parameters, algorithms and deemed savings values, as well as accounting for new codes and standards for existing residential, and commercial and industrial (C&I) EE&C measures. The Commission believes that these proposed changes will make the TRM a more effective and professional tool for validating energy savings and providing support for the Act 129 goals.

The major goals of the proposed modifications are as follows:

1. To add protocols for EE&C measures being implemented by the EDCs as part of their Phase II EE&C plans and to broaden the scope of the TRM;
2. To appropriately balance the integrity and accuracy of claimed energy savings estimates with costs incurred to measure and verify the claimed energy savings;
3. To clarify existing calculation methods;
4. To minimize the number of EE&C measures that must be evaluated through custom protocols;
5. To allow more flexibility for the EDCs to use territory-specific data when calculating savings; and,
6. To provide additional reasonable methods for measurement and verification of energy savings associated with EE&C measures without unduly burdening EE&C program and evaluation staff.

Below is a summary list of the changes proposed in the 2014 TRM update:

1. General Improvements to the TRM:
   1. Discussion of thresholds and paradigm shift regarding use of the TRM to determine *ex-ante* and *ex-post* savings;[[14]](#footnote-14)
   2. Clarification of which TRM version to use for reporting claimed savings;
   3. Update of language regarding custom measure protocols (CMPs) for the C&I sector and clarification of mass market protocols (MMPs) for the residential sector;
   4. Modification of coincident peak demand savings, peak hours in Table 1-1;
   5. Clarification regarding the EDCs’ option to use alternative methods for calculating savings;
   6. Clarification of line loss factors for transmission & distribution (T&D) system losses;
   7. Clarification of weather mapping methodology in Section 1.16 (Impact of Weather);
   8. Clarification regarding measure retention and persistence of savings;
   9. Update references to the 2011 TRC Test Final Order;[[15]](#footnote-15)
   10. Clarification regarding use of residential and C&I measure protocols for multifamily complexes;
   11. Update of measure lives in Appendix A.
2. Inclusion of eighteen new residential EE&C measure protocols.
3. Inclusion of sixteen new C&I EE&C measure protocols.
4. Clarification of the following residential EE&C measure protocols:
   1. Updates to residential Heating, Ventilation and Air Conditioning (HVAC) protocols including updates to the equivalent full load hours (EFLH) and maintenance factors for central air conditioners and air source heat pumps (ASHPs), updating the methodology for calculating savings for desuperheaters, and clarifying the savings methodology for duct sealing and insulation;
   2. Updates to residential lighting measures including updates to coincidence factors (CFs), in-service rates (ISRs), hours of use (HOU), HVAC interactive effects, and baseline updates from the Energy Independence and Security Act (EISA) standards;
   3. Updates to wall and ceiling insulation including updates to the R-value and attic heating factor;
   4. Clarification of oversizing factor for HVAC systems for new construction;
   5. Updates to ENERGY STAR appliances using updated ENERGY STAR calculators, qualified products list and new program requirements;
   6. Updates to residential water heating measures including an update to the default temperature and allowance of nameplate data gathering by EDCs;
   7. Updates to residential water heating fuel switching measures to allow for alternative fuels and the use of ENERGY STAR requirements as the baseline for replacement units;
   8. Updates to low-flow faucet aerators and showerheads protocols;
   9. Addition of a default value for pool pump base connected load;
   10. Addition of a CF for furnace whistles;
   11. Updates to the smart strips methodology;
   12. Updates to the refrigerator and freezer recycling savings algorithm;
   13. Removal of the two-speed pool pump, home audit conservation kit, and FirstEnergy low income lighting protocols.
5. Clarification of the following C&I EE&C measure protocols:
   1. Clarification of the protocol regarding implementation of federal legislation and regulations for linear fluorescent lighting, algorithms for calculating peak demand savings for lighting control improvements and use of usage groups and HOU and CF values;
   2. Clarification of HVAC protocol for EFLH heating and cooling values and use of Section 3.18 for water-source and evaporative-cooler measures;
   3. Clarification of motor and variable frequency drive (VFD) protocols;
   4. Clarification of strip curtains measure algorithms;
   5. Discussion of load factor assumptions for ductless mini split heat pump measures;
   6. Discussion of office equipment network power management systems protocol deemed savings values;
   7. Modification of power factor values for refrigeration - evaporator fan controller protocols;
   8. Modification of capacities for baseline and efficient units for clothes washers;
   9. Modification of light-emitting diode (LED) channel signage protocol to update savings algorithm and include indoor and outdoor applications;
   10. Discussion of market baseline adjustment factor for low flow pre-rinse sprayer measures;
   11. Modification of deemed savings values and expansion of protocol to include reach-in units for refrigeration – auto closer measures;
   12. Modification of deemed savings values and expansion of protocol to include reach-in units for refrigeration – door gaskets for walk-in coolers and freezers;
   13. Modification of deemed savings values for refrigeration – suction pipe insulation measures;
   14. Adding new light fixtures, such as LED lights to the C&I lighting protocol included in Appendix C;
   15. Updated algorithms for VFDs included in Appendix D to reflect revisions to the protocol in the TRM manual.

Below, we will discuss in more detail the more significant proposed changes and updates. Minor administrative changes will not be discussed.

1. **General Improvements**
2. **Discussion of Thresholds and use of the TRM to Determine *Ex-Ante* and *Ex-Post* Savings**

The proposed 2014 TRM provides a standardized statewide methodology for calculating energy and demand savings and a consistent framework for estimating *ex-ante* (claimed) savings and *ex-post* (verified) savings. Specifically, the TRM categorizes all prescriptive measures into two categories: deemed measures and partially deemed measures. Methods used to estimate *ex-ante* and/or *ex-post* savings differ for deemed measures and partially deemed measures. Deemed measure protocols have specified deemed[[16]](#footnote-16) energy and demand savings values which require no additional measurement or calculation. These protocols also may contain an algorithm with stipulated variables[[17]](#footnote-17) to provide transparency into deemed savings values and to facilitate the updating of deemed savings values in future TRMs.

Partially deemed measure protocols have algorithms with stipulated and open[[18]](#footnote-18) variables, that require measurement of certain parameters to calculate the energy and demand savings. Customer-specific or program-specific information is used for each open variable, resulting in multiple savings values for the same measure. Default values may be provided for some open variables for instances when customer-specific or program-specific information is unavailable. Only those variables specifically identified as open variables may be adjusted using customer-specific or program-specific information.

**a. Customer and Program Specific Data**

The Commission proposes that the EDCs, their CSPs and independent evaluators collect and apply customer-specific or program-specific data in the *ex-ante* and/or *ex-post* savings calculations for as many open variables as possible in order to reflect the most accurate savings values. Site-specific data or information should be used for measures with important variations in one or more input values (e.g. delta watts, efficiency level, equipment capacity, operating hours). Customer-specific data comes directly from the measure application form or application process and/or EDC data gathering, such as, facility staff interviews, posted schedules, building monitoring systems (BMS), panel data, or metered data. In addition, stipulated variables and default values for some open variables provided in the TRM are to be based on evaluations completed in Pennsylvania or the best available measured or industry data from other jurisdictions or industry associations. The Commission’s proposal allows the EDCs to use default values for open variables in the TRM if customer-specific or program-specific information is unreliable or unattainable.

In developing this proposal, the SWE and the Commission reviewed all measures in the 2013 TRM and their protocols to identify variables that must be classified as stipulatedor open variables. Values for exact variables that should be determined using customer-specific information will be clearly described in the measure protocols. The Commission believes that this methodology will provide the EDCs with more flexibility to use customer-specific data, when available, to improve the accuracy and reliability of savings. In addition, definitions for types of protocols, deemed savings values, stipulated variables, open variables, default values, measure, end-use categories and usage groups have been added to clarify how to interpret and use the TRM.

**b. Thresholds for Using Default Values**

The determination of when to use default values for open variables in the savings calculations is a function of the savings impact and uncertainty associated with the measure. The Commission believes that default values are appropriate for low-impact and low-uncertainty measures, such as lighting retrofits in a small business facility. In contrast, the Commission believes that customer-specific values are appropriate for high-impact and high-uncertainty measures, such as HVAC or lighting retrofits in universities or hospitals that have diverse building types, and where those types of projects represent a significant share of program savings for a year.

As such, the Commission proposes to establish end-use specific savings thresholds[[19]](#footnote-19) for certain measure protocols in the 2014 TRM. For projects above the threshold, EDCs would be required to collect customer-specific data at the measure level in order to calculate *ex-ante* and/or *ex-post* savings. The proposed 2014 TRM puts all measures into various end-use categories (e.g. lighting, HVAC, motors & VFDs) for which a kilowatt-hour (kWh) threshold will be established. If a project involves multiple measures or technology types that fall under the same end-use category, the savings for all those measures or technology types would be grouped together to determine if the project falls above a particular kWh threshold.[[20]](#footnote-20) The proposed 2014 TRM lists all the end-use categories and the sections for measures within a particular end-use category. For projects with savings above the established kWh threshold, the EDCs must collect site-specific information for open variables used in the calculation of energy and demand savings. If savings for individual end-use categories within projects fall below the kWh threshold, the EDCs may gather customer-specific data, or may use the default stipulated value for each open variable.

The following table lists the end-use category kWh thresholds above which the CSPs and/or independent evaluators would be required to use customer-specific data for calculating energy and demand savings.

|  |  |
| --- | --- |
| **End-Use Category** | **Expected kWh Savings Threshold[[21]](#footnote-21)** |
| C&I Lighting | >= 500,000 kWh |
| C&I HVAC | >= 250,000 kWh |
| C&I Motors & VFDs | >= 250,000 kWh |
| C&I Building Shell | >= 250,000 kWh |

The SWE and the Commission took a two-step approach to determine the most appropriate kWh thresholds for the Act 129 EE&C Programs. First, the SWE and the Commission carefully reviewed approaches used by other jurisdictions. For instance, we found that the New York State Energy Research and Development Authority (NYSERDA) requires industrial and process efficiency program participants to perform measurement and verification (M&V) for up to one year after installation for projects expected to save *ex-ante* (claimed) savings over 1,000,000 kWh/year for lighting or 500,000 kWh/year for other technologies.[[22]](#footnote-22) Similarly, for projects larger than the 200,000 kWh threshold, where there is no applicable Regional Technical Forum (RTF) standardized approach, [[23]](#footnote-23) the Bonneville Power Administration (BPA) requires the M&V practitioners to establish an appropriate M&V protocol based on pre-and post-installation energy measurements as the default choice. BPA further discourages the use of engineering calculations for projects over 200,000 kWh unless there are clear reasons why a comprehensive M&V protocol should not be used. [[24]](#footnote-24)

Second, the SWE and the Commission performed a sensitivity analysis using different thresholds based on all of the partially deemed, non-custom energy efficiency measures implemented by all of the EDCs during Phase I. Based on this analysis, the Commission believes that the proposed thresholds will balance the level of evaluation rigor and the need for accurate savings estimates with the level of costs required to collect customer-specific data.

The Commission notes that the proposed thresholds would be subject to review and adjustment by the EDCs’ independent evaluators, in coordination with the SWE, to minimize the uncertainty of estimates. End-use metering is the preferred method of data collection for projects above the kWh threshold, but trend data from BMS or panel data would be acceptable substitutes. The EDCs are encouraged to meter those projects with savings below the proposed kWh thresholds that have high uncertainty regarding the savings (i.e. where data is unknown, variable, or difficult to verify). The exact conditions of high uncertainty would be determined by the CSPs and independent evaluators in order to appropriately manage variance. Metering completed by a CSP may be leveraged by the independent evaluator.[[25]](#footnote-25) This approach is intended to determine values for key variables and verify savings at a high level of rigor for projects that account for the majority of the programs expected savings.

**2. Determining *Ex-Ante* Savings**

The Commission adds the following language in the proposed 2014 TRM to clarify which TRM version the EDCs must use for calculating *ex-ante* savings:

For replacements and retrofits, the applicable date for determining which TRM version to use to estimate EDC claimed savings is the “in-service date” (ISD) or “commercial date of operation” (CDO) – the date at which the measure is “installed and commercially operable,”[[26]](#footnote-26) and when savings actually start to occur. This is analogous to when a commercial customer’s meter “sees” the savings under expected and designed-for operation. For most projects, this is obvious. For projects with commissioning, the CDO occurs after the commissioning is completed. For incented measures that have been installed, but are not being used because there is no occupant, or will not be used until another, unrelated installation/project is completed; the equipment is not “commercially operable.” For these projects, the CDO is the date at which the customer begins using the incented equipment, not the date at which the equipment is energized. For new construction, selection of the appropriate TRM must be based on the date when the building/construction permit was issued (or the date construction starts if no permit is required) because that aligns with codes and standards that define the baseline. Savings begin to accrue at the project’s ISD.

**3. Update of Custom Measure Protocols for the C&I Sector and Clarification of Mass Market Protocols for Residential Sector**

Section 1.15[[27]](#footnote-27) (Custom Measures) and Appendix B[[28]](#footnote-28) (Relationship between Program Savings and Evaluation Savings) in the 2013 TRM describe a process for managing custom measures and establishes a method for documenting energy and demand savings. Custom measures are considered to be too complex or unique to be included in the list of standard measures provided in the TRM.[[29]](#footnote-29) The TRM requires the EDCs to submit Custom Measure Protocols (CMPs) to the SWE and/or to Commission Staff for approval and to then follow these protocols once approved. Based on input from the SWE and the PEG, the Commission proposes to update all references to CMPs and any related process to reflect the latest status of the CMPs, as outlined in the Phase II Evaluation Framework.

While TRM measures are reviewed and approved by the Commission through the TRM update process, custom measures do not undergo the same approval process. While the custom programs offered by the EDCs are approved by the Commission during the EE&C Plan filings procedures, the associated savings protocols are not. The EDCs are not required to submit savings protocols for custom measures to the Commission or the SWE for each measure or technology type prior to implementing the custom measure. The Commission recommends that these protocols be established in general conformity to the International Performance Measurement and Verification Protocol (IPMVP)[[30]](#footnote-30) or Federal Energy Management Program M&V Guidelines.[[31]](#footnote-31) All custom projects selected in the sample by the independent evaluator for verification require a Site-Specific Measurement and Verification Plan (SSMVP), which is developed by the EDC’s independent evaluator and must be available for SWE review. The SWE reserves the right to audit and review the claimed and verified impacts of all custom measures. The Commission further clarifies that, CMPs approved during Phase I are considered available for use in Phase II by the EDCs’ CSPs and independent evaluators.[[32]](#footnote-32)

In addition, certain mass market programs in the residential sector are a subset of custom measures. These programs offer measures, or groups of measures, which are not included in the TRM. As with the CMPs, during Phase I of Act 129, the PEG developed mass market protocols (MMPs) for calculating the energy and demand savings associated with residential behavioral modification and low-income weatherization programs. MMPs approved during Phase I are considered available for use in Phase II by the EDCs’ CSPs and independent evaluators. The Phase II Evaluation Framework provides additional guidance regarding the gross impact evaluation of CMPs and MMPs that do not have TRM savings protocols.

**4. Modification of Coincident Peak Demand Savings**

During Phase I, the EDCs were required to determine the 100 hours of highest peak load to meet the peak demand reduction obligation. Section 1.9[[33]](#footnote-33) (Electric Resource Savings) in the 2013 TRM provides guidance as to how hourly peak load reductions will be determined and evaluated. The Commission notes that peak demand reduction goals were not established for Phase II. As such, the Commission proposes to update peak hours for estimating coincident peak demand savings.

The Commission proposes to adopt the PJM definition of summer peak. The coincident summer peak period is defined as the period between the hour ending 15:00 Eastern Prevailing Time (EPT) and the hour ending 18:00 EPT during all days from June 1 through August 31, except for weekends or federal holidays.[[34]](#footnote-34) The time periods for energy savings and coincident peak demand savings were chosen to best fit the Act 129 requirement, which reflects the seasonal avoided cost patterns for electric energy and capacity that were used for energy efficiency program cost-effectiveness purposes.

**5. Option to use Alternative Methods for Calculating Savings**

Section 1.1[[35]](#footnote-35) in the 2013 TRM describes the purpose of the TRM and provides guidance as to when the TRM must be used to determine EDC-reported gross savings and EM&V-verified savings. This section further describes the process that EDCs must use if they wish to use alternative protocols instead of the standard protocols included in the TRM. The 2013 TRM allows EDCs to use alternative measurement approaches or CMPs for calculating savings provided they are approved for use by TUS staff.

Based on input from the SWE and the PEG, the Commission proposes to revise this language to reflect the direction provided by the SWE in the Phase II Evaluation Framework. The proposed language allows an EDC to use an alternative method to calculate *ex-ante* savings and/or have its independent evaluator use a custom method to verify *ex-post* savings, instead of using the energy and demand savings values for standard measures contained in the TRM. The EDC, however, must also report the savings based on the TRM protocols, along with the savings utilizing its alternative method in its quarterly and/or annual EDC report(s). Furthermore, the EDC must justify why it deviated from the TRM’s protocols in the same quarterly and/or annual report(s) in which it provides its alternative calculation of savings. The Commission and its Staff reserve the right, at any time, to request the EDC’s alternative methodology and calculation of savings in order to ensure its accuracy and legitimacy.

We again note that the TRM is merely guidance or a statement of policy that is not binding regulation. A final determination of an EDC’s EE&C Plan’s energy savings will be determined in an adjudicatory proceeding where the EDC will be afforded the opportunity to present evidence demonstrating what energy savings its plan obtained and the credibility of that evidence. An EDC is free to use any method to determine the energy savings produced by its plan, in place of the TRM, provided it can support such determinations with substantial credible evidence, if necessary. However, in the absence of EDC (or another party’s) testimony to support alternative TRM protocols and values, the TRM protocols and values adopted herein will be deemed to be reasonable. With this proposed TRM change, we are merely requiring the EDCs to report savings based on the TRM protocols for measures covered by the TRM, in addition to reporting savings based on an alternative method selected by the EDC along with a justification for using the alternative method.

**6. Line Loss Factors for Transmission & Distribution System Losses**

Section 1.13[[36]](#footnote-36) in the 2013 TRM provides guidance on how to calculate energy and demand savings from a compliance standpoint and for TRC test valuation. As the 2013 TRM calculates the energy savings at the customer meter level, these savings need to be increased to account for transmission and distribution system losses in order to determine the energy savings at the system level, which are required for the TRC test.

The Commission proposes to provide additional guidance in the proposed 2014 TRM for calculating energy and demand savings for compliance purposes and resource calculations. In addition, the Commission proposes language to clarify how line loss factors are to be used to account for T&D system losses. The language can be found in Section 1.14 of the proposed 2014 TRM.

**7. Weather Mapping Methodology in Section 1.16**

Several commercial refrigeration protocols in the 2013 TRM (Section 3.23,[[37]](#footnote-37) 3.24[[38]](#footnote-38) and 3.25[[39]](#footnote-39)) rely on the work and analysis completed in California. The source equations, values for input parameters and deemed savings values were adopted from the Database for Energy Efficient Resources[[40]](#footnote-40) (DEER). The values for each Pennsylvania reference city were taken from the associated California climate zones listed in the California work paper to account for differences in climate. For the purposes of energy efficiency, California is divided into 16 climate zones defined by the California Public Utilities Commission. Each of the seven reference Pennsylvania cities are mapped to a California climate zone as shown in Table1-2[[41]](#footnote-41) based on comparable number of cooling degree days and average dry bulb temperatures. These protocols use California-based models and follow the mapping table in the TRM. The methodology of mapping Pennsylvania cities to California climate zones to account for differences in weather was discussed in the 2013 TRM Final Order.[[42]](#footnote-42)

Based on the feedback received from the PEG, the Commission believes that mapping Pennsylvania cities to California climate zones based on comparable number of cooling degree hours and wet bulb temperatures will produce more accurate deemed savings values. The Commission proposes to update the deemed savings values based on this revised weather mapping methodology. In addition, reference to the weather mapping table will be clearly mentioned in the protocol to clarify which protocols rely on the mapping table. Although this estimation may not be perfect, it serves as a reasonable proxy to translate savings from the DEER or the California work papers. The Commission further clarifies that, due to the relatively small contribution of savings and lack of Pennsylvania-specific data, the *ex-ante* savings from DEER will be used until Pennsylvania-specific research is conducted.

**8. Measure Retention and Persistence of Savings**

Section 1.11.2[[43]](#footnote-43) of the 2013 TRM describes a methodology to account for measure retention and persistence of savings for measures. The Commission proposes language to clarify the difference between measure retention and savings persistence, consistent with the 2013 TRC Test Final Order.[[44]](#footnote-44)

**9. Multifamily Complexes**

Section 1.17[[45]](#footnote-45) in the 2013 TRM provides guidance to the EDCs on how to calculate energy and peak demand savings for air sealing, duct sealing, and ceiling/attic and wall insulation measures installed in multifamily complexes. The 2013 TRM requires the EDCs to apply residential protocols and standards to calculate savings for apartment units in multifamily complexes and to apply C&I protocols and standards to calculate savings for the common areas in multifamily complexes. Based on the feedback received from the PEG, the Commission proposes to distinguish between two to four unit apartment buildings and larger apartment complexes in the proposed 2014 TRM. The SWE and the Commission believe that smaller apartment buildings are more residential in nature, whereas larger apartment complexes typically follow commercial building practices. The proposed 2014 TRM requires the EDCs to use residential protocols for measures installed in two to four unit multifamily complexes, whereas C&I protocols are to be used for measures installed in larger multifamily complexes.

**10. Measure Lives in Appendix A**

Appendix A[[46]](#footnote-46) in the 2013 TRM contains measure lives for informational purposes and for use in other applications, such as reporting lifetime savings or in benefit/cost studies. The Commission proposes to update the list of measures in Appendix A to ensure that measure lives are included for all measure protocols contained in the TRM.

1. **Additional Residential EE&C Measure Protocols**

The Commission understands that the expansion of the residential section of the TRM is essential for the accurate and timely M&V of the EDCs’ Act 129 energy efficiency programs. This proposed update to the TRM includes the addition of eighteen new residential EE&C measure protocols. The EDCs’ independent evaluators, in collaboration with the SWE, produced, reviewed and edited these new residential EE&C measure protocols. The following new residential EE&C measure protocols are being proposed for the 2014 TRM update:

* Fuel Switching- Electric Water Heater to Oil and Propane Water Heaters;
* Fuel Switching- Heat Pump Water Heater to Oil and Propane Water Heaters;
* Fuel Switching- Electric Heat Oil and Propane Heaters;
* Fuel Switching- Electric Water Heater to Gas, Oil, and Propane Tankless Water Heater;
* Fuel Switching- Heat Pump Water Heater to Gas, Oil and Propane Tankless Water Heater;
* Water Heater Temperature Setback;
* Compact Fluorescent Lighting (CFL) Specialty Bulbs;
* LED Specialty Bulbs;
* ENERGY STAR Water Coolers;
* Variable Speed Drives (VSD) on Dairy Vacuum Pumps;
* Automatic Milker Take-offs;
* Circulating Fans;
* High Volume Low Speed (HLVS) Fans;
* Dairy Scroll Compressors;
* Low Pressure Irrigation Systems;
* Livestock Waterers;
* Heat Reclaimers for Dairy; and,
* Ventilation Fans with Thermostats.

1. **Additional Commercial and Industrial EE&C Measure Protocols**

As with residential measures, expansion of the C&I section of the TRM is also essential for the M&V of the EDC EE&C programs. Based on collaborative discussions between the SWE and the EDCs and the available research, the following additional sixteen C&I EE&C measures and associated protocols are being proposed for the 2014 TRM update:

* Fuel Switching- Electric Water Heater to Gas, Oil, and Propane Water Heater;
* Fuel Switching- Heat Pump Water Heater to Gas, Oil and Propane Water Heater;
* Fuel Switching- Electric Water Heater to Gas, Oil, and Propane Tankless Water Heater;
* Fuel Switching- Heat Pump Water Heater to Gas, Oil and Propane Tankless Water Heater;
* Fuel Switching- Electric Heat (Baseboard, Furnace, ASHP) to Gas, Oil and Propane Heaters;
* Floating Head Pressure Controls;
* Refrigeration VSD Compressor;
* VSD on Dairy Vacuum Pumps;
* Automatic Milker Take-offs;
* Circulating Fans;
* High Volume Low Speed (HLVS) fans;
* Dairy Scroll Compressors;
* Low Pressure Irrigation Systems;
* Livestock Waterers;
* Heat Reclaimers for Dairy; and,
* Ventilation Fans with Thermostats.

1. **Existing Residential EE&C Measure Protocols and Processes**

The following sections describe clarifications and modifications to the residential measure protocols:

1. **Electric HVAC Protocols** 
   1. **Equivalent Full Load Hours**

In its 2013 TRM update, the Commission directed the PEG to consider a suggested modification to the methodology used for EFLH estimation based on the concern that the current methodology weights home characteristics across the state rather than for cities specific to each EDC.[[47]](#footnote-47) The Commission proposes to revise the methodology to include cooling EFLH and heating EFLH tables showing EFLH data for each EDC. These tables may be used in place of the default weighted values[[48]](#footnote-48) currently in the protocol if they are more appropriate. The more detailed EFLH data for the tables relies on the same data that was used to determine the 2013 weighted average EFLH, and was developed using REM/Rate modeling with EDC-specific housing characteristics obtained from the Phase I SWE’s Pennsylvania Statewide Residential End-Use and Saturation Study (Phase I Residential Baseline Study).[[49]](#footnote-49)

These proposed new and more detailed EFLH tables would affect the following sections of the 2013 TRM: Section 2.1 – Electric HVAC,[[50]](#footnote-50) Section 2.5 – Furnace Whistle,[[51]](#footnote-51) Section 2.11 – Programmable Thermostat,[[52]](#footnote-52) Section 2.17 – Ductless Mini-Split Heat Pumps,[[53]](#footnote-53) Section 2.20 – Fuel Switching: Electric Heat to Gas Heat[[54]](#footnote-54) and Section 2.21 – Ceiling/Attic and Wall Insulation.[[55]](#footnote-55)

With regard to Section 2.20 – Fuel Switching: Electric Heat to Gas Heat, heating EFLH tables were also created for various types of heating systems. In addition to the heating EFLH based on ASHPs determined in Section 2.1 – Electric HVAC, heating EFLH was calculated for electric forced-air furnaces, electric baseboard heating and natural gas furnaces. These additional heating EFLH tables were calculated using the same methodology and modeling utilized to determine the 2013 weighted average heating EFLH, and follow the same format and appearance as the revised EFLH tables presented in Section 2.1 – Electric HVAC.

* 1. **Duct Sealing**

In its 2013 TRM Final Order, the Commission directed the PEG to review the Duct Sealing methodology and provide recommendations for future TRM updates based on concerns of overstating of savings.[[56]](#footnote-56) Based on a review of the 2013 Mid-Atlantic TRM[[57]](#footnote-57) and the 2013 Illinois Statewide TRM,[[58]](#footnote-58) the Commission proposes to remove the duct sealing measure from the Electric HVAC protocol and develop a new protocol specifically for duct sealing in the 2014 TRM.

The proposed duct sealing measure protocol is modeled after the approach used in both the Mid-Atlantic and Illinois Statewide 2013 TRMs. The approach allows two options for calculating savings:

1. Modified Blower Door Subtraction (the preferred method); and,
2. Evaluation of Distribution Efficiency.

The modified blower door test is the preferred method and requires a blower door test in order to estimate duct leakage. Determining distribution efficiency requires the evaluation of three duct characteristics through visual inspection and the use of the Building Performance Institute’s Distribution Efficiency Look-Up Table[[59]](#footnote-59) to determine duct leakage. The lookup table provides distribution efficiencies ranging from 58% to 95%, which are then used in the protocol algorithms to determine energy savings from duct sealing.

* 1. **Central Air Conditioning and Air Source Heat Pump Maintenance**

In its 2013 TRM Final Order, the Commission directed the PEG to review the central air conditioner and ASHP maintenance savings factor based on concerns of overstating of savings and provide recommendations for future TRM updates.[[60]](#footnote-60) Based on a review of the 2013 Illinois Statewide TRM, the Commission proposes to update the maintenance factors for central air conditioners and ASHPs from 10% to 5%.

* 1. **Ground Source Heat Pumps and Desuperheaters**

In its 2013 TRM Final Order, the Commission directed the PEG to determine possible methods of adjusting the Air-Conditioning, Heating and Refrigeration Institute (AHRI) ratings due to the fact that AHRI ratings do not account for energy consumed by auxiliary water loop pumps. The Commission also directed the PEG to review the assumed savings per desuperheater because of concerns that savings are overstated and provide recommendations for future TRM updates.[[61]](#footnote-61) In order to address the impact of the auxiliary water loop pump on system performance, the Commission proposes to add a de-rate factor in order to calculate a system heating coefficient of performance (COP) and system cooling energy efficiency ratio (EER) from the heat pump rated COP and EER. The de-rate factor is determined as 100% minus the estimated percentage of system energy attributed to the loop pump based on heat pump design guidelines[[62]](#footnote-62) and a typical single family home heat pump system size. In addition, the desuperheater methodology will be revised to include an algorithm to calculate desuperheater savings by applying a desuperheater savings factor to the algorithm for calculating total annual hot water use from Section 2.3.2 of the 2013 TRM. The desuperheater savings factor was estimated based on a review of recent studies of desuperheaters.[[63]](#footnote-63) The new algorithm results in significantly reduced desuperheater savings – from 1,842 kWh to 576 kWh and from 0.34 kW to 0.05 kW.

1. **ENERGY STAR Lighting** 
   1. **Coincidence Factor**

In its 2013 TRM Final Order, the Commission directed the PEG to research the CF utilized in the Residential ENERGY STAR Lighting protocol and provide recommendations for future TRM updates.[[64]](#footnote-64) The SWE and Commission reviewed a number of metering studies and determined that the residential lighting coincidence factor of 9.1% from the most recent study from EmPOWER Maryland was the most appropriate study to use in Pennsylvania.[[65]](#footnote-65) The study includes a CF based on the PJM definition of peak, with a precision of ±3% at the 90% confidence level. In addition, the 129 metered homes in Maryland have geographic attributes, weather and other factors that are similar to Pennsylvania.

* 1. **Baseline Wattage for General Service Lamps vs. Reflectors**

In its 2013 TRM Final Order, the Commission directed the PEG to develop applicable and appropriate support for the sources for baseline wattages and to consider the possibility of differentiating lumen bins for directional versus non-directional bulbs.[[66]](#footnote-66) After the SWE’s review of various sources of general service and reflector baseline wattages, the Commission proposes that the 2014 TRM include separate default values for general service and reflector bulbs. The general service lamp baseline should be consistent with the 2013 TRM, matching the EISA requirements. The reflector lamp default values should be based on manufacturer available products. Because the provided reflector baselines may not encompass all technologies, lumens and wattages on the market and because the manufacturer may be issuing new products during the course of the year, the EDCs are given the option of using the manufacturer-rated equivalent baseline wattage, as noted on the retail bulb package, in cases where the manufacturer ratings differ from the default values.

In addition, EISA pertains to the import and manufacturing of bulbs, not the sale of bulbs. There is likely to be a sell-through period of the existing stock of legacy incandescent bulbs. As the 2014 TRM does not become effective until June 1, 2014, the rated baselines have an inherent sell-through period following the regulatory requirements.

* 1. **HVAC Interactive Effects**

In residential and commercial lighting protocols, the HVAC interactive effects input, also known as waste heat factor, accounts for the impact that efficient lighting has on HVAC usage. Efficient lighting equipment emits less heat to the conditioned building space, which in turn increases the need for heating from the HVAC system during winter months to maintain the same temperature set-points, while also decreasing the need for cooling in air conditioned spaces during summer months. These effects vary based on space conditioning mode, saturation of space heating and cooling technologies, and their relative efficiencies and climate zones.

In the 2013 PA TRM Final Order, the Commission directed the PEG to investigate and evaluate residential lighting-HVAC interactive effects for consideration in future TRM updates.[[67]](#footnote-67) The SWE has reviewed the inclusion of an HVAC interactive effect and the potential calculation of the impact HVAC interactive effects present with residential lighting installations resulting from EDC program installations. The SWE constructed building energy models to determine the HVAC impacts from efficient lighting installations in the EDCs’ service territories. The SWE used these models to calculate energy and demand HVAC interaction factors, which are used to adjust the program lighting savings to account for the reduced waste heat. The EDC-specific interactive effect values reflect the unique climates, housing types and HVAC equipment saturations present in each service territory. The Commission proposes the inclusion of an HVAC interactive effect input to the existing efficient lighting savings algorithms and the inclusion of the EDC-specific HVAC interactive effect values for savings calculations.

* 1. **In-Service Rate**

In its 2013 TRM Final Order, the Commission directed the PEG to research possible definitions for in-service rate (ISR) and to provide recommendations for future TRM updates.[[68]](#footnote-68) The ENERGY STAR Lighting Protocol defines the ISR as a factor used to reflect that not all lighting products purchased are actually installed. The Commission proposes the use of this definition in the 2014 TRM.

The 2013 TRM utilized an ISR based on a 2004 New England study, which was based on bulbs actually installed or planned to be installed within a year.[[69]](#footnote-69) However, following the 2013 TRM update, the SWE examined various jurisdictions’ ISRs in more detail. The SWE believes that it is appropriate to model an ISR trajectory and include savings for all program bulbs that are believed to ultimately be installed. Evaluations of the PECO Smart Lighting Discounts Program determined a first-year ISR of 78% for customers that purchased a bulb through a retailer or were provided a CFL through a give-a-way program. For future installations, the Commission believes that the recommendations of the Uniform Methods Project (UMP) can be incorporated.[[70]](#footnote-70) The UMP recommends using the findings from the evaluation of the 2006-2008 California Residential Upstream Lighting Programs, which estimated that 99% of program bulbs get installed within three years, including the program year.

Future installations can be handled in one of two ways: (1) by discounting future savings; or, (2) by staggering the timing of future savings claims. Due to the complexity of the staggering methods and due to the disconnect between program expenditures and program savings, the Commission proposes discounting future savings to the program year in which the expenditures take place.

* 1. **Lighting Installed in Commercial Settings**

As noted above, the incentive structure of upstream lighting programs does not allow for assurances that each purchaser of a program bulb is a residential customer in the sponsoring EDC’s service territory. As such, some program bulbs may be purchased by commercial customers and have different HOU, peak coincidence and ISRs than bulbs sold to residential customers.

The SWE and the Commission believe that the commercial TRM values for HOU and CF should be used for bulbs that are estimated to have been sold to commercial customers. The Commission proposes that the EDCs conduct data gathering to estimate this percentage and classify the business type so that the proper value by business type can be utilized. The Commission also proposes that future versions of the TRM attempt to break out screw-based versus linear fluorescent HOU and peak CF, ideally using the results of the Phase II Lighting Metering Study.[[71]](#footnote-71) In addition, the Commission proposes that, because the ISR is based on an upstream purchase, the default ISR should be based on the residential ISR rate.

1. **Wall and Attic Insulation** 
   1. **Un-insulated Wall R-Value**

In its 2013 TRM Final Order, the Commission directed the PEG to research whether or not un-insulated walls perform as R-5 or R-6 and provide recommendations for future TRM updates.[[72]](#footnote-72) Based on a review of the 2013 Illinois Statewide TRM and its sources on the topic,[[73]](#footnote-73) the SWE and the Commission believe that R-5 appears to be an appropriate R-value for an un-insulated wall. The Commission, therefore, proposes to update the default value in Table 2-35 from R-3 to R-5.

* 1. **Attic Heating Effect on Space Cooling**

In its 2013 TRM Final Order, the Commission directed the PEG to investigate cooling savings values as it was suggested that attics often become warmer than outdoor ambient temperatures and that the current algorithm did not factor this into the calculation of space cooling savings.[[74]](#footnote-74) Based on a review of a study on attic heating by the Florida Solar Energy Center,[[75]](#footnote-75) it appears that on sunny days, during the middle of the day, attic temperatures can be 30% to 35% higher than ambient outdoor temperatures. During the morning and late afternoon/early evening, the temperature difference is not as extreme, and during the night there is very little temperature difference. The result is an average hourly increase in attic temperature of about 9%. In addition, the attic heating effect is only significant on sunny or partly cloudy days. According to the National Oceanic and Atmospheric Administration (NOAA) Climatic Data for Pennsylvania,[[76]](#footnote-76) it is sunny or partly cloudy an average of 62% of the days. It is assumed that there is an attic heating effect on both sunny and partly cloudy days, but not on cloudy days; therefore, an appropriate attic heating factor would be 1.056 based on the fact that the average hourly difference between attic temperature and outdoor air temperature is +5.6% (9% average hourly increase of attic temperatures x 62% of days). The Commission proposes to add the attic heating factor 1.056 to the roof insulation portion of the cooling savings equation.

1. **Residential New Construction Protocols**

In the 2013 TRM, the residential new construction protocol[[77]](#footnote-77) provides an over-sizing factor input to account for the reduction of oversized HVAC units in participating ENERGY STAR new homes. Thus, there is a need to determine the amount by which the ENERGY STAR new homes program reduces over-sizing and how the coincidence factor is affected.

In its 2013 TRM Final Order, the Commission agreed that there is an inverse relationship between the over-sizing factor and CF and that further work should to be done to calculate the probability that an over-sized air conditioner is running at any given point during the peak period. The Commission also agreed that the over-sizing of each qualifying home can be calculated on a per-home basis. The Commission determined that further discussion and research was warranted and directed the PEG to investigate and determine the amount by which the ENERGY STAR new homes program reduces over-sizing in residential homes and how the CF is affected and provide recommendations for consideration in a future update to the TRM.[[78]](#footnote-78)

This direction led the SWE to further research existing energy efficiency new construction programs from various jurisdictions to understand the prevalence, magnitude and potential effect on savings of HVAC over-sizing. After the SWE’s review of the research and approaches in other jurisdictions, the Commission believes that there is insufficient evidence to support the current over-sizing factor input present in the 2013 TRM. While studies do show strong evidence that HVAC systems are often over-sized, they do not provide precise information on the percent impact on savings. Additionally, most research on this topic was collected almost ten years ago and the Commissions believes that the magnitude and frequency of HVAC over-sizing in new construction homes has changed during that time. The SWE notes that other jurisdictions do not include an over-sizing factor in their residential new construction TRM protocols.

The Commission proposes to remove the over-sizing factor from the new construction protocol until updated studies provide the percent of standard efficiency new construction homes that install over-sized HVAC systems and the precise impact this over-sizing has on the efficacy of systems. The Commission proposes that this input be reviewed during future TRM updates in order to incorporate the findings from research studies conducted in Pennsylvania and in other jurisdictions.

1. **ENERGY STAR Appliances** 
   1. **ENERGY STAR Calculator Updates**

The 2013 TRM deemed energy savings for ENERGY STAR clothes washers,[[79]](#footnote-79) ENERGY STAR dishwashers,[[80]](#footnote-80) ENERGY STAR dehumidifiers,[[81]](#footnote-81) ENERGY STAR room air conditioners,[[82]](#footnote-82) ENERGY STAR televisions[[83]](#footnote-83) and ENERGY STAR office equipment[[84]](#footnote-84) were derived from the ENERGY STAR savings calculators as they appeared in August 2012. The ENERGY STAR calculators have since been updated to reflect current market conditions and available appliances. Therefore, the Commission proposes updating the ENERGY STAR default values for these appliances in the 2014 TRM to reflect the latest available ENEGY STAR calculator values.

* 1. **Qualified Products List Updates**

The 2013 TRM deemed energy savings for ENERGY STAR refrigerators[[85]](#footnote-85) and ENERGY STAR freezers[[86]](#footnote-86) were calculated by averaging the available models from the ENERGY STAR qualified products list as it appeared in August 2012. The Commission proposes to update the deemed savings during each TRM update to reflect the energy usage of the ENERGY STAR models on the qualified products list and their equivalent baselines available at the time of the TRM update. The Commission believes that averaging the annual energy usage of ENERGY STAR products available to consumers and their equivalent federal baselines will produce credible savings estimates.

* 1. **ENERGY STAR Televisions**

The 2013 TRM energy savings for ENERGY STAR televisions[[87]](#footnote-87) reflected the federal standards for ENERGY STAR 5.3 televisions. The Commission notes that Federal ENERGY STAR standards for version 6.0 televisions became effective June 1, 2013. The Commission, therefore, proposes to update the protocol for the 2014 TRM to reflect these new standards. The Commission further notes that the federal baseline standard has not been updated from the version 5.0 ENERGY STAR television and proposes that it remain consistent with the 2013 TRM.

* 1. **Electric Clothes Dryer with Moisture Sensor**

In its 2013 TRM Final Order, the Commission directed the PEG to review the analyses from the U.S. Department of Energy (DOE) and other sources regarding the expected equipment life for electric clothes dryers and provide recommendations for future TRM updates. The Commission proposes to update the expected life from 11 years to 13 years based on review of ENERGY STAR[[88]](#footnote-88) and National Association of Home Builders (NAHB)[[89]](#footnote-89) studies.

**e. ENERGY STAR Room Air Conditioners**

The Commission notes that the Federal ENERGY STAR standards for Version 3.0 Room Air Conditioners came into effect October 1, 2013. The Commission, therefore, proposes to update the protocol in 2014 TRM to reflect these new standards.

1. **Water Heating Measure Protocols** 
   1. **Adjusted Temperature**

The 2013 TRM assumed 120 degrees as the default temperature of residential hot water for all residential water heating measures. Based on findings from the Phase I Residential Baseline Study,[[90]](#footnote-90) the Commission recommends that this value be updated to 123 degrees to reflect the average temperature of the hot water in the homes surveyed in Pennsylvania.

* 1. **Efficient Electric Water Heaters**

During the 2013 TRM update, PECO commented that the energy factors of most new electric water heaters are higher than 0.95[[91]](#footnote-91) and that the current deemed savings based on energy factors of 0.93-0.95 understate savings. The Commission proposes to revise the protocol to allow the nameplate energy factor of a new water heater to be entered into a simplified algorithm in order to calculate savings.

* 1. **Heat Pump Water Heaters**

During the 2013 TRM update, PECO commented that the energy factors of many new electric water heaters being incented are higher than 2.3[[92]](#footnote-92) and that the current deemed savings based on energy factors of 2.2-2.3 understate savings. The Commission proposes to revise the protocol to allow the nameplate energy factor of a new water heater to be entered into a simplified algorithm in order to calculate savings.

* 1. **Fuel Switching to Alternative Fuels**

The 2013 TRM includes only natural gas as an alternative fuel for water heating fuel-switching measures. The 2013 TRM neglects to provide the algorithms to use for calculating fuel consumption of the alternative fuel when the customer has switched from electricity to propane or oil. The Commission proposes to include protocols allowing for a switch from electricity to propane or oil. In addition, the Commission proposes that the EDCs use the same algorithms for new alternative fuels to estimate savings and alternative fuel consumption as is currently outlined in the 2013 TRM for fuel switching measures.

* 1. **Fuel Switching to ENERGY STAR Measures**

In its 2013 TRC Test Final Order, the Commission stated the following:

We determined for Phase I that only equipment earning the EPA’s ENERGY STAR performance rating should be eligible for inclusion in EE&C fuel switching plans. This provision is, however, only applicable to fuel switching proposals where EPA ENERGY STAR performance rated equipment is available for installation.[[93]](#footnote-93)

The Commission proposes to update the fuel consumption of the replacement units to reflect the ENERGY STAR standard for natural gas and propane water heaters. In addition, the Commission notes that ENERGY STAR does not currently have a standard for oil water heaters. As such, the Commission proposes that the fuel consumption for oil water heaters remain equivalent to the federal standard.

1. **Low Flow Faucet Aerators**

The 2013 TRM relied on several other TRMs and citations for low flow faucet aerators that have since been updated to reflect the most current published studies. Based on the feedback received from the PEG, the Commission believes that there is a need to update low flow faucet aerator parameter inputs based on more recent studies’ findings and assumptions published in other jurisdictions’ TRMs.

The SWE and the Commission reviewed the most recent metering studies from Michigan, which indicate that the assumptions for aerator savings may be significantly low for kitchen aerators. Additionally, a recent study showed savings greater than 200 kWh for kitchen aerators. The data from the Michigan, Maryland and New York TRMs was also reviewed. Based on these reviews, the SWE and the Commission believe that there is sufficient evidence to support revisions to the low flow faucet aerator measures within the TRM. Specifically, the Commission proposes to update the following parameters:

* Daily water faucet usage;
* Differentiation between kitchen and bathroom faucet aerators;
* Differentiation between single and multifamily housing;
* Drain factor; and,
* Electric water heater saturation.

A recent 2013 metering study performed in Michigan concluded that the daily water faucet usage assumption should be revised downwards to 6.1 from the currently assumed value of 9.85 minutes per person, per day. [[94]](#footnote-94) While the 9.85 minutes per person, per day figure is cited from the 2013 Illinois TRM, the original citations are from a variety of studies that relied primarily on data from the 1990s and early 2000s for the calculations.

Previous versions of the TRM did not distinguish between kitchen and bathroom faucet aerators. The Commission believes that identifying the aerator type is a more accurate approach to estimating savings for these measures. The Commission proposes that the average kitchen usage be 4.5 minutes per person, per day and that the bathroom usage be 1.6 minutes per person, per day. Additionally, a default value of 6.1 minutes per person, per day is proposed for use if the installation location is unknown.

The average persons per household and average faucets per home should be updated to reflect the most recent data gathered in the Phase I Residential Baseline Study. While the average number of persons per household remained constant at 2.6 persons per household, the Commission proposes that the differentiation between a single family installation (2.7 persons per household) and a multifamily installation (1.8 persons per household) be included. The Commission also proposes that the number of faucets per home be increased from 3.5 faucets to 3.8 faucets. Allowing the faucet type to be identified increases the precision of the savings estimate, resulting in an average of 1.0 kitchen faucets per home and 2.8 bathroom faucets per home. The Commission proposes that both of these parameters be changed from fixed to open to allow for EDC data gathering.

The Commission also proposes that the drain factor parameter be updated to reflect the location of the aerator as specified in the 2013 Illinois TRM. This results in a drain factor of 75% for kitchen faucets, 90% for bathroom faucets and 79.5% for unknown faucets.

Program offerings may potentially distribute energy savings kits that include low flow faucet aerators to homes where the water heater fuel type is unknown. According to the Phase I Residential Baseline Study, only 43% of homes have electric water heaters.[[95]](#footnote-95) The Commission proposes to open this parameter to allow EDCs to use gathered data or to incorporate additional information pertaining to a given EDC’s percentage of electric water heaters in its service territory. Otherwise, the default value would be the statewide 43 percent.

1. **Low Flow Showerheads**

The 2013 TRM relied on other TRMs and citations for low flow showerhead parameters that have since been updated to reflect the most current published studies. The Commission believes that there is a need to update low flow showerhead parameter inputs based on more recent studies’ findings and assumptions. After reviewing the most recent studies and TRMs, the SWE and the Commission believe that there is sufficient evidence to support the revisions to the low flow showerhead measures in the proposed 2014 TRM. Specifically, the Commission proposes to update the following parameters:

* Number of persons and showers per household;
* Daily average gallons of hot water shower usage per person (dependent on daily length of shower and number of showers taken per person);
* Shower temperature; and,
* Electric water heater saturation.

The average number of persons and showers per household should be updated to incorporate a default value when household type is unknown, as the current values are listed exclusively for either single family or multifamily. The Commission proposes the use of the default values of 2.6 persons and 1.6 showers per household, based on statewide averages from the Phase I Residential Baseline Study. The Commission proposes that these parameters be made open to allow for EDC data gathering.

The Commission also proposes to update the recommended average gallons of hot water used for showering per person, per day from 11.6 gallons per person, per day to 11.7 gallons per person, per day based upon the 2013 Michigan metering study.[[96]](#footnote-96) The 2013 Michigan metering study also recommends a showerhead water temperature of 101ºF, which the Commission proposes to adopt for the 2014 TRM. The 2013 TRM includes 105ºF as shower water temperature, which is sourced from the 2013 Illinois TRM. However, the 2013 Illinois TRM cites a study from 1994 to support the use of this value, [[97]](#footnote-97) which the Commission feels is now outdated information.

Program offerings may potentially distribute energy savings kits that include low flow showerheads to homes where the water heater fuel type is unknown. According to the Phase I Residential Baseline Study, only 43% of homes have electric water heaters.[[98]](#footnote-98) The Commission proposes to open this parameter to allow EDCs to use gathered data or to incorporate additional information pertaining to a given EDC’s percentage of electric water heaters in its service territory. Otherwise, the default value would be the statewide 43 percent.

1. **Pool Pump Load Shifting**

Because a customer’s default base connected load is not necessarily a readily available data point for a customer to supply, the Commission proposes to add a default value of 1.364 kilowatt (kW) to Table 2-89[[99]](#footnote-99) for the base connected load.

1. **Variable Speed Pool Pump**

Because a customer’s default base connected load is not necessarily a readily available data point for a customer to supply, the Commission proposes to add a default value of 1.364 kW to Table 2-93[[100]](#footnote-100) for the base connected load. The Commission also proposes to correct a circular reference in the algorithms for calculating peak demand.

1. **Furnace Whistle**

The Commission proposes to revise the protocol to include an algorithm for calculating peak demand reduction for furnace whistles. The Commission also proposes adding a CF of 70% to Table 2-5 to allow for calculation of peak demand.[[101]](#footnote-101)

1. **Smart Plug Outlets**

In its 2013 TRM Final Order, the Commission agreed with comments[[102]](#footnote-102) that the deemed savings per Smart Plug strip should be significantly lower than the value of 184 kWh shown in the 2013 TRM based on a recent study by the Energy Center of Wisconsin.[[103]](#footnote-103) The Commission directed the PEG to review the appropriate savings value for this protocol and provide recommendations for future TRM updates. Based on a review of an Energy Center of Wisconsin study and another study on the subject completed by ECOS,[[104]](#footnote-104) the Commission proposes to reduce the average connected loads for entertainment centers and computer systems. Additional research indicates that the CFs for Smart Plug strips should be increased to 0.80[[105]](#footnote-105) from 0.50 and that the measure life should be lowered to four years[[106]](#footnote-106) from five years. The Commission also proposes that the average daily idle time be increased from 19 hours to 20 hours. The resulting average savings from the existing algorithms for a default five-plug Smart Plug strip, in which the intended use is unknown, were calculated to be 48.9 kWh. If the intended use is known to be with an entertainment center, default savings were calculated to be 62.1 kWh for 5-plug Smart Plug strips. The Commission proposes the adoption of these values within the protocol and the addition of the 62.1 kWh savings value be added to Table 2-23.[[107]](#footnote-107)

Additionally, during the 2013 TRM update, parties stated in comments that the savings for a seven-plug Smart Plug strip would be expected to be higher than the savings for a five-plug Smart Plug strip.[[108]](#footnote-108) In order to approximate additional savings potential for a seven-plug Smart Plug strip while also considering that some consumers may buy a seven-plug Smart Plug strip for future capacity and not use all of the plugs, the SWE and the Commission assumed that six of the seven plugs would be used versus all five plugs in a five-plug Smart Plug strip. Savings for the seven-plug Smart Plug strip were therefore estimated to be 20% higher than the savings for a five-plug Smart Plug strip. The Commission proposes the adoption of these values and their addition to Table 2-23. Specifically, the Commission proposes 58.7 kWh for a seven-plug Smart Plug strip with unknown intended use and 74.5 kWh for a seven-plug Smart Plug strip with the known use intended to be for an entertainment center.

1. **Refrigerator/Freezer Recycling**

The 2013 TRM utilized the U.S. DOE Uniform Methods Project (UMP) as the basis for deemed savings for refrigerator removal/replacement. The Commission proposes that the algorithms from the UMP continue to be used in the 2014 TRM. The Commission also proposes to update the inputs to the algorithm with EDCs’ Program Year Four data to represent the most accurate savings specific to Pennsylvania.

1. **Removal of Residential EE&C Measure Protocols**

* 1. **Two-Speed Pool Pump Protocol**

Based on discussions with the PEG, the Commission believes that the two-speed algorithm for pool pumps has proven to be problematic in that the kW defaults for two-speed pumps are not likely to result in equivalent water throughput rates given the assumed annual run hours of the baseline and efficient motor. Additional research indicates that two-speed pumps are often not able to supply the required flow at the 50% speed setting and then switch back to 100% speed, resulting in very little energy savings. It is much easier to optimize efficiency at the required flow with a variable speed pump. As such, the Commission proposes to remove Measure 2.42 - High Efficiency Two-Speed Pool Pump and maintain Measure 2.43 – Variable Speed Pool Pumps (with Load Shifting Option) as the only replacement option for single-speed pool pumps.

* 1. **Home Audit Conservation Kits Protocol**

This measure was included in the 2013 TRM to provide a deemed value for Home Audit Conservation Kits. This value was calculated by summing the deemed savings values of specified measures included in the kits. Upon further review, the SWE has found that this methodology limits the EDCs on which measures to include in the kits. In order to allow EDCs the flexibility to choose which measures to include in kits, the Commission proposes eliminating this measure from the TRM. Instead, the EDCs would create kits using other measures from the TRM and calculate the savings using the TRM protocols for these measures. Additionally, the Commission proposes that the EDCs use an ISR specific to Home Audit Conservation Kits when calculating savings for all measures included in the kit. This ISR would be determined through EDC surveys and data gathering.

* 1. **FirstEnergy Low Income Lighting Protocol**

This measure was included in the 2013 TRM to account for specific program requirements of FirstEnergy’s Low Income Lighting program. Because the program targeted light bulbs with only one to two hours of use per day, as opposed to the three hours a day specified in the general residential lighting measure, a separate protocol was required. This specified targeting no longer exists in FirstEnergy’s program design and, therefore, the Commission proposes eliminating this measure from the TRM.

1. **Commercial and Industrial EE&C Measure Protocols**

The following sections describe clarifications and modifications to the C&I measure protocols:

1. **Lighting Protocols** 
   1. **Linear Fluorescent Lighting**

The Energy Policy Act of 2005 (EPAct 2005)[[109]](#footnote-109) introduced new efficiency standards for linear fluorescent bulbs and ballasts, effectively phasing out magnetic ballasts effective October 1, 2010 and T-12 bulbs effective July 14, 2012. This induces a shift in what a participant would have purchased in the absence of the program because T-12 bulbs on magnetic ballasts are no longer viable options and, therefore, adjusts the baseline assumption. Leftover retail stock may sustain sales for T-12 bulbs and use of T-12 systems for a period, but its market share is expected to decrease naturally as T-8 systems are adopted and the existing stock of T-12s is exhausted. In addition, C&I lighting retrofit projects for Act 129 are all considered early replacement scenarios, i.e. the baseline is defined as what was previously in place rather than minimally code compliant equipment. In the 2013 TRM Final Order,[[110]](#footnote-110) the Commission directed the PEG to investigate the impacts of new lighting standards and recommend future adjustments to the TRM when necessary.

After reviewing approaches by other jurisdictions, the Commission believes that the assumptions made by the 2012 Illinois TRM[[111]](#footnote-111) are reasonable and proposes that the same methodology be used in future TRM updates to account for new code changes. The Commission proposes that the baseline for a lighting retrofit project continue to be the existing lighting system for the entirety of Phase II. The Commission believes that this will provide the time required for the market to adjust to the new code standards, taking into account the fact that end-users may have an existing stock of T-12 lamps and do not need to purchase new replacement lamps for several years.

With this understanding, the Commission clarifies that its proposal regarding these new code standards will not impact the EDCs’ first year savings that are used to determine EDC compliance. These changes, however, appear to affect the TRC Test valuation for T-12 replacements as the energy savings and useful life are reduced each year due to the changing lighting baseline values as such lighting becomes unavailable. The Commission proposes to include a methodology in the 2014 TRM to calculate lifetime savings for linear fluorescent measures that replace T-12s in program years 6 (June 1, 2014 – May 31, 2015) and 7 (June 1, 2015 – May 31, 2016) (PY6 and PY7). The Commission proposes that standard T-8s become the baseline for all T-12 linear fluorescent retrofits beginning June 1, 2016, should the Commission implement a Phase III of the Act 129 EE&C Programs. Therefore, measures installed in PY6 and PY7 will claim full savings until June 1, 2016. Savings adjustment factors would be applied to the full savings for savings starting June 1, 2016, and for the remainder of the measure life. Savings adjustment is defined as the ratio between the wattage reduction from the T-8 baseline to HPT-8 or T-5 lighting and the wattage reduction from the T-12 fixture. Savings adjustments are developed for different combinations of retrofits from T-12s to T-8 or T-5 lighting. In TRC Test calculations, the EDCs may adjust lifetime savings either by applying savings adjustment factors or by reducing the effective useful life[[112]](#footnote-112) (EUL) to adjust lifetime savings. Savings adjustment factors and reduced EULs for HPT-8 and T-5 measures are specified in the proposed 2014 TRM. The Commission believes it is important to standardize a methodology to ensure consistency across the state.

In addition, the Commission notes that the SWE is planning to collect T-12 storage and expected improvement strategies of customers during the Phase II C&I Baseline Study[[113]](#footnote-113) and the Phase II Lighting Metering Study. As such, the Commission proposes that these new code standards be reviewed during future TRM updates in order to incorporate the findings from these statewide studies, as well as research studies conducted in other jurisdictions.

* 1. **Peak Demand Savings for Lighting Control Improvements**

The C&I lighting protocol[[114]](#footnote-114) in the 2013 TRM was constructed in such a way to account for energy savings only for lighting control retrofits. The savings algorithms[[115]](#footnote-115) did not account for peak demand savings. The Commission proposes to modify the savings algorithms to allow the EDCs to claim peak demand savings for lighting control retrofits in addition to the energy savings. The Commission also proposes to include separate savings algorithms for fixture improvements and control improvements to make it easier for CSPs and independent evaluators to utilize.

* 1. **Usage Groups and Hours of Use Values**

The annual energy savings for C&I lighting are heavily dependent on the annual hours of usage. In the 2013 TRM, the C&I lighting protocol differentiated between projects with a connected load savings of 20 kW or more and projects with a connected load savings below 20 kW.[[116]](#footnote-116) Section 3.2.6[[117]](#footnote-117) describes the use of usage groups within a facility and methods to determine the HOU for different usage groups and/or the whole facility for lighting projects with these thresholds. If usage groups are considered, the 2013 TRM requires EDCs to determine the HOU using Table 3-4,[[118]](#footnote-118) facility staff interviews, posted schedules or metered data. Table 3-4 that represents whole building HOU may pose challenges for CSPs who wish to use customer specific HOU for lighting projects that would result in more accurate and reliable savings estimates. For example, many C&I lighting projects retrofit only a portion of a building which is not well represented by the whole building HOU values provided in Table 3-4. The 2013 TRM, however, does not provide the flexibility for EDCs to use customer-specific information.

Based on feedback received from the PEG, the Commission proposes to clarify the language in the TRM regarding when the usage groups should be considered and how to determine the HOU for lighting projects. In addition, separate thresholds and sections have been added to the proposed 2014 TRM to clarify when usage groups should be used and when metering should be conducted.  These proposed changes are designed to make it easier for CSPs and independent evaluators to use and to calculate accurate savings.

The Commission believes this will provide more flexibility for the CSPs and independent evaluators contracted to calculate energy and demand savings using customer-specific information.

1. **HVAC Protocols**
2. **Heating and Cooling Equivalent Full Load Hours**

The 2013 TRM calculates EFLH[[119]](#footnote-119) for HVAC measures by adjusting EFLH values reported in the Connecticut Program Savings Documentation[[120]](#footnote-120) using full load hours from the DOE ENERGY STAR calculator[[121]](#footnote-121) based on a degree-day scaling methodology. Degree-day scaling ratios were calculated using heating degree day and cooling degree day values for seven Pennsylvania cities: Allentown, Erie, Harrisburg, Philadelphia, Pittsburgh, Scranton, and Williamsport. These reference cities provide a representative sample of the various climate and utility regions in Pennsylvania.

The SWE ran computer simulation models to determine EFLH values for HVAC measures using eQUEST[[122]](#footnote-122) software for the 2014 TRM update. These computer simulation models are expected to provide state-specific values that do not need to be scaled using degree-days. Several TRMs from other states, including the Mid-Atlantic, Delaware, New York, and Illinois TRMs, use eQUEST modeling to develop ELFH values.

The SWE performed simulations for a set of prototypical small and large building types using eQUEST modeling. These prototypical simulation models were derived from the publically-available commercial building types created for the California DEER Study.[[123]](#footnote-123) The SWE made adjustments to these models, incorporating results from the Phase I SWE’s Pennsylvania Statewide Commercial and Industrial End-Use and Saturation Study (Phase I C&I Baseline Study),[[124]](#footnote-124) Commercial Buildings Energy Consumption Survey (CBECS),[[125]](#footnote-125) and Typical Meteorological Year Three (TMY3) Weather data to account for differences in local building practices and climate to create Pennsylvania-specific building prototypes. For example, end-use energy use intensities, equipment efficiencies and building vintages information collected from the Phase I C&I Baseline Study were used to inform the models. A prototype was created for each building type and differed by building characteristics including, but not limited to, HVAC system, operating schedule, facility size, number of floors, building envelope.

This exercise showed that the EFLH values derived from the eQUEST modeling may not provide any improvement over the methodology used in the 2013 TRM due to some uncertainties in data inputs. For example, many of the space heating and cooling temperature set points obtained from the Phase I C&I Baseline Study differed greatly from DEER model values and did not seem realistic. Some example cooling and heating temperature set points are shown below.

|  |  |  |
| --- | --- | --- |
|  | Heating (Occupied/Unoccupied) | Cooling (Occupied/Unoccupied) |
| **DEER model** | 72 / 62 | 76 / 86 |
| **PA Baseline Study Average** | 68.3 / 62.7 | 71.5 / 75.6 |

The Commission, therefore, proposes to use the existing EFLH values in the 2013 TRM for the 2014 TRM until more accurate information is available. The Commission proposes that the SWE run computer simulation models to determine EFLH values for HVAC measures using eQUEST software for various building types across each climate zone in Pennsylvania for future TRM updates. The Commission proposes that the SWE compare the results from the Phase II C&I Baseline Study with the Phase I C&I Baseline Study findings and make improvements to the models to develop the most accurate Pennsylvania-specific EFLH values. The Commission believes this will reduce the burden on the EDCs in updating their tracking systems.

In addition, the SWE and Commission found some inconsistencies in the heating EFLH values for heat pump measures for several building types in Table 3-22,[[126]](#footnote-126) Section 3.6. The heating EFLH values appear to vary considerably between cities and building types while other EFLH values are identical across different building types. For example, the heating EFLH value for convenience stores is over 2,500 for all cities except for Allentown, which has a value of 603. The Commission believes these errors were due to changes not being transferred correctly between documents and/or data inconsistencies in previously used secondary sources. The analysis conducted by the SWE showed that the cumulative impact on energy and demand savings in Phase I among all EDCs due to the inconsistencies is less than one percent based on the analysis conducted by SWE. The Commission proposes to update heating EFLH values for some cities and/or building types in the 2014 TRM by adjusting EFLH values reported in the Connecticut Program Savings Documentation[[127]](#footnote-127) using full load hours from the DOE ENERGY STAR Calculator based on a degree-day scaling methodology.

1. **Update of Table 3-20 in Section 3.6 and Table 3-65 in Section 3.18 and Clarification of Use of Section 3.18 for Water-Source and Evaporatively-Cooled Air Conditioners Measures**

Section 3.6[[128]](#footnote-128) in 2013 TRM applies to air source air conditioner (Air Source AC), packaged terminal air conditioner (PTAC), ASHP and packaged terminal heat pump (PTHPs) measures and Section 3.18[[129]](#footnote-129) applies to water source and geothermal heat pump measures. Table 3-20[[130]](#footnote-130) includes the baselines for water-source and evaporatively-cooled AC, water-source heat pumps and ground source heat pumps, which do not apply to Section 3.6. Likewise, Table 3-65[[131]](#footnote-131) includes the baselines for Air Source AC and packaged terminal systems, which does not apply to Section 3.18. To avoid confusion, the Commission proposes to update Tables 3-20 and 3-65 to only cover the measures that the protocols allow. In addition, the Commission proposes to add language in the 2014 TRM to clarify that Section 3.18 should be used to calculate savings for water-source and evaporatively-cooled AC measures. The Commission notes that these clarifications only remove extraneous information and do not affect savings values.

1. **Motor and Variable Frequency Drive Protocols**
2. **Operating Hours, Energy Savings and Demand Savings**

The motor operating hours in Table 3-15[[132]](#footnote-132) for the Motor measure and energy savings factor (ESF) and demand savings factor (DSF) values in Table 3-17[[133]](#footnote-133) for the VFD measures in the 2013 TRM were adopted from the 2012 Connecticut TRM.[[134]](#footnote-134) As with the EFLH values for HVAC measures, the SWE ran computer simulation models to determine the motor operating hours, ESF and DSF values for motor and VFD protocols using eQUEST[[135]](#footnote-135) software for the 2014 TRM update. These computer simulation models are expected to provide state-specific values which are considered to be the most credible information after metered data.

The SWE performed simulations for a set of prototypical small and large building types using eQUEST modeling. These prototypical simulation models were derived from the publically-available commercial building types created for the California DEER Study.[[136]](#footnote-136) The SWE made adjustments to these models, incorporating results from the Phase I C&I Baseline Study, CBECS and TMY3 Weather data to account for differences in local building practices and climate to create Pennsylvania-specific building prototypes. For example, end-use energy use intensities, equipment efficiencies and building vintages information collected from the Phase I C&I Baseline Study were used to inform the models. A prototype was created for each building type and differed by building characteristics including, but not limited to, HVAC system, operating schedule, facility size, number of floors, building envelope.

This exercise showed that the motor operating hours and ESF and DSF values derived from the eQUEST modeling may not provide any improvement over the methodology used in the current TRM due to some uncertainties in data inputs. For example, many of the space heating and cooling temperature set points obtained from the Phase I C&I Baseline Study differed greatly from DEER model values and did not seem realistic. Some example cooling (occupied/unoccupied) and heating (occupied/unoccupied) temperature set points are shown below.

|  |  |  |
| --- | --- | --- |
|  | Heating (Occupied/Unoccupied) | Cooling (Occupied/Unoccupied) |
| **DEER model** | 72 / 62 | 76 / 86 |
| **PA Baseline Study Average** | 68.3 / 62.7 | 71.5 / 75.6 |

The Commission, therefore, proposes to use the existing motor operating hours and ESF and DSF values in the 2013 TRM for the 2014 TRM until more accurate information is available. The Commission proposes that the SWE run computer simulation models to determine motor operating hours and ESF and DSF values for motors and VFD measures using eQUEST software for various building types across each climate zone in Pennsylvania for future TRM updates. The Commission proposes that the SWE compare the results from the Phase II C&I Baseline Study with Phase I C&I Baseline Study findings and make improvements to the models to develop the most accurate Pennsylvania-specific values. The Commission believes this will reduce the burden on the EDCs in updating their tracking systems several times.

1. **Algorithms to Calculate Energy and Demand Savings**

As described above, the ESF and DSF values for VFD protocol in 2013 TRM were adopted from the 2012 Connecticut TRM. The algorithms, however, do not match the 2012 Connecticut TRM. The algorithms in the 2013 TRM include a conversion factor of 0.746 to convert from horsepower (HP) to kW for calculating energy and peak demand savings in contrast to the 2012 Connecticut TRM. The Commission believes the ESF and DSF values contained in the 2012 Connecticut TRM already account for the conversion factor. The Commission, therefore, proposes to update the algorithms by removing the 0.746 conversion factor to accurately estimate savings.

1. **Strip Curtains**

The strip curtains[[137]](#footnote-137) protocol documents the energy and peak demand savings attributed to installation of auto closers in walk-in coolers and freezers. The equations and the values for the input parameters were adopted from the 2006-2008 California Public Utility Commission’s evaluation of strip curtains.[[138]](#footnote-138)

The Commission proposes to remove the factor of 60 in the equation used to calculate energy savings. The SWE reviewed the actual source documentation[[139]](#footnote-139) and the savings calculation spreadsheet that was embedded in the original interim measure protocol document submitted to the SWE and realized that the equation contains an unnecessary factor of 60 for calculating deemed savings. The Commission notes that this update will not require any revisions to the deemed savings values in the protocol as the protocol reflects the accurate values.

1. **Ductless Mini Split Heat Pumps - Commercial <5.4 Tons**

The ductless mini split heat pump protocol[[140]](#footnote-140) documents the energy savings attributed to ENERGY STAR ductless mini-split heat pumps. In its 2013 TRM Final Order, the Commission directed the PEG to review this measure and determine if updates were necessary.[[141]](#footnote-141) The protocol assumes a load factor value of 25%, which is used to account for inverter-based ductless heat pump (DHP) units operating at partial loads. The SWE reviewed the load factor value of 25% to check the reasonableness of the assumptions and to determine if updating was necessary. Several TRMs in other jurisdictions do not differentiate mini-splits from other packaged and split systems and, therefore, do not account for load factor. Other TRMs, however, include ductless mini-split heat pumps only for the residential sector and not for the C&I sector. While the SWE and the PEG have done some research on this topic, the Commission believes that further review is required to determine how to revise the load factor assumption to accurately represent savings. Therefore, the Commission proposes that this topic be referred to the PEG for review and that recommendations be provided for future TRM updates.

1. **Office Equipment Network Power Management Systems**
2. **Deemed Savings Values**

The 2013 TRM[[142]](#footnote-142) deemed savings for the office equipment network power management system measure were 135 kWh per unit and 0.0078 kW per unit. The energy savings were based on an evaluation study conducted in the Pacific Northwest[[143]](#footnote-143) that has an expiration date of July 1, 2013. The Commission, therefore, directed the PEG to monitor technological changes related to the systems and provide recommendations for future TRM updates.[[144]](#footnote-144)

The SWE and the Commission found that the Pacific Northwest study is the most recent and comprehensive study available. This study contains a broader sample and investigated a variety of applications that are more representative of this technology and involve actual field measurements. The Commission proposes to use the existing deemed savings values in the 2013 TRM for the 2014 TRM until better information is available. The Commission proposes that the PEG continue to monitor this issue and provide recommendations for consideration during future TRM updates.

1. **Update Assumptions Table**

The Commission proposes to update Table 3-73[[145]](#footnote-145) in the 2013 TRM by removing the assumptions for variables IMC per unit ($) and Net to Gross Ratio as they are not relevant to the TRM and also to be consistent with other protocols in the TRM.

1. **Refrigeration - Evaporator Fan Controllers**

The refrigeration – evaporator fan controller protocol in the 2013 TRM[[146]](#footnote-146) assumes a power factor (PF) value of 0.6 for fan motors and 0.9 for compressor motors. In its 2013 TRM Final Order, the Commission directed the PEG to review the PF assumption and provide recommendations during future TRM updates.[[147]](#footnote-147) The SWE and the Commission found several sources which listed a PF value of 0.6 for shaded-pole (SP) motors and 0.9 for permanent split capacitor (PSC) motors.[[148]](#footnote-148) In general, the sources reviewed showed that roughly 50% of the evaporator fan motors are SP type and that 50% are PSC type, with evaporator compressor motors being mostly PSC type. The Commission, therefore, proposes to update the PF assumption for fan motors from 0.6 to 0.75, which is an average of PF value for SP and PSC motors.

1. **Clothes Washers**

The ENERGY STAR clothes washer protocol[[149]](#footnote-149) identifies the calculation methodology and the assumptions regarding baseline equipment, efficient equipment and usage patterns used to estimate annual energy savings expected from the replacement of a standard clothes washer with an ENERGY STAR clothes washer. The 2013 TRM assumes an average capacity of 2.8 cubic feet (cu. ft.) in Table 3-84[[150]](#footnote-150) for baseline and efficient units for front-loading and top-loading washer types. In its 2013 TRM Final Order, the Commission directed the PEG to continue conducting research and provide recommendations, as new data becomes available, for future TRM updates.[[151]](#footnote-151)

The SWE reviewed the California Energy Commission (CEC) Appliance Efficiency database, which contains all the commercial front-loading and top-loading clothes washers that meet minimum federal standards and ENERGY STAR requirements.[[152]](#footnote-152) The Commission notes that all ENERGY STAR-qualified commercial clothes washers are likely to be front-loading units because there are no top-loading commercial clothes washers that have been certified by the DOE as meeting the 2013 ENERGY STAR requirements. Based on the information contained in the CEC database, the Commission proposes updating the average capacities in the TRM as follows:

|  |  |  |
| --- | --- | --- |
| Type | Capacity (Cu. ft.) | |
| **Baseline** | **ENERGY STAR** |
| **Front Loading** | 2.84 | 2.84 |
| **Top Loading** | 2.95 | 2.84 |

In addition, the Commission recommends updating the deemed savings to reflect the proposed changes to the capacities. The protocol in the 2013 TRM uses the calculation methodology, the assumptions regarding baseline equipment and efficient equipment and usage patterns from the DOE’s Life-Cycle Cost and Payback Period tool[[153]](#footnote-153) to estimate annual energy savings. Deemed savings would be updated for top-loading and front-loading washing machines for different combinations of water heater and dryer types in laundry rooms of multifamily complexes and commercial Laundromats. In addition, the Commission proposes to add a user-input data field for baseline and efficient clothes washer capacities, thereby allowing the EDCs to calculate savings in cases where the capacities are different.

1. **Light-Emitting Diode Channel Signage**

In its 2013 TRM Final Order, the Commission directed the PEG to determine the appropriateness of splitting the savings for the LED channel signage[[154]](#footnote-154) measure into two categories based on sizing.[[155]](#footnote-155) The Commission proposes to modify the LED channel signage protocol by splitting the deemed savings into channel signs greater than two feet tall and those two feet or less. In addition, the Commission proposes to add separate algorithms to calculate energy and peak demand savings for indoor and outdoor applications. The savings and analysis rely on the work completed in California.[[156]](#footnote-156) The Commission believes this will improve the accuracy of the savings estimates and simplifies the protocol.

1. **Low Flow Pre-Rinse Sprayers**

The low flow pre-rinse sprayers protocol in the 2013 TRM[[157]](#footnote-157) assumed a market baseline adjustment factor of 0.95 in the savings algorithm to adjust the Federal standard of 1.6 gallons per minute (GPM) to a lower and more likely value for the market baseline in the absence of a program to accurately represent savings for a time of sale (TOS)/retail program. As a result, the market baseline is adjusted to 1.52 GPM. This update was based on performance rating results of 29 models listed on the Food Service Technology Center Website, which showed that the highest flow rate was 1.51 GPM[[158]](#footnote-158) and the manufacturer on-line product catalogs[[159]](#footnote-159) that did not uncover a model rated higher than 1.51 GPM. The Commission directed the PEG to review the market baseline adjustment factor assumption and provide recommendations for future TRM updates.[[160]](#footnote-160)

The SWE reviewed the market baseline adjustment factor assumption to check the reasonableness of the value and to determine if any updates were needed based on the latest information available. The SWE found that there are no additional models added to the Food Service Technology Center Website or the manufacturer on-line product catalogs used as sources in 2013 TRM. The Commission believes that the sources used in 2013 TRM are the most reliable and that no updates to the protocol are necessary at this time. The Commission proposes to use the existing assumption for market baseline adjustment factor and deemed savings values from the 2013 TRM for the 2014 TRM.

1. **Refrigeration – Auto Closers**
2. **Deemed Savings Values**

The refrigeration – auto closers[[161]](#footnote-161) protocol documents the energy and peak demand savings attributed to the installation of auto closers in walk-in coolers and freezers. The savings protocol in the 2013 TRM relies on the work and analysis completed in California. The deemed savings values are adopted from the 2005 DEER weather sensitive commercial data.[[162]](#footnote-162) Therefore, the values for each Pennsylvania reference city were taken from the associated California climate zones listed in the 2005 DEER database to account for differences in climate. There are sixteen California climate zones. Each of the seven reference cities are mapped to a California climate zone as shown in Table1-2[[163]](#footnote-163) based on comparable number of cooling degree days and average dry bulb temperatures. Savings estimates are averaged across six building vintages for each climate-zone for grocery stores. The methodology of mapping Pennsylvania cities to California climate zones to account for differences in weather was previously described in this Tentative Order.

The Commission believes that mapping Pennsylvania cities to California climate zones based on comparable number of cooling degree hours and wet bulb temperatures will provide better metrics for mapping purposes and will represent more accurate deemed savings values. The Commission proposes to update deemed savings values based on revised weather mapping methodology. In addition, reference to the weather mapping table will be clearly mentioned in this protocol to provide clarity. Although this estimation is not perfect, i.e. there are no direct matches of weather characteristics between California and Pennsylvania, it serves as a reasonable proxy to translate savings from DEER or California work papers. The Commission further proposes that, due to the relatively small contribution of savings toward the EDCs’ portfolios as a whole and due to the lack of Pennsylvania-specific data, the *ex-ante* savings based on the analysis completed in California will be used until Pennsylvania-specific research is conducted.

1. **Expansion of Protocol to Include Reach-In Units**

In its 2012 TRM Final Order, the Commission directed the PEG to review the applicability of reach-in units for this protocol.[[164]](#footnote-164) The SWE performed research to expand the protocol to include deemed savings values for reach-in units because the existing protocol only applies to the installation of auto closers in walk-in coolers and freezers. The SWE did not come across any information regarding savings values for reach-in units in the California work papers or TRMs in other jurisdictions. The Commission directs the PEG to monitor this issue and provide recommendations for consideration during future TRM updates.

1. **Refrigeration – Door Gaskets for Walk-in Coolers and Freezers**
2. **Deemed Savings Values**

As with the refrigeration – auto closers protocol, the refrigeration – door gaskets[[165]](#footnote-165) protocol documents the energy and peak demand savings attributed to installation of door gaskets in walk-in coolers and freezers. The savings protocol in the 2013 TRM relies on the work and analysis completed in California. The deemed savings values are adopted from the Southern California Edison work paper.[[166]](#footnote-166) Therefore, the values for each Pennsylvania reference city were taken from the associated California climate zones listed in the California work paper[[167]](#footnote-167) to account for differences in climate. There are sixteen California climate zones. Each of the seven reference cities are mapped to a California climate zone as shown in Table1-2 based on comparable number of cooling degree days and average dry bulb temperatures. The methodology of mapping Pennsylvania cities to California climate zones to account for differences in weather was previously discussed in this Tentative Order.

The Commission believes that mapping Pennsylvania cities to California climate zones based on comparable number of cooling degree hours and wet bulb temperatures will provide better metrics for mapping purposes and will represent more accurate deemed savings values. The Commission proposes to update deemed savings values based on revised weather mapping methodology. In addition, reference to the weather mapping table will be clearly mentioned in this protocol to provide clarity. Although this estimation is not perfect, i.e. there are no direct matches of weather characteristics between California and Pennsylvania, it serves as a reasonable proxy to translate savings from DEER or California work papers. The Commission further proposes that, due to the relatively small contribution of savings toward the EDCs’ portfolios as a whole and due to the lack of Pennsylvania-specific data, the *ex-ante* savings based on the analysis completed in California will be used until Pennsylvania-specific research is conducted.

1. **Expansion of Protocol to Include Reach-In Units**

In its 2012 TRM Final Order, the Commission directed the PEG to review the applicability of reach-in units for this protocol.[[168]](#footnote-168) The SWE performed research to expand the protocol to include deemed savings values for reach-in units because the existing protocol only applies to the installation of door gaskets in walk-in coolers and freezers. The Commission proposes to add deemed savings for door gaskets installed for glass doors of medium and low temp reach-in display cases and solid doors of reach-in coolers and freezers based on the analysis completed in California.[[169]](#footnote-169)

1. **Refrigeration – Suction Pipes Insulation**

As with the refrigeration – auto closersand the refrigeration – door gaskets protocols, the refrigeration – suction pipes insulation[[170]](#footnote-170) protocol documents the energy and peak demand savings attributed to insulation of bare refrigeration suction pipes in coolers and freezers. The savings protocol in the 2013 TRM relies on the work and analysis completed in California. The deemed savings values are adopted from the Southern California Edison work paper.[[171]](#footnote-171) Therefore, the values for each Pennsylvania reference city were taken from the associated California climate zones listed in the California work paper to account for differences in climate. There are sixteen California climate zones. Each of the seven reference cities are mapped to a California climate zone as shown in Table1-2 based on comparable number of cooling degree days and average dry bulb temperatures. The methodology of mapping Pennsylvania cities to California climate zones to account for differences in weather was previously described in this Tentative Order.

The Commission believes that mapping Pennsylvania cities to California climate zones based on comparable number of cooling degree hours and wet bulb temperatures will provide better metrics for mapping purposes and will represent more accurate deemed savings values. The Commission proposes to update deemed savings values based on revised weather mapping methodology. In addition, reference to the weather mapping table will be clearly mentioned in this protocol to provide clarity. Although this estimation is not perfect, i.e. there are no direct matches of weather characteristics between California and Pennsylvania, it serves as a reasonable proxy to translate savings from DEER or California work papers. The Commission further proposes that, due to the relatively small contribution of savings toward the EDCs’ portfolios as a whole and due to the lack of Pennsylvania-specific data, the *ex-ante* savings based on the analysis completed in California will be used until Pennsylvania-specific research is conducted.

1. **Appendix C**

The proposed improvements to the C&I lighting protocols for the 2014 TRM will be captured in Appendix C - Lighting Inventory Tool. The major changes will include updating the algorithms for calculating energy and demand savings for fixture and control improvements to be consistent with the protocol in the TRM. In addition, the Commission proposes to expand the wattage table based on the feedback received from the PEG.

1. **Appendix D**

As with Appendix C, the proposed improvements to the C&I VFD protocol in the 2014 TRM will be captured in Appendix D – Motors and VFD Savings Calculator. The major changes will include updating the algorithms for calculating energy and demand savings to be consistent with the protocol in the TRM.

# CONCLUSION

With this Tentative Order, the Commission seeks comments on the proposed additions and updates to the TRM. This Tentative Order represents the Commission’s continuing efforts in establishing a comprehensive TRM with a purpose of supporting both the AEPS Act and the EE&C Program provisions of Act 129. We look forward to receiving comments from interested stakeholders regarding the proposed changes to the TRM.

**THEREFORE,**

**IT IS ORDERED:**

1. That the proposed 2014 Technical Reference Manual update be issued for comment.

2. That a copy of this Tentative Order shall be served upon the Office of Consumer Advocate, the Office of Small Business Advocate, the Commission’s Bureau of Investigation and Enforcement, the Pennsylvania Department of Environmental Protection and all parties who commented on the 2013 Technical Reference Manual update.

3. That the Secretary shall deposit a notice of this Tentative Order and proposed 2014 version of the TRM with the Legislative Reference Bureau for publication in the *Pennsylvania Bulletin*.

4. That interested parties shall have 30 days from the date the notice is published in the *Pennsylvania Bulletin* to file written comments referencing Docket Number M-2012-2313373 with the Pennsylvania Public Utility Commission.

5. That interested parties shall have 40 days from the date the notice is published in the *Pennsylvania Bulletin* to file written reply comments referencing Docket Number M-2012-2313373 with the Pennsylvania Public Utility Commission.

6. That a Word formatted copy of all comments and reply comments shall be electronically mailed to Megan G. Good at [megagood@pa.gov](mailto:megagood@pa.gov) and Kriss Brown at [kribrown@pa.gov](mailto:kribrown@pa.gov). Attachments may not exceed three megabytes.

7. That this Tentative Order, the proposed 2014 version of the TRM and all filed comments and reply comments related to this Tentative Order be published on the Commission’s website at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/technical_reference_manual.aspx>.

8. That the contact person for technical issues related to this Tentative Order and the proposed 2014 version of the TRM is Megan G. Good, Bureau of Technical Utility Services, 717-425-7583 or [megagood@pa.gov](mailto:megagood@pa.gov). The contact person for legal and process issues related to this Tentative Order and the proposed 2014 version of the TRM is Kriss Brown, Law Bureau, 717-787-4518 or [kribrown@pa.gov](mailto:kribrown@pa.gov).



**BY THE COMMISSION**

Rosemary Chiavetta

Secretary

(SEAL)

ORDER ADOPTED: August 29, 2013

ORDER ENTERED: August 29, 2013

1. Order entered on October 3, 2005, at Docket No. M-00051865 (October 3, 2005 Order). [↑](#footnote-ref-1)
2. As of August 11, 2011, the Bureau of CEEP was eliminated and its functions and staff transferred to the newly created Bureau of Technical Utility Services. *See Implementation of Act 129 of 2008; Organization of Bureaus and Offices*, Final Procedural Order, entered August 11, 2011, at Docket No. M-2008-2071852, at page 4. [↑](#footnote-ref-2)
3. *See* October 3, 2005 Order at page 13. [↑](#footnote-ref-3)
4. *See Energy Efficiency and Conservation Program* Implementation Order at Docket No. M-2008-2069887, (Phase I Implementation Order), at page 13, entered January 16, 2009. [↑](#footnote-ref-4)
5. *Id*. [↑](#footnote-ref-5)
6. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual* Update Order at Docket No. M‑00051865, (2009 TRM), entered June 1, 2009. [↑](#footnote-ref-6)
7. *Id*. at pages 17 and 18. [↑](#footnote-ref-7)
8. *See Energy Efficiency and Conservation Program* Implementation Order, at Docket No. M-2012-2289411, (*Phase II Implementation Order*), entered August 3, 2012, at page 71. [↑](#footnote-ref-8)
9. *Id*. at page 75. [↑](#footnote-ref-9)
10. The PEG is chaired by staff of the Commission’s Bureau of Technical Utility Services and is comprised of representatives from the EDCs and the SWE for the purpose of encouraging discussion of EDC program-specific issues and associated evaluation, measurement and verification. [↑](#footnote-ref-10)
11. The TWG is chaired by staff of the Commission’s Bureau of Technical Utility Services and is comprised of representatives from the EDCs, the SWE and other interested parties for the purpose of encouraging discussion of the technical issues related to the evaluation, measurement and verification of savings programs to be implemented pursuant to Act 129. [↑](#footnote-ref-11)
12. The Commission held a TWG meeting on July 15, 2013, to provide stakeholders with the opportunity to review proposed high impact changes to residential, commercial and industrial measures, and also allow for a question and answer session regarding those changes. Additionally, stakeholders had the opportunity to propose any other changes they would like to have made to the TRM. [↑](#footnote-ref-12)
13. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual Update*, Final Order at Docket No. M-00051865, (2010 TRM), entered June 8, 2010. *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual Update*, Final Order at Docket No. M-00051865, (2011 TRM), entered February 28, 2011. *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2012 Update*, Final Order at Docket No. M‑00051865, (2012 TRM), entered December 16, 2011. And *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2013 Update*, Final Order at Docket No. M-2012-2313373, (2013 TRM), entered December 20, 2012. [↑](#footnote-ref-13)
14. *Ex-ante* savings are also known as claimed savings and result directly from completed program-related actions taken by participants. *Ex-post* savings are also known as verified savings and are based on an independent assessment of the reliability of the ex-ante savings. [↑](#footnote-ref-14)
15. *See Implementation of Act 129 of 2008 – Total Resource Cost (TRC) Test 2011 Revisions* Final Order, at Docket No. M-2009-2108601, (2011 TRC Test Final Order*)*, entered August 2, 2011. [↑](#footnote-ref-15)
16. A stipulated value for a stipulated variable refers to a single input value to an algorithm, while a deemed savings estimate is the result of calculating the end result of all of the stipulated values in the savings algorithm. [↑](#footnote-ref-16)
17. A stipulated value for a stipulated variable refers to a single input value to an algorithm. [↑](#footnote-ref-17)
18. Open variables are listed with a default value and an option for EDC data gathering. [↑](#footnote-ref-18)
19. The thresholds kWh/year will be stipulated in the 2014 TRM and will vary depending on the type of end-use category. [↑](#footnote-ref-19)
20. For example, linear fluorescent lighting, CFL lighting and LED lighting are individual measures within the Lighting end-use category. [↑](#footnote-ref-20)
21. In situations where a CSP meters a project because the expected kWh savings are above the established threshold and then realizes that the actual savings are below the threshold, metered results should be used for reporting claimed and verified savings. [↑](#footnote-ref-21)
22. NYSERDA 2009-2010 Industrial and Process Efficiency Program Impact Evaluation Final Report, September 24, 2012. http://www.nyserda.ny.gov/Program-Evaluation/NYE$-Evaluation-Contractor-Reports/2012-Reports/~/media/Files/EDPPP/Program%20Evaluation/2012ContractorReports/2012%20IPE%20Impact%20Final%20Report.pdf. [↑](#footnote-ref-22)
23. <http://rtf.nwcouncil.org/protocols/Default.asp>. [↑](#footnote-ref-23)
24. Measurement & Verification (M&V) Protocol Selection Guide and Example M&V Plan, Bonneville Power Administration, May 2012. <http://www.bpa.gov/Energy/n/pdf/1_BPA_MV_Protocol_Selection_Guide_May2012_FINAL.pdf>. [↑](#footnote-ref-24)
25. EDC independent evaluators must verify the project-specific M&V data, including pre and post metering results, obtained by the CSPs, as practicable, for projects in the evaluation sample. If the independent evaluator determines that data collected by the CSPs are not reasonably valid, then the evaluator must perform measurements consistent with International Performance Measurement and Verification Protocol options to collect post-retrofit information for projects that have estimated savings above a threshold kWh/year level. The SWE reserves the right to audit and review claimed and verified impacts of any project selected in the evaluation sample. [↑](#footnote-ref-25)
26. *See Phase II Implementation Order* at page107. [↑](#footnote-ref-26)
27. *See* Section 1.15, page 8, of the 2013 TRM. [↑](#footnote-ref-27)
28. *See* Appendix B, page 346, of the 2013 TRM. [↑](#footnote-ref-28)
29. The 2013 TRM does not provide calculations or algorithms for custom measures since the category covers a wide range of equipment, approaches, and measures. Where custom measures are discussed, the TRM requires site-specific equipment, operating schedules, baseline and installed efficiencies, and calculation methodologies to estimate energy and demand savings. [↑](#footnote-ref-29)
30. http://www.evo-world.org/index.php?option=com\_content&task=view&id=272&Itemid=279. [↑](#footnote-ref-30)
31. www1.eere.energy.gov/femp/pdfs/mv\_guidelines.pdf. [↑](#footnote-ref-31)
32. If the CMPs use a top 100 hours approach for calculating peak demand savings, the protocol must be revised to address the new peak demand window definition. [↑](#footnote-ref-32)
33. *See* Section 1.9, page 6, of the 2013 TRM. [↑](#footnote-ref-33)
34. PJM Manual 18B for Energy Efficiency Measurement & Verification is available at <http://www.pjm.com/~/media/documents/manuals/m18b.ashx>. [↑](#footnote-ref-34)
35. *See* Section 1.1, page 1, of the 2013 TRM. [↑](#footnote-ref-35)
36. *See* Section 1.13, page 8, of the 2013 TRM. [↑](#footnote-ref-36)
37. *See* Section 3.23, page 291, of the 2013 TRM. [↑](#footnote-ref-37)
38. *See* Section 3.24, page 293, of the 2013 TRM. [↑](#footnote-ref-38)
39. *See* Section 3.25, page 296, of the 2013 TRM. [↑](#footnote-ref-39)
40. <http://www.deeresources.com/>; ftp://deeresources.com/pub/WorkpaperReview/13-14Phase1/. [↑](#footnote-ref-40)
41. *See* Section 1.16, page 9, of the 2013 TRM. [↑](#footnote-ref-41)
42. *See* Section 2, page 14, of the 2013 TRM Final Order. [↑](#footnote-ref-42)
43. *See* Section 1.11.2, pages 6 and 7, of the 2013 TRM. [↑](#footnote-ref-43)
44. *See 2012 PA Total Resource Cost (TRC) Test; 2009 PA Total Resource Cost Test* Final Order, at Docket Nos. M-2012-2300653 and M-2009-2108601, (2013 TRC Test Final Order*)*, entered August 30, 2012. [↑](#footnote-ref-44)
45. *See* Section 1.17, pages 10, of the 2013 TRM. [↑](#footnote-ref-45)
46. *See* Appendix A, page 342, of the 2013 TRM. [↑](#footnote-ref-46)
47. *See* page 23 of the 2013 TRM Final Order. [↑](#footnote-ref-47)
48. *See* Section 2.1.2, pages 15 and 16, Table 2-1, of the 2013 TRM. [↑](#footnote-ref-48)
49. *See* GDS Associates, Inc. Pennsylvania Statewide Residential End-Use Saturation Study, 2012. Available at <http://www.puc.pa.gov/electric/pdf/Act129/PA_Residential_Baseline_Report2012.pdf>. [↑](#footnote-ref-49)
50. *See* Section 2.1, page 15, Table 2-1, of the 2013 TRM. [↑](#footnote-ref-50)
51. *See* Section 2.5, page 28, Table 2-6, of the 2013 TRM. [↑](#footnote-ref-51)
52. *See* Section 2.11, page 50, Table 2-19, of the 2013 TRM. [↑](#footnote-ref-52)
53. *See* Section 2.17, page 71, Table 2-26, of the 2013 TRM. [↑](#footnote-ref-53)
54. *See* Section 2.20, page 87, Table 2-34, of the 2013 TRM. [↑](#footnote-ref-54)
55. *See* Section 2.21, page 91, Table 2-35, of the 2013 TRM. [↑](#footnote-ref-55)
56. *See* page 27 of the 2013 TRM Final Order. [↑](#footnote-ref-56)
57. *See* page 48 of the 2013 Mid-Atlantic TRM. [↑](#footnote-ref-57)
58. Illinois Statewide TRM, 2013, “Central Air Conditioning in Wisconsin,” Energy Center of Wisconsin, May 2008, (2013 Illinois Statewide TRM). [↑](#footnote-ref-58)
59. “Distribution Efficiency Look-Up Table”, Building Performance Institute, Updated 1/12, <http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf>. [↑](#footnote-ref-59)
60. *See* page 26 of the 2013 TRM Final Order. [↑](#footnote-ref-60)
61. *See* 2013 TRM Final Order, pages 27-28. [↑](#footnote-ref-61)
62. McQuay Application Guide 31-008, Geothermal Heat Pump Design Manual, 2002. [↑](#footnote-ref-62)
63. Residential Ground Source Heat Pumps with Integrated Domestic Hot Water Generation: Performance Results from Long-Term Monitoring”, U.S. Department of Energy, November 2012 and Desuperheater Study, New England Electric System, 1998 42 U.S.C.A 6295(i) (West Supp. 2011) and 10 C.F.R. 430.32 (x) (2011). [↑](#footnote-ref-63)
64. *See* page 31 of the 2013 TRM Final Order. [↑](#footnote-ref-64)
65. EmPOWER Maryland 2012 Final Evaluation Report: Residential Lighting Program, Prepared by Navigant Consulting and the Cadmus Group, Inc., March 2013. [↑](#footnote-ref-65)
66. *See* page 30 of the 2013 TRM Final Order. [↑](#footnote-ref-66)
67. *See* page 33 of the 2013 TRM Final Order. [↑](#footnote-ref-67)
68. *See* page 32 of the 2013 TRM Final Order. [↑](#footnote-ref-68)
69. Nexus Market Research, “Impact Evaluation of the Massachusetts, Rhode Island and Vermont 2003 Residential Lighting Programs”, Final Report, October 1, 2004. [↑](#footnote-ref-69)
70. See <http://www1.eere.energy.gov/wip/pdfs/53827-6.pdf> for the final set of UMP Residential Lighting Evaluation Protocols. [↑](#footnote-ref-70)
71. The Phase II Lighting Metering Study is outlined in the Commission’s Phase II SWE Contract available at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/act_129_statewide_evaluator_swe_.aspx>. [↑](#footnote-ref-71)
72. *See* page 77 of the 2013 TRM Final Order. [↑](#footnote-ref-72)
73. 2013 Illinois Statewide TRM - An estimate based on review of Madison Gas and Electric, Exterior Wall Insulation, R-value for no insulation in walls, and NREL's Building Energy Simulation Test for Existing Homes (BESTEST-EX). [↑](#footnote-ref-73)
74. *See* page 77 of the 2013 TRM Final Order. [↑](#footnote-ref-74)
75. ”Improving Attic Thermal Performance”, Home Energy, November 2004. [↑](#footnote-ref-75)
76. NOAA Climatic Data for Pennsylvania cities- Cloudiness (mean number of days Sunny, Partly Cloudy, and Cloudy), <http://ols.nndc.noaa.gov/plolstore/plsql/olstore.prodspecific?prodnum=C00095-PUB-A0001>. [↑](#footnote-ref-76)
77. *See* Section 2.23, page 101, of the 2013 TRM. [↑](#footnote-ref-77)
78. *See* page 62 of the 2013 TRM Final Order. [↑](#footnote-ref-78)
79. *See* Section 2.26 – ENERGY STAR Clothes Washers, page 114, of the 2013 TRM. [↑](#footnote-ref-79)
80. *See* Section 2.27 – ENERGY STAR Dishwashers, page 120, of the 2013 TRM. [↑](#footnote-ref-80)
81. *See* Section 2.28 – ENERGY STAR Dehumidifiers, page 123, of the 2013 TRM. [↑](#footnote-ref-81)
82. *See* Section 2.29 – ENERGY STAR Room Air Conditioners, page126, of the 2013 TRM. [↑](#footnote-ref-82)
83. *See* Section 2.34 – ENERGY STAR Televisions, page 143, of the 2013 TRM. [↑](#footnote-ref-83)
84. *See* Section 2.35 – ENERGY STAR Office Equipment, page 147, of the 2013 TRM. [↑](#footnote-ref-84)
85. *See* Section 2.24 – ENERGY STAR Refrigerators, page 106, of the 2013 TRM. [↑](#footnote-ref-85)
86. *See* Section 2.25 – ENERGY STAR Freezers, page 111, of the 2013 TRM. [↑](#footnote-ref-86)
87. *See* Section 2.23 – ENERGY STAR Televisions, page 143, of the 2013 TRM. [↑](#footnote-ref-87)
88. ENERGY STAR Market & Industry Scoping Report, 2011. [↑](#footnote-ref-88)
89. NAHB Study of Life Expectance of Home Components, 2007. [↑](#footnote-ref-89)
90. *See* GDS Associates, Inc. Pennsylvania Statewide Residential End-Use Saturation Study, 2012. Available at <http://www.puc.pa.gov/electric/pdf/Act129/PA_Residential_Baseline_Report2012.pdf>. [↑](#footnote-ref-90)
91. PECO’s October 31, 2012 comments at Docket No. M-2012-2313373 at page 1. [↑](#footnote-ref-91)
92. *Id.* [↑](#footnote-ref-92)
93. *See* page 42 of the 2013 TRC Test Final Order. [↑](#footnote-ref-93)
94. The Showerhead and Faucet Aerator Metering Study for Michigan Evaluation Working Group, the Cadmus Group and Opinion Dynamics Evaluation Team, June 2013. [↑](#footnote-ref-94)
95. *See* footnote 2 of the Phase I Residential Baseline Study. [↑](#footnote-ref-95)
96. The Showerhead and Faucet Aerator Metering Study for Michigan Evaluation Working Group, the Cadmus Group and Opinion Dynamics Evaluation Team, June 2013. [↑](#footnote-ref-96)
97. Shower temperature cited from SBW Consulting, Evaluation for the Bonneville Power Authority, 1994, <http://www.bpa.gov/energy/n/reports/evaluation/residential/faucet_aerator.cfm>. [↑](#footnote-ref-97)
98. *See* footnote 2 of the Phase I Residential Baseline Study. [↑](#footnote-ref-98)
99. *See* Table 2-91 – High Efficiency Pool and Motor – Two Speed Pump Calculations Assumptions, page 168, of the 2013 TRM. [↑](#footnote-ref-99)
100. *Id.* [↑](#footnote-ref-100)
101. *See* Table 2-1 - Residential Electric HVAC – References, page 15, of the 2013 TRM. [↑](#footnote-ref-101)
102. *See* page 69 of the 2013 TRM Final Order. [↑](#footnote-ref-102)
103. “Electricity Savings Opportunities for Home Electronics and Other Plug-In Devices in Minnesota Homes,” Energy Center of Wisconsin, May 2010. [↑](#footnote-ref-103)
104. “Smart Plug Strips,” ECOS, July 2009. [↑](#footnote-ref-104)
105. Efficiency Vermont coincidence factor for smart strip measure – in the absence of empirical evaluation data, this was based on the assumptions of the typical run pattern for televisions and computers in homes. [↑](#footnote-ref-105)
106. “Smart Strip Electrical Savings and Usability”, David Rogers, Power Smart Engineering, October 2008. [↑](#footnote-ref-106)
107. *See* Table 2-23 – Smart Strip Plug Outlet Calculation Assumptions, page 59, of the 2013 TRM. [↑](#footnote-ref-107)
108. *See* page 66 of the 2013 TRM Final Order. [↑](#footnote-ref-108)
109. *See* 42 U.S.C.A. § 6295(g)(8) [↑](#footnote-ref-109)
110. *See* page 95 of the 2013 TRM Final Order. [↑](#footnote-ref-110)
111. *See* Section 6.5.3, page 239, of the 2012 Illinois TRM. [↑](#footnote-ref-111)
112. EUL adjustments are calculated by applying the savings adjustment factor to the remaining useful life of the measure and reducing the EUL accordingly. The savings adjustment factor methodology and the adjusted EUL methodology will produce the same lifetime savings. [↑](#footnote-ref-112)
113. The Phase II C&I Baseline Study is outlined in the Commission’s Phase II SWE Contract available at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/act_129_statewide_evaluator_swe_.aspx>. [↑](#footnote-ref-113)
114. *See* Section 3.2, page 176, of the 2013 TRM. [↑](#footnote-ref-114)
115. *See* Section 3.2.2, page 176, of the 2013 TRM. [↑](#footnote-ref-115)
116. *See* Section 3.2.6: Quantifying Annual Hours of Operation, pages 179, of the 2013 TRM. [↑](#footnote-ref-116)
117. *See* Table 3-4 – Lighting HOU and CF by Building Type or Function, pages 185-186, of the 2013 TRM. [↑](#footnote-ref-117)
118. *See* Section 3.2.7, pages 185 and 186, of the 2013 TRM. [↑](#footnote-ref-118)
119. *See* Section 3.6, pages 213-214, of the 2013 TRM. [↑](#footnote-ref-119)
120. Connecticut Program Savings Documentation for 2012 Program Year, United Illuminating Company, September 2011. [↑](#footnote-ref-120)
121. <http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_CAC.xls>. [↑](#footnote-ref-121)
122. eQUEST stands for “the Quick Energy Simulation Tool” which is a building energy analysis tool used to perform detailed analysis of today's state-of-the-art building design technologies. More information regarding the software can be found at: <http://doe2.com/equest/>. [↑](#footnote-ref-122)
123. <http://www.energy.ca.gov/deer/> . [↑](#footnote-ref-123)
124. *See* GDS Associates, Inc. Pennsylvania Statewide Commercial and Industrial End-Use Saturation Study, 2012. Available at <http://www.puc.pa.gov/electric/pdf/Act129/PA_CI_Baseline_Report2012.pdf>. [↑](#footnote-ref-124)
125. <http://www.eia.gov/consumption/commercial/>. [↑](#footnote-ref-125)
126. *See* Section 3.6, pages 214, of the 2013 TRM. [↑](#footnote-ref-126)
127. UI and CL&P Program Savings Documentation for 2012 Program Year, United Illuminating Company, September 2011. [↑](#footnote-ref-127)
128. *See* Section 3.6, pages 209, of the 2013 TRM. [↑](#footnote-ref-128)
129. *See* Section 3.18, pages 266, of the 2013 TRM. [↑](#footnote-ref-129)
130. *See* Section 3.18, pages 212, of the 2013 TRM. [↑](#footnote-ref-130)
131. *See* Section 3.18, pages 273, of the 2013 TRM. [↑](#footnote-ref-131)
132. *See* Section 3.3, pages 199, of the 2013 TRM. [↑](#footnote-ref-132)
133. *See* Section 3.4, pages 205, of the 2013 TRM. [↑](#footnote-ref-133)
134. Connecticut Program Savings Documentation for 2012 Program Year, United Illuminating Company, September 2011. [↑](#footnote-ref-134)
135. eQUEST stands for “the Quick Energy Simulation Tool” which is a building energy analysis tool used to perform detailed analysis of today's state-of-the-art building design technologies. More information regarding the software can be found at: <http://doe2.com/equest/>. [↑](#footnote-ref-135)
136. <http://www.energy.ca.gov/deer/>. [↑](#footnote-ref-136)
137. *See* Section 3.17, page 258, of the 2013 TRM. [↑](#footnote-ref-137)
138. <http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/EM+and+V/2006-2008+Energy+Efficiency+Evaluation+Report.htm>. [↑](#footnote-ref-138)
139. Are They Cool(ing)?: Quantifying the Energy Savings from Installing/Repairing Strip Curtains, Taghi Alereza, Sasha Baroiant, Donald R. Dohrmann, Daniel Mort, ADM Associates, Inc., Sacramento, CA. [↑](#footnote-ref-139)
140. *See* Section 3.19, page 275, of the 2013 TRM. [↑](#footnote-ref-140)
141. *See* page 110 of the 2013 TRM Final Order. [↑](#footnote-ref-141)
142. *See* Section 3.22, page 288, of the 2013 TRM. [↑](#footnote-ref-142)
143. <http://www.nwcouncil.org/energy/rtf/measures/measure.asp?id=95&decisionid=117> [↑](#footnote-ref-143)
144. *See* page 98 of the 2013 TRM Final Order. [↑](#footnote-ref-144)
145. *See* Section 3.22, page 289, of the 2013 TRM. [↑](#footnote-ref-145)
146. *See* Sections 3.26, page 298, of the 2013 TRM. [↑](#footnote-ref-146)
147. *See* page 107 of the 2013 TRM Final Order. [↑](#footnote-ref-147)
148. ESource Customer Direct to Touchstone Energy for Evaporator Fan Controllers, 2005, LBNL 57651 Energy Savings in Refrigerated Walk-in Boxes, 1998, and E Source Refrigeration Walk-in Cooler Controllers Purchasing Advisor, 2009. [↑](#footnote-ref-148)
149. *See* Section 3.27, page 301, of the 2013 TRM. [↑](#footnote-ref-149)
150. *Id*. [↑](#footnote-ref-150)
151. *See* page 113 of the 2013 TRM Final Order. [↑](#footnote-ref-151)
152. <http://www.appliances.energy.ca.gov/>. [↑](#footnote-ref-152)
153. <http://www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers_snopr_spreadsheets.html>. [↑](#footnote-ref-153)
154. *See* Section 3.30, page 320, of the 2013 TRM. [↑](#footnote-ref-154)
155. *See* page 100 of the 2013 TRM Final Order. [↑](#footnote-ref-155)
156. San Diego Gas & Electric, LED Channel Letter Signs, Work Paper WPSDGENRLG0021, Revision #1, August 25, 2010. [↑](#footnote-ref-156)
157. *See* Section 3.32, page 327, of the 2013 TRM. [↑](#footnote-ref-157)
158. Food Service Technology Center, 12949 Alcosta Blvd., Suite 101, San Ramon, CA 94583. Web address: http://www.fishnick.com/equipment/sprayvalves/, Accessed September 21, 2012. Sprayer by T&S Brass Model JetSpray B-0108 was rated at 1.48 GPM, and tested at 1.51 GPM. [↑](#footnote-ref-158)
159. Global Industrial. Web address: <http://www.globalindustrial.com/g/plumbing/faucets/food-service-faucets/TS-Brass-Pre-Rinse-Hose-Reels>. Listings for 27 models from multiple manufacturers. Highest ratings were 1.42 GPM. Two models by Zurn listed on the summary table at 1.6 GPM were found to be rated at 1.24 GPM upon checking. Accessed September 21, 2012. [↑](#footnote-ref-159)
160. *See* page 105 of the 2013 TRM Final Order. [↑](#footnote-ref-160)
161. *See* Section 3.23, page 291, of the 2013 TRM. [↑](#footnote-ref-161)
162. DEER2005-CommercialResultsReview-15August2005, <http://www.deeresources.com/>. [↑](#footnote-ref-162)
163. *See* Section 1.16, page 9, of the 2013 TRM. [↑](#footnote-ref-163)
164. *See* page 19 of the 2012 TRM Final Order. [↑](#footnote-ref-164)
165. *See* Section 3.24, page 293, of the 2013 TRM. [↑](#footnote-ref-165)
166. Southern California Edison Company, Design & Engineering Services, Work Paper WPSCNRRN0001, Door Gaskets for Main Door of Walk-in Coolers and Freezers. [↑](#footnote-ref-166)
167. Work papers developed by SCE filed with the CA PUC in support of its 2006 – 2008 energy efficiency program plans. [↑](#footnote-ref-167)
168. *See* page 20 of the 2012 TRM Final Order. [↑](#footnote-ref-168)
169. Southern California Edison Company, Design & Engineering Services, Work Paper WPSCNRRN00013, Revision 0, Door Gaskets for Glass Doors of Medium and Low Temp Reach-in Display Cases & Solid Doors of Reach-in Coolers and Freezers, October 15, 2007. [↑](#footnote-ref-169)
170. *See* Section 3.25, page 296, of the 2013 TRM. [↑](#footnote-ref-170)
171. Southern California Edison Company, “Insulation of Bare Refrigeration Suction Lines”, Work Paper WPSCNRRN0003.1. [↑](#footnote-ref-171)