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

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|  | Public Meeting held December 18, 2014 |
| Commissioners Present: |  |

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| Robert F. Powelson, Chairman |  |
| John F. Coleman, Jr., Vice ChairmanJames H. Cawley |  |
| Pamela A. Witmer |  |
| Gladys M. Brown |  |
|  |  |
| Implementation of the Alternative Energy PortfolioStandards Act of 2004: Standards for the Participationof Demand Side Management Resources – TechnicalReference Manual 2015 Update | Docket No. M-2012-2313373 M-00051865 |

**2015 TRM ANNUAL UPDATE FINAL 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-2) In adopting the original version of the TRM, this Commission directed its Bureau of Conservation, Economics and Energy Planning (CEEP)[[2]](#footnote-3) to oversee the implementation, maintenance and periodic updating of the TRM.[[3]](#footnote-4) 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-5) 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-6)

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-7) In adopting the 2009 TRM, the Commission recognized the importance of updating the TRM on an annual basis.[[7]](#footnote-8)

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-9) The *Phase II Implementation Order* also recognized the importance of the continued use of an annual updating process for the TRM.[[9]](#footnote-10) With this Final Order, the Commission advances the sixth annual update of the TRM to be applied beginning with the 2015‑2016 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-11) 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-12) meeting to discuss the proposed 2015 TRM updates.[[12]](#footnote-13)

As indicated above, the Commission has previously updated the TRM on five 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-14)

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 2014 TRM and proposed several changes and additions for consideration for inclusion in the 2015 TRM. A notice of the Tentative Order and proposed 2015 TRM update was published in the Pennsylvania Bulletin on September 27, 2014. Comments were due on October 14, 2014, with reply comments due October 21, 2014.

The following parties filed comments to the proposed 2015 TRM update: Duquesne Light Company (Duquesne); Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power Company and West Penn Power Company (collectively, FirstEnergy); Mitsubishi Electric Cooling and Heating (Mitsubishi Electric); PECO Energy Company (PECO); and PPL Electric Utilities Corporation (PPL). FirstEnergy was the only party to file reply comments.

**DISCUSSION**

The changes and improvements to the TRM are based on more recent research, a review of TRMs from other states, the needs and experiences of the EDCs and the comments provided by stakeholders. The EDCs provided, through the SWE evaluation, measurement and verification (EM&V) process, much of the data that forms the basis of the changes and improvements being adopted in the 2015 version of the TRM. Specifically, the current proposed improvements were the result of SWE site inspections, and comments from conservation service providers (CSPs) and EDC independent evaluators. Additionally, many of the issues raised during the 2014 TRM update process were referred to the PEG for discussion in order to provide recommendations during the 2015 TRM update. The adopted changes focus on improving assumptions for key parameters, algorithms and deemed savings values, as well as accounting for new codes and standards for residential, and commercial and industrial (C&I) EE&C measures. The Commission believes that these adopted changes will make the TRM a more effective and professional tool for validating energy savings and providing support for the Act 129 goals.

Below, we will discuss in more detail the more significant TRM changes and updates that are being adopted. Minor administrative and uncontested changes being adopted will not be discussed. Regarding instances where the Commission refers an issue to the SWE for further research in collaboration with the PEG, we would like to make it clear that the SWE is not required to attain a consensus before providing its recommendations to the Commission.

## General Improvements

### Updates to Federal and Environmental Protection Agency’s ENERGY STAR Requirements

 In recognizing that Federal codes and ENERGY STAR guidelines are at the core of many measures and that the baseline standards of the TRM should align with industry standards while fostering efficiency opportunities, the Commission proposed to update multiple stipulated values[[14]](#footnote-15) in the TRM in accordance with federal code minimums.[[15]](#footnote-16) Additionally, the Commission proposed that the multiple stipulated values for applicable measures using ENERGY STAR guidelines be updated to the active version of the ENERGY STAR standards as determined by the EPA.[[16]](#footnote-17)

For Section 2.2.1 – Electric HVAC,[[17]](#footnote-18) the Commission proposed updating the Heating Seasonal Performance Factor of the Baseline Unit (HSPFb) used in a Replace on Burnout scenario from 7.7 to 8.2 for air source heat pumps (ASHPs). Additionally, we proposed updating the seasonal energy efficiency ratio of the baseline unit (SEERb) used in a Replace on Burnout scenario from 13 to 14 for ASHPs. We proposed updating these values to align with the federal standards that become effective on January 1, 2015.[[18]](#footnote-19) Additionally, these same updates were proposed for the HSPFb and SEERb values in Section 2.2.3 – Ductless Mini-Split Heat Pumps.[[19]](#footnote-20)

 Similarly, the Commission proposed updating the Heating Seasonal Performance (HSPF) and seasonal energy efficiency ratio (SEER) values for the heating and cooling efficiencies of air source and geothermal heat pumps in Section 2.6.3 – Residential New Construction.[[20]](#footnote-21) The Commission also proposed updating the HSPF value to 8.2 and the SEER value to 14 for both types of heat pumps, per the federal standards changes.

 Lastly, the Commission proposed the following language in Section 1.7 – Baseline Estimates[[21]](#footnote-22) of the TRM to provide clarity in addressing which published standard will be applicable to a particular measure:

When an existing Federal standard expires in a given **calendar year**, then that change will be reflected in the **following** **program year**’s TRM.[[22]](#footnote-23) This applies only to measures where the Federal standard is considered the baseline as described in the TRM or otherwise required by law. In the case of a January 1st effective date for a new Federal standard, the previous standard will be said to have expired on December 31 of the previous calendar year, and thus the change will be reflected in the TRM to be released in June of that year. Likewise, it is proposed that when an existing ENERGY STAR Product Specification Version expires in a given **calendar year**, then that change will be reflected in the **following** **program year’s** TRM.[[23]](#footnote-24) This applies only to measures where the ENERGY STAR criterion is considered the eligibility requirement.

 **a. Comments**

Duquesne comments that Section 1.7 – Baseline Estimates describes two methodologies for defining baseline efficiencies that have critical issues relating to enforcement and sell-through. It avers that there is no funding available for an entity to monitor the market or the specifications of equipment and that enforcement is inactive. Duquesne states that it takes several years for the standards to align with the market with below standard products being available for many years after a standard is updated. Duquesne provides examples of 10 SEER units and T-12 light bulbs being readily available after the code update. Duquesne recommends that the timing of baseline updates be discussed on a case-by-case basis through the existing working groups or other collaborative structures.[[24]](#footnote-25)

 **b. Disposition**

 The Commission rejects Duquesne’s request to alter the guidance delivered in Section 1.7 – Baseline Estimates in order to manage code updates on a measure by measure basis. It is the intent of the TRM to align with the industry’s product regulations and to promote gross savings calculations. In instances where market trends were used to set the baseline standards, the TRM would show characteristics of promoting net savings calculations. Additionally, the logistics of coming to a consensus-based decision repeatedly for individual measures is not a realistic expectation, nor is it the optimum use of stakeholder time and resources.

### Measure Characterizations Assigned to All Measures

In the Tentative Order, the Commission proposed the assignment of a measure Vintage to all measures listed in the 2015 TRM. The Vintage description would be listed at the beginning of the measure language to provide clarity on the intent of the measure and assist the user in classifying the approach.

 **a. Comments**

 Duquesne comments that the 2015 TRM delineates the differences between the baselines for market-driven activity and discretionary activity in Section 1.7 – Baseline Estimates. Duquesne notes that having a baseline that initially is calculated using the efficiency of existing equipment and then is changed to a replace-on-burnout baseline at some estimated date creates theoretical and practical issues. Duquesne asserts that the use of dual baselines introduces greater uncertainty and inaccuracy to TRM algorithm inputs; imposes onerous implementation routines; increases the opportunity for calculation error and will drive costly tracking system upgrades. Duquesne requests that the Commission remove the dual baseline language and allow EDCs to cite, as baselines, pre-existing equipment or standards. That is, to identify installations as either 1) early retirement or 2) replace on burn-out, not both, and to employ identical treatment to cost-effectiveness reporting where TRCs include either full or incremental measure cost, respectively.[[25]](#footnote-26)

 **b. Disposition**

 The Commission rejects Duquesne’s recommendation to remove the dual baseline language from the TRM. Although the Commission recognizes that this approach may add complexity to program tracking, evaluation and TRC calculations, the Commission believes that it is the most accurate way to capture savings. The dual baseline method takes into account improvements in technology that would be driven by the market in cases where baseline changes are known and significant. To credit an EE&C program with lifetime energy and peak savings that will be necessitated by market changes would produce distorted benefit cost ratios in the TRC Test.

The Commission further clarifies that the dual baseline approach will not impact EDCs’ first year energy and peak demand savings, which are used to determine EDC compliance. The measure vintages and measure lives provide guidelines for TRC tests as energy savings or useful life are reduced to reflect the changing baseline values. For example, The Energy Policy Act of 2005 (EPAct)[[26]](#footnote-27) introduced new efficiency standards for linear fluorescent bulbs and ballasts, effectively phasing out magnetic ballasts on October 1, 2010, and T-12 bulbs on July 14, 2012. The Commission believes that T-12 linear fluorescents will continue to be the baseline for lighting retrofit projects for the entirety of Phase II in order to account for the time required for the market to adjust to the new code standards. However, beginning June 1, 2016, standard T-8s will become the baseline for all T-12 linear fluorescent retrofits. This baseline shift will be accounted for by applying savings adjustment factors or reducing the effective useful life of general service fluorescent lighting measures. This adjustment accounts for the fact that customers would have to replace their T-12 fixtures, absent the program, at some point in the effective useful life of the efficient equipment. Therefore, using a T-12 baseline for the entirety of the measure life would overstate savings.

The Commission also notes that Table 3-2 and Table 3-3 in the Tentative 2015 TRM presented the savings adjustment factor as the percent reduction after the baseline changes take effect. Upon further review, the savings adjustment factor would be more clearly stated as the percent of savings remaining. To apply the savings adjustment factors, savings adjustment factors should be multiplied by the full savings for savings starting June 1, 2016, and for the remainder of the measure life. The Commission has updated the TRM to reflect the changes in the savings adjustment factor and adjusted EUL values. The Commission also added a table to include savings adjustment factors and adjusted EULs for standard T-8 retrofits. Finally, the Commission has provided, in the TRM, an example to further explain how these values are used.

### TRM Measure Formatting Changes – Organization of Measures

The Commission proposed the reorganization of the 2015 TRM in order to align with other statewide TRMs and to provide for a more intuitive way to locate data within the TRM. To accomplish this, the Commission proposed updating the Residential and C&I measure order and measure identification numbers to classify them by end use,[[27]](#footnote-28) intended as an expansion of Section 1.2.3 - End-Use Categories & Thresholds for Using Default Values of the TRM. Table 1-1: End-Use Categories and Measures in the TRM in Section 1.2.3 – End-Use Categories and Measures in the TRM was proposed to be updated as follows:

| **End-Use Categories** | **List of Measures (Sections)**[[28]](#footnote-29) |
| --- | --- |
| **Residential Market Sector** |
| Lighting - 2.1 | 2.1.1 – 2.1.5 |
| HVAC - 2.2 | 2.2.1 – 2.2.9 |
| Domestic Hot Water - 2.3 | 2.3.1 – 2.3.11 |
| Appliances – 2.4 | 2.4.1 – 2.4.11 |
| Consumer Electronics – 2.5 | 2.5.1 – 2.5.3 |
| Building Shell – 2.6 | 2.6.1 – 2.6.7 |
| Miscellaneous – 2.7 | 2.7.1 – 2.7.2 |
| **Commercial & Industrial Market Sector** |
| Lighting – 3.1 | 3.1.1 – 3.1.7 |
| HVAC – 3.2 | 3.2.1 – 3.2.9 |
| Motors & VFDs – 3.3 | 3.3.1 – 3.3.4 |
| Domestic Hot Water – 3.4 | 3.4.1 – 3.4.6 |
| Refrigeration – 3.5 | 3.5.1 – 3.5.14 |
| Appliances – 3.6 | 3.6.1 |
| Food Service Equipment – 3.7 | 3.7.1 – 3.7.5 |
| Building Shell – 3.8 | 3.8.1 |
| Consumer Electronics – 3.9 | 3.9.1 – 3.9.3 |
| Compressed Air – 3.10 | 3.10.1 – 3.10.3 |
| Miscellaneous – 3.11 | 3.11.1 |
| **Agricultural Market Sector** |
| Agricultural Equipment | 4.1 – 4.8 |

Additionally, the Commission proposed to update the layout of the information presented in each measure to be more uniform throughout the 2015 TRM.

 **a. Comments**

PECO comments that, overall, the TRM is now more user-friendly and supports the categorization of measures by end-use, further recommending that future TRMs incorporate any new measures in the same fashion. PECO further comments that the listing of measure life in both the measure introductory table as well as the appendix may create confusion or errors during TRM updates as one measure life may be changed without updating the corresponding measure life in either the appendix or measure body. PECO recommends that all measure lives be listed in the appendix of the TRM.[[29]](#footnote-30)

 **b. Disposition**

 The Commission agrees that the reorganization of the TRM makes navigation throughout much easier and the grouping of measures by end-use does align with industry standards. As the TRM progresses into another version, careful consideration will be applied in order to preserve the improved format. The Commission, however, does not agree that the measure life for individual measures should only be listed in the appendix as opposed to both the appendix and the measure categorical information. Prior comments have led the Commission to believe that the multiple listings provide easier access and, therefore, will remain.

### Updating Coincident Factors

The Commission proposed the updating of factors used for estimating coincident peak demand savings, as we expect the EDCs to track relevant coincident peak demand reductions occurring as a result of their Phase II EE&C Programs. Additionally, the Commission proposed the addition of the following definition to be added to Section 1.3 – Definitions[[30]](#footnote-31) of the TRM:

Coincidence Factor - The ratio of the (1) sum of every unit’s average kW [kilowatt] load during the PJM peak load period (June through August, non-holiday weekdays, 2 pm to 6 pm) to the (2) sum of the non-coincident maximum kW connected load for every unit.

Given the guidelines for the peak period from PJM, the Commission proposed multiple updates to coincidence factors (CFs) throughout the 2015 TRM so that the CFs are based as closely as possible to the conditions found in the Pennsylvania electric distribution company service territories and are developed using the most reliable and up-to-date data. Additionally, the Commission proposed updates to the deemed demand savings with algorithms that include a CF for Section 2.4.4 – ENERGY STAR Clothes Washers;[[31]](#footnote-32) Section 2.4.7 – ENERGY STAR Dishwashers;[[32]](#footnote-33) and Section 2.4.8 – ENERGY STAR Dehumidifiers.[[33]](#footnote-34) The proposed changes were to correct misleading information and to more closely align with the PJM peak period definition.

Regarding Section 2.5.2 – ENERGY STAR Office Equipment,[[34]](#footnote-35) the SWE determined that the last update to the calculator for demand and energy savings occurred in 2011 and that only emission rates have been updated since that time. Some analysis of the data within the calculator showed that a CF was most likely built into the demand savings value. Therefore, the Commission proposed that the CF be removed from the algorithms and to maintain values used in previous versions of the TRM.

Regarding C&I CFs, following the SWE’s completion of a computer simulation study, using eQuest software, the Commission proposed new CFs for the HVAC measures which are based on reference-city-specific values that align with the peak demand definition. We proposed specific CFs based on each reference city and building type. The Commission also proposed referencing the same table of CFs for both the heat pump unit and ground source loop pump units and geothermal heat pumps, unless the ground source loop pump runs continuously, in which case, we propose the use of a value of 100%.

 **a. Comments**

No comments were received on the general update to the coincidence factors. However, multiple comments were received concerning the formatting and delivery of the coincidence factor in the TRM, with PPL and PECO requesting adjustment to the redundant use of the percentage designation.[[35]](#footnote-36)

 **b. Disposition**

The Commission agrees with those parties requesting clarification of the units used throughout the TRM and has adjusted all coincidence factors to be presented in decimal format. In addition, the following sentence was added to the aforementioned definition of “Coincidence Factor” in Section 1.3 – Definitions: “This value is expressed in decimal format throughout the TRM unless designated otherwise.”

### Incorporation of the 2014 Baseline Study Results

In the 2014 TRM Final Order, the Commission directed the PEG to review the baselines used in the TRM and address the potential for updating them based on the 2014 Residential Baseline Study, the 2014 C&I Baseline Study and the SWE Potential Studies.[[36]](#footnote-37) In April 2014, the SWE completed the 2014 Residential Baseline Study. The Commission proposed the use of the information provided in the 2014 Residential Baseline Study to align the 2015 TRM sources with current data for multiple measures in the residential sector.

Specifically, in Section 2.2.1 – Electric HVAC[[37]](#footnote-38) of the TRM, the Commission proposed an update to the default SEERb value, to be used in lieu of EDC data gathering, for Early Replacement measures. Additionally, for Section 2.4.4 – ENERGY STAR Clothes Washers, the Commission proposed updating the following variables using the 2014 Residential Baseline Study as a source: Cycles and %ElectricDryer. For Section 3.4.1 – Electric Resistance Water Heaters[[38]](#footnote-39) and Section 3.4.2 – Heat Pump Water Heaters,[[39]](#footnote-40) the Commission proposed updating the source to the 2014 Residential Baseline Study for those calculation assumptions that had previously used the 2012 Residential Baseline Study as a source. With regard to Section 3.4.6 – Heat Pump Water Heaters to Gas/Oil/Propane,[[40]](#footnote-41) the Commission proposed updating the source to the 2014 Residential Baseline Study for those hot water temperature assumptions that had previously used the 2012 Residential Baseline Study as a source.

 **a. Comments**

 PPL questions the baseline water temperature value in Section 2.3.1 – Efficient Electric Water Heaters,[[41]](#footnote-42) as well as the baseline value for gallons per minute (GPM) used in Section 2.3.11 – Thermostatic Shower Restriction Valve. PPL requests confirmation that the temperature and GPM values are current and consistent with other measures.[[42]](#footnote-43)

 **b. Disposition**

 The Commission acknowledges the request to review the baseline values and has performed a review of multiple measures that use information from the 2014 Residential Baseline Study. In certain measures, such as the domestic hot water measures discussed in the comments, some baseline default values did not receive updates from the 2012 Residential Baseline Study to the 2014 Residential Baseline Study. However, in Sections 2.3.1 – Efficient Electric Water Heaters, 2.3.2 – Heat Pump Water Heaters,[[43]](#footnote-44) 2.3.3 – Solar Water Heaters,[[44]](#footnote-45) 2.3.4 – Fuel Switching: Electric Resistance to Fossil Fuel Water Heater,[[45]](#footnote-46) 2.3.5 – Fuel Switching: Heat Pump Water Heater to Fossil Fuel Water Heater,[[46]](#footnote-47) 2.3.6 – Water Heater Tank Wrap[[47]](#footnote-48) and 2.3.7 – Water Heater Temperature Setback,[[48]](#footnote-49) the water heater temperature setting has been updated to reflect the findings in the 2014 Residential Baseline Study.

### Discussion of Weather Impacts on C&I Measures

There are two commercial refrigeration measures in the TRM (Section 3.5.11 – Auto Closers[[49]](#footnote-50) and Section 3.5.14 – Suction Pipe Insulation for Walk-In Coolers and Freezers[[50]](#footnote-51)) that rely on work and analysis completed in California. In the 2014 TRM, seven reference cities in Pennsylvania are mapped to a corresponding California climate zone, as shown in the Table 1-4: California CZ Mapping Table,[[51]](#footnote-52) based on cooling degree hours and wet bulb temperatures. Stakeholders raised concerns regarding the feasibility and appropriateness of the mapping methodology. In the Tentative Order, the Commission proposed using a single California climate zone. Specifically, the Commission proposed using California climate zone 4 for all weather-dependent measures referencing California work papers.

 **a. Comments**

PPL notes that the proposal used California climate zone 4 while Section 1.17 – Impact of Weather[[52]](#footnote-53) referenced Climate Zone 11.[[53]](#footnote-54)

 **b. Disposition**

The Commission clarifies that climate zone 4 will be used and has updated Section 1.17 – Impact of Weather to reflect this change. The Commission further notes that in the Proposed 2015 TRM, the savings values in the two refrigeration protocols were calculated using climate zone 4 and therefore do not need to be updated.

### Updating Sources

The Commission proposed to update a variety of reference sources to provide more accurate information. This includes the following sections:

* Section 2.2.7 – Furnace Whistle;[[54]](#footnote-55)
* Section 3.2.1 – HVAC Systems;[[55]](#footnote-56)
* Section 3.5.1 – High-Efficiency Refrigeration/Freezer Cases;[[56]](#footnote-57)
* Section 3.5.2 – High-Efficiency Evaporator Fan Motors for Reach-In Refrigerated Cases;[[57]](#footnote-58)
* Section 3.5.3 – High-Efficiency Evaporator Fan Motors for Walk-In Refrigerated Cases;[[58]](#footnote-59)
* Section 3.7.2 – Controls: Beverage Machine Controls;[[59]](#footnote-60)
* Section 3.7.1 – High-Efficiency Ice Machines;[[60]](#footnote-61)
* Section 3.8.1 – Wall and Ceiling Insulation;[[61]](#footnote-62)
* Section 3.7.4 – ENERGY STAR Electric Steam Cooker;[[62]](#footnote-63)
* Section 3.9.2 – Office Equipment – Network Power Management Enabling;[[63]](#footnote-64)
* Section 3.5.14 – Suction Pipe Insulation for Walk-In Coolers and Freezers;
* Section 3.5.4 – Controls: Evaporator Fan Controllers;[[64]](#footnote-65)
* Section 3.6.1 – ENERGY STAR Clothes Washers;[[65]](#footnote-66)
* Section 3.4.2 – Heat Pump Water Heaters;
* Section 4.1.1 – Automatic Milker Takeoffs;[[66]](#footnote-67)
* Section 4.1.4 – Heat Reclaimers;[[67]](#footnote-68) and
* Section 4.1.6 – Livestock Waterer.[[68]](#footnote-69)

 **a. Comments**

 PECO notes that the source used for the DEER database references should be updated to correct hyperlink issues and to reference an updated measure life.[[69]](#footnote-70)

 **b. Disposition**

 The Commission agrees with PECO that hyperlinks for sources referenced in the measures using the DEER database are not functional. This is due to accessibility issues involved with registering for the database. The Commission has adjusted the DEER references to avoid detailed links to individual files or member-only access portions of the database.

### Thresholds for Using Default Values

 The Commission did not propose changes to the thresholds for using site-specific information for open variables used in the calculation of energy and demand savings. However, comments were received and are addressed below.

 **a. Comments**

 FirstEnergy notes that, consistent with comments on the 2014 TRM, thresholds for requiring site-specific information for open variables are lower than necessary. FirstEnergy recommends that thresholds be reviewed through the PEG process for the 2016 TRM update. FirstEnergy states that overall certainty in verified megawatt-hours (MWh) and megawatt (MW) estimates will actually increase if the thresholds – particularly for lighting projects— are increased, because trade allies or applicants generally do not have the capability to conduct monitoring. This results in the need for evaluators to manage a constant trickle of medium-sized projects, instead of focusing M&V efforts on projects that represent the most savings.[[70]](#footnote-71)

 **b. Disposition**

 The Commission acknowledges FirstEnergy’s comments and agrees that thresholds may require a review. Since the thresholds went into effect in program year five (PY5), the Commission is still awaiting evaluation results to determine if adjustments to the thresholds are necessary for the 2016 TRM update. The Commission directs the SWE to review the results from PY5 and identify thresholds for future TRM updates that will balance the level of evaluation rigor and the need for accuracy of savings estimates with the level of costs required to collect customer-specific data.

### Applicability of the TRM for Estimating *Ex-Ante* Savings

The Commission did not propose changes to the applicability of the TRM with regards to determining the in-service date of certain measures. However, the Commission did receive comments and they are addressed below.

 **a. Comments**

 PPL notes that Section 1.2.4 – Applicability of the TRM for Estimating *Ex Ante* (Claimed) Savings[[71]](#footnote-72) does not correctly address appliance in-service dates with regards to new construction. Specifically, PPL recommends rephrasing the first sentence in the section to read the following:

For replacements, retrofits and new construction appliances, 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," and when savings actually start to occur.

 PPL further comments that appliances are typically purchased closer to the building finish date than to the permit date of the home. This finish date would also be or close to the actual rebate date for a specific appliance.[[72]](#footnote-73)

 **b. Disposition**

 The Commission agrees with PPL’s proposed changes and has updated the TRM.

## Additional Residential EE&C Measure Protocols

The Commission proposed the inclusion of the following residential measure protocols:

* Section 2.3.11 – Thermostatic Shower Restriction Valve;
* Section 2.4.5 – ENERGY STAR Dryers;
* Section 2.4.6 – Fuel Switching: Electric Clothes Dryer to Gas Clothes Dryer;
* Section 2.4.10 – ENERGY STAR Ceiling Fans;
* Section 2.6.2 – Air Sealing;[[73]](#footnote-74) and
* Section 2.6.5 – ENERGY STAR Manufactured Homes.

The Commission adopts the addition of five new residential protocols noting the changes to certain measures, outlined below. The Commission rejects the addition of the Air Sealing protocols for the reasons outlined below.

1. **Section 2.3.11 – Thermostatic Shower Restriction Valve**

**a. Comments**

PPL comments that the Eligibility section of the measure should include clarification on combining the savings of the measure with the low-flow showerhead measure. PPL also notes discrepancies in the measure algorithm. Additionally, PPL questions the algorithm’s necessity and the calculation of the default variables. PPL recommends that an EDC data gathering option be included to calculate the variable for the assumed temperature of the water used by the showerhead.[[74]](#footnote-75)

 **b. Disposition**

The Commission agrees with PPL’s suggestions. The 2015 TRM has been modified to clarify that the Thermostatic Shower Restriction Valve measure and the Low-Flow Showerhead measure may have combined savings values and that the same baseline must be used in both cases. Further, the algorithm has been adjusted to correctly multiply Npersons by the average number of showers per person per day (NShowers-day), while Tperson/day was removed as it does not apply to this measure. An EDC data gathering option was added to Tout and the default values have been adjusted to align with the 2014 Residential Baseline Study.

1. **Section 2.6.2 – Air Sealing**

 **a. Comments**

 No comments were received regarding the addition of this protocol.

 **b. Disposition**

 While no comments were received regarding this protocol, based on further review by the SWE, the Commission has concerns with certain aspects of the measure, including the deemed savings. Therefore, we have removed this protocol from the 2015 TRM. However, we direct the SWE to do further research and develop this protocol as we believe, when corrected, it may be a beneficial addition to the TRM. Therefore, we request the SWE to provide recommendations for the 2016 TRM update. If it deems it appropriate, the SWE may collaborate with the PEG to develop a recommendation on this protocol.

1. **Section 2.6.5 – ENERGY STAR Manufactured Homes**

 **a. Comments**

PPL comments that the SEER of the baseline unit for ASHP, SEERb, should be updated to account for a federal code change that becomes effective January 1, 2015. Additionally, PPL suggests that other associated measure values be updated accordingly as well.[[75]](#footnote-76)

 **b. Disposition**

The Commission agrees with PPL and has updated all affected values.

## Additional Commercial and Industrial EE&C Measure Protocols

 The Commission proposed for inclusion the following twelve C&I EE&C measure protocols:

* Section 3.1.7 – LED [Light-Emitting Diode]: Refrigeration Display Case Lighting;
* Section 3.2.8 – Controls: Guest Room Occupancy Sensor;
* Section 3.2.9 – Controls: Economizer;
* Section 3.3.3 – ECM [Electronically Commutated Motor] Circulating Fan;
* Section 3.3.4 – VSD [Variable Speed Drive] on Kitchen Exhaust Fan;
* Section 3.5.7 – Controls: Evaporator Coil Defrost Control;
* Section 3.7.3 – Controls: Snack Machine Controls;
* Section 3.7.5 – ENERGY STAR Refrigerated Beverage Machine;
* Section 3.10.1 – Cycling Refrigerated Thermal Mass Dryer;
* Section 3.10.2 – Air-Entraining Air Nozzle;
* Section 3.10.3 – No-Loss Condensate Drains; and
* Section 3.11.1 – ENERGY STAR Servers.

The Commission adopts these protocols noting the changes outlined below.

* 1. **Section 3.7.5 – ENERGY STAR Refrigerated Beverage Machine**

 **a. Comments**

 Duquesne requests changing the title of Table 3-140 to “Default Beverage Vending Machine Savings.” In addition, Duquesne notes that the default savings for “Equipment Class A” should be 71 kWh instead of 1,422 kWh.[[76]](#footnote-77)

 **b. Disposition**

 The Commission agrees with and adopts Duquesne’s recommendations.

## Existing Residential EE&C Measure Protocols and Processes

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

### 1. Section 2.1.1 – ENERGY STAR Lighting[[77]](#footnote-78)

In the 2014 TRM Final Order, the Commission noted that the 2014 TRM had been updated to clarify that any bulbs outside the lumen bins presented are exempt from the Energy Independence and Safety Act of 2007 (EISA)[[78]](#footnote-79) standards and should use the manufacturer-rated incandescent equivalent wattage.[[79]](#footnote-80) The Commission proposed to augment this language to include the following in Section 2.1.1 – ENERGY STAR Lighting: Variable Input Values:

For bulbs that do not fall within EISA regulations, such as exempt bulbs and bulbs with lumens greater than 2,600, the manufacturer rated equivalent wattage should be used as the baseline. The manufacturer rated wattage can vary by bulb type, but is usually clearly labeled on the bulb package. Note the EISA 2007 standards apply to general service incandescent lamps.  A complete list of the 22 incandescent lamps exempt from EISA 2007 is listed in the United States Department of Energy Impact of EISA 2007 on General Service Incandescent Lamps: FACT SHEET.[[80]](#footnote-81)

 **a. Comments**

 PPL recommends adding the subscript LED [light-emitting diode] to the ENERGY STAR Indoor LED Fixture algorithm. Second, PPL requests clarification on the language that pertains to bulbs with wattages that fall outside of the EISA regulations guidance as the language may be confused with the directive to use Table 2-3 for Specialty Lamps for exempt specialty bulbs. Third, PPL requests clarification on how to treat candelabra bulbs when determining wattage. Lastly, PPL recommends updating the source for EISA information.[[81]](#footnote-82)

 PECO requests that a source be provided in order to reference the baseline shift in footnote 28. Next, PECO recommends that the measure life for an LED be changed from 14.7 to 15 years. Additionally, PECO proposes that the in-service rate (ISR) factor for LED bulbs be independent of the ISR factor for compact fluorescent light bulbs (CFLs), as they are currently similar but will likely be different in future evaluation findings. PECO further recommends adding a separate ISR for bulbs in direct install programs, as well as bulbs included in giveaway kits. PECO requests the addition of more options, besides CFLs, to the hours of use (HOU) variables available for bulb types and a more customized designation for each bulb type. PECO suggests that an EDC data gathering option be added to the lighting coincidence factor variable in Table 2-1 referencing an internal evaluation of other residential lighting load shapes that it has determined to be more reliable.

PECO requests that language be added to the TRM that explains the assumption of bulb leakage out of the utility territory being equal to leakage into the territory. PECO suggests that Table 2-4 be updated to a more comprehensive table to include a larger range of wattages and lumens. PECO submits that the interactive effect (IE) values in Table 2-5 and Table 2-6 are not as accurate as the recent analysis performed by the evaluator and the BEopt simulation software. Therefore, PECO requests that the tables be updated with these specific IE values. Finally, PECO requests clarification on the discount rate underlying Source 2.[[82]](#footnote-83)

 FirstEnergy supports the use of unified ISRs and IEs for LED and CFL bulbs. FirstEnergy further comments that there are no studies being reviewed by the PEG that support different ISRs for LEDs or CFLs. FirstEnergy submits that the use of any specific ISR should be supported by an ISR growth curve that accounts for long-term equivalent savings as opposed to the first-year savings with only initial ISRs. It requests that the Commission approve the continued use of the same default ISR based on the premise that there is no supported convention for adapting first-year evaluation findings to long-term equivalents. FirstEnergy recommends that the Commission encourage the use of evaluated results and review the issue for inclusion in the 2016 TRM.[[83]](#footnote-84)

 With regards to PECO’s request that Table 2-5 and Table 2-6 be modified to account for PECO-specific interactive effect values, FirstEnergy states that the use of REM/Rate modeling is insufficient for use as a basis for supporting those tables containing EDC-specific values. FirstEnergy recommends common variables be used for the IEs and demand effects expressed in the algorithms.[[84]](#footnote-85)

 **b. Disposition**

 The Commission would like to clarify that the manufacturer-rated equivalent should be the same as column C in Table 2-3 for exempt specialty bulbs. The EDC can either find the manufacturer wattage on the bulb package or use the chart in Table 2-3. The Table 2-3 chart was taken from the ENERGY STAR-required manufacturer-rated equivalent values and, therefore, should be the same as what is listed on the package for these bulbs.

 Regarding PPL’s request for classification of the candelabra bulb, the Commission will clarify in footnote 34 that the charts are based on bulb shape and that the candelabra is classified as a general service bulb. Additionally, the Commission has updated the source link for EISA 2007 information in the TRM.

 The Commission agrees with PECO’s request to add to footnote 28 background information on the baseline shift as well as adjust the measure life for an LED up to 15 years. Concerning PECO’s request to add a separate ISR for direct install programs, the Commission directs the EDCs to footnote 32 that reinforces the option of data gathering for direct install, giveaway and efficiency kits.

 The Commission rejects PECO’s request to allow for EDC data gathering for the CF and further clarifies that the new CF is based on the new peak PJM definition as designated in the Section 1.3 – Definitions of the TRM. In response to the request to modify the HOU definitions, the HOUs for the 2015 TRM have consistent values for LEDs and CFLs, so the Commission will modify this variable to HOU-EFFBULB. However, as LEDs gain more prominence among EDC programs and additional research is conducted on this technology, future TRMs may include differing values for LED and CFL technologies. Additionally, the Commission has changed the HOU variables to be HOU with a subscript for the technology, as recommended.

The Commission rejects the proposed modification to Table 2-4 as the tables provided are consistent with the ENERGY STAR-mandated equivalent wattages, which are required to be advertised on the bulb packages. We believe that this is the information that customers will use to compare new technologies to legacy incandescent technologies and, therefore, the best bins to establish baseline wattages. Bulbs outside of these ranges can use the manufacturer-equivalent wattage. We do agree, however, that the reflector categories and baseline wattages are changing rapidly as new products come on the market. As such, we direct the SWE to monitor such changes and provide recommendations, as necessary, during future TRM updates. If it deems it appropriate, the SWE may collaborate with the PEG to develop recommendations.

 With regards to the modifications proposed for Table 2-5 and Table 2-6, the Commission accepts the values submitted by PECO for the IEs and has adjusted Table 2-5 and removed Table 2-6.

 The Commission agrees with FirstEnergy that further research is needed to adapt a first year ISR to a long-term ISR. Therefore, we direct the SWE to examine this issue and provide recommendations, as necessary, during the 2016 TRM update. If it deems it appropriate, the SWE may collaborate with the PEG. Because the ISR and IE for the 2015 TRM have consistent values for LEDs and CFLs, we will change this variable to ISR-EFFBULB and IEEFFBULB. However, as LEDs gain more prominence among EDC programs and additional research is conducted on this technology, future TRMs may include differing values for LED and CFL technologies. We would like to note that the ISR is not an open variable for upstream delivery mechanisms.

### Section 2.1.2 – Residential Occupancy Sensors[[85]](#footnote-86)

The Commission did not propose modifications to the Residential Occupancy Sensor measure. However, comments were received and are addressed below.

 **a. Comments**

PECO comments that the IE factor used in Section 2.1.1 – ENERGY STAR Lighting should be included in the savings algorithms for this measure.[[86]](#footnote-87)

 **b. Disposition**

 The Commission rejects the proposed modification to the measure as any IEs due to occupancy sensors are from reduced hours, not reduced wattage, and would require assumptions regarding the reduced wattage. Given the uncertainty regarding the reduced wattage, IEs for occupancy sensors has not been included.

### 3. Section 2.1.3 – Electroluminescent Nightlight[[87]](#footnote-88) and Section 2.1.4 - LED Nightlight[[88]](#footnote-89)

The Commission did not propose modifications to these measures. However, comments were received for both and are addressed below.

 **a. Comments**

PECO states that the ISR of nightlights has not been shown to equate to the ISR of CFLs as it is currently reflecting, approximately 97%. In the absence of better data, PECO recommends an ISR of between 60% and 85% and refers to school giveaway kits. PECO further recommends that EDC data gathering be applied as the open variable for the ISR for these measures.[[89]](#footnote-90)

 **b. Disposition**

 The Commission rejects the proposed modification to the measures as the ISR of nightlights in a school kit is not comparable to those in an upstream or rebate program. In lieu of better data, the current ISR for nightlights in both measures will remain. EDC data gathering has been included as an option for this input in both measures.

### 4. Section 2.1.5 – Holiday Lights[[90]](#footnote-91)

The Commission did not propose modifications to this measure protocol. However, comments were received and are addressed below.

 **a. Comments**

PECO notes that percentages of holiday lights that are miniature (Wmini), C7 (WC7) and C9 (WC9) are explained as key assumptions, but they do not appear in the algorithms. PECO suggests clarification regarding their significance and use. It also notes that for the number of bulbs per strand (#Bulbs) variable, using the “bulbs/strand” unit as written in the protocol leaves “bulbs” as a unit in the final result. PECO recommends that the units on all of the wattage variables be changed to “Watts/bulb.” This will make the units of the algorithm come out as kWh or kW savings per package rather than “kWh or kW savings\*Bulb/package.”[[91]](#footnote-92)

Additionally, PECO states that for the number of strands of lights per package (#Strands) variable, using the “strands/package” unit as written in the protocol leaves “package” as a unit in the final result. There is no other reference to “packages” in the protocol. The protocol should be clarified so that the algorithm is used to calculate savings per package.[[92]](#footnote-93) Finally, PECO notes the assumptions listed as Source 3 are important to the savings algorithms and are a duplicate of the “Key assumptions” listed in the “Algorithms” section. The assumptions are listed in Sources, but they do not cite a source.[[93]](#footnote-94)

 **b. Disposition**

The Commission has added an additional algorithm and language to the protocol to clarify the application of the Wmini, WC7 and WC9 inputs. The Commission also agrees that “Watts” should be “Watts/bulb” for all the bulb units and an additional statement has been added to clarify that the algorithms yield kWh savings results *per package* (kWh/yr per package of LED holiday lights). The Commission agrees that source 3 is a copied version of assumptions from earlier in the protocol and has replaced it with an updated source, as well as updated the default #Bulbs from 25 to 50. Fifty bulbs/strand was typical when surveying Home Depot, Target and Walmart, whereas 25 bulbs/strand was for specialty large bulbs only.

### 5. Section 2.2.1 – Electric HVAC

 In its 2014 TRM Final Order, the Commission directed the PEG to consider a modification to the value used for Heating Seasonal Performance Factor for maintenance (HSPFm) of ASHPs receiving maintenance.[[94]](#footnote-95) We proposed including the option of EDC Data Gathering to this measure to allow for EDC-specific information to be used in lieu of the default value provided by the TRM. Additionally, we proposed to update the value of HSPFm from 6.8 to 6.9 in accordance with the adjustment to the HSPFb,. The Commission also proposed an update to the baseline HSPFb to include a default HSPF value of 6.9 for Early Replacement measures.

 **a. Comments**

PPL requests clarification on whether there will be a statewide definition of the term “early retirement,” noting that contractors may have different definitions which may affect the algorithms chosen. PPL further requests clarification of whether the EERb and the energy efficiency ratio of the unit being installed (EERe) will be adjusted for ASHPs to account for the change in SEER. Finally, PPL requests a reformatting of the.[[95]](#footnote-96)

PECO requests the formatting of measure components including the cooling capacity of the central air conditioner or heat pump being installed (CAPYcool); the heating capacity of the central air conditioner or heat pump being installed (CAPYheat); SEERb; and CF, as well as source references. Further, PECO requests clarification to the SEERb definition to include the values for single or split package designations. In addition, PECO comments that the assumed peak-demand savings per furnace high efficiency fan (PDFS) is calculated incorrectly according to Source 18.[[96]](#footnote-97)

 **b. Disposition**

The Commission advises PPL that the definition of “early retirement” is included in the Section 1.3 - Definitions and will not be modified. We agree with PPL’s request to clarify the EER values for ASHPs and have adjusted the values in the Table 2-11. Further, the Commission agrees with PECO’s request to reformat certain measure components for clarity and to update sources, as well as to clarify the SEERb for packaged or split systems. Lastly, the Commission agrees with PECO’s comment to correct the PDFS value.

### 6. Section 2.2.3 – Ductless Mini-Split Heat Pumps

The Commission proposed revising the algorithms for Section 2.2.3 – Ductless Mini-Split Heat Pumps based on data showing that the 2014 TRM algorithms under-estimated savings.[[97]](#footnote-98) We proposed removing the Load Factor (LF) and instead, in certain cases, apply an Oversize Factor (OF) to the baseline capacity to account for the fact that central AC and ASHP systems are typically oversized.[[98]](#footnote-99) A ductless system is assumed to be either properly sized or sized to offset some portion of the central system’s load. Additionally, the Commission proposed applying, in instances where the baseline is a ducted system, a Duct Loss Factor (DLF) of 1.15 to the baseline energy usage to account for the fact that approximately 15% of the energy is lost to leakage and conduction through the ductwork.[[99]](#footnote-100) In addition, the Commission proposed revising the multi-zone algorithms to allow different baselines for each zone, if applicable.

 **a. Comments**

PECO comments that the source for the duct leakage factor (DLF) should be added. PECO also comments that the text in Source 4 is incomplete and recommends more detail.[[100]](#footnote-101) Mitsubishi Electric suggests making the measure life 18 years.[[101]](#footnote-102)

 **b. Disposition**

The Commission has added a source for the DLF. The Commission also agrees that Source 4 is confusing and has added clarification. The Commission rejects Mitsubishi Electric’s suggestion since the maximum measure life allowed under Act 129 is 15 years.[[102]](#footnote-103)

### 7. Section 2.2.5 – Room AC (RAC) Retirement[[103]](#footnote-104)

New federal standards for room air conditioners (RACs) took effect June 1, 2014, but as of July 31, 2014, no new ENERGY STAR specifications have been proposed. The Commission proposed an update to the default savings for ENERGY STAR RACs to those provided in the ENERGY STAR Version 3.1 standard, assuming a capacity of 8,000 British thermal units per hour (Btuh) from the 2014 Residential Baseline Study. Since the combined energy efficiency ratio metric (CEER) is used as the metric in both of the new standards, which would be incorporated into the measure for the “After RUL years” savings calculations.

 **a. Comments**

PPL recommends adding a definition for the term EERee to Table 2-27 because it appears in the Algorithms section. Further, in Table 2-28, the values for Energy Impact (kWh) do not appear to be updated in accordance with variable updates in Table 2-27.[[104]](#footnote-105)

PECO states that the energy efficiency ratio of an RAC that just meets the minimum federal appliance standard efficiency (CEERbase) and the energy efficiency ratio for an ENERGY STAR RAC (CEERee) should be renamed as “Combined Energy Efficiency Ratio” instead of “Energy Efficiency Ratio.”[[105]](#footnote-106)

FirstEnergy points out that the Demand Impact in Table 2-28 should be updated based on the new CF and that reference to the old CF should be removed from the definition of demand CF (CFrac).[[106]](#footnote-107)

 **b. Disposition**

The Commission agrees with the changes proposed by PPL, PECO and FirstEnergy and has updated the TRM accordingly.

### 8. Section 2.2.7 – Furnace Whistle

The Commission did not propose changes to this measure protocol. However, comments were received and are addressed below.

 **a. Comments**

 PPL recommends adding an EDC Data Gathering option for the ISR variable, with the option to use the default value similar to other kit measures. They also note that in the Default Savings section, the values for kWpeak below each table should be updated.[[107]](#footnote-108)

 **b. Disposition**

The Commission agrees with PPL and has updated the TRM accordingly.

### 9. Section 2.3.2 – Heat Pump Water Heaters

In the 2014 TRM Final Order, the Commission directed the PEG to investigate the effect that installation location has on heat pump water heater (HPWH) performance.[[108]](#footnote-109) Based on a review of several studies, the Commission proposed the revision of the existing coefficient of performance de-rating factor (Fderate) to be location-dependent. New Fderate values have been adapted from a 2013 NEEA HPWH field study,[[109]](#footnote-110) which calculated the effective energy factor in various installation locations. The results used are for “Heating Zone 1,” which is comprised of Olympia, Washington and Portland, Oregon and have average dry (DB) and wet bulb (WB) temperatures comparable to Pennsylvania.[[110]](#footnote-111) The Commission proposed these same updates for Section 2.3.5 – Fuel Switching: Heat Pump Water Heater to Fossil Fuel Water Heater.

 **a. Comments**

PPL recommends clarifying that the first algorithm shown in the Algorithms section applies only if the HPWH is installed in a location inside the conditioned space. Otherwise, the alternative algorithms in the Default Savings section must be used. Additionally, for the alternative algorithms in the Default Savings section, PPL requests clarification regarding whether garages and basements fall into the category of "not located inside conditioned space."[[111]](#footnote-112)

FirstEnergy comments that, while the enhanced detail related to IEs for HPWHs upgrades engineering considerations, it will significantly increase evaluation costs while providing little additional accuracy given the minimal penetration, to date, for that measure. FirstEnergy suggests waiting until there is further penetration of the measure to include such information in the TRM.[[112]](#footnote-113)

 **b. Disposition**

 The Commission agrees with PPL and has clarified when IEs are to be applied. The Commission also agrees that it is unclear whether basements and garages are considered “conditioned” and has re-labeled the corresponding installation locations as “Unconditioned Garage” and “Unconditioned Basement.” The Commission rejects FirstEnergy’s suggestion, as this addition will more accurately capture the real-world kWh and kW savings.

### 10. Section 2.4.1 – ENERGY STAR Refrigerators[[113]](#footnote-114)

The Commission proposed updating the default Annual Energy Consumption values in Section 2.4.1 – ENERGY STAR Refrigerators based on the new Federal[[114]](#footnote-115) and ENERGY STAR[[115]](#footnote-116) standards that become effective September 14, 2014. These are a series of formulas giving the number of kWh per year, provided a known configuration and refrigerator volume. Additionally, we proposed updating the ENERGY STAR Most Efficient annual energy usage values based on the Most Efficient Version 5.0 ENERGY STAR criteria.[[116]](#footnote-117)

 **a. Comments**

PECO states that the numbers for the models in column “Refrigerator Category” of Table 2-70 may be confusing and recommends that they be deleted or that a clarifying note be added before the table. PECO also notes that the title of the “Deemed” sub-section is confusing.[[117]](#footnote-118)

 **b. Disposition**

The Commission agrees that the purpose of the numbering in Table 2-70 may be confusing and has added a clarifying footnote. The Commission agrees that the title of the “Deemed” section may be misleading and has changed it to “Default.”

### Section 2.4.2 – ENERGY STAR Freezers[[118]](#footnote-119)

The Commission proposed updating the default Annual Energy Consumption values based on the new Federal[[119]](#footnote-120) and ENERGY STAR[[120]](#footnote-121) standards that become effective September 14, 2014. These are a series of formulas giving the number of kWh per year, provided a known configuration and refrigerator volume. Additionally, we proposed updating the ENERGY STAR Most Efficient annual energy usage values based on the Most Efficient Version 5.0 ENERGY STAR criteria.[[121]](#footnote-122)

 **a. Comments**

PECO notes that the numbers used to list models in column “Freezer Category” of Table 2-74 may be confusing and recommends that a clarifying note be added.[[122]](#footnote-123)

 **b. Disposition**

The Commission agrees with PECO’s suggestions and has added a clarifying note.

### Section 2.4.3 – Refrigerator/Freezer Recycling with and without Replacement[[123]](#footnote-124)

The Commission proposed updating the REPLACEMENTUEC values in Section 2.4.3 – Refrigerator/Freezer Recycling with and without Replacement, based on the updated ENERGY STAR Appliance savings calculator, last modified in May 2014. Each new value is an average of the six options provided in the appliance savings calculator.

 **a. Comments**

PPL, PECO and Duquesne believe that the protocol should be updated to fully comply with the Uniform Methods Project (UMP) Refrigerator Recycling Protocol. Additionally, the method for determining part-use factors should be updated to the UMP as well.[[124]](#footnote-125) PPL also recommends updating the default values for each EDC using PY5 data.[[125]](#footnote-126)

 **b. Disposition**

The Commission agrees that this measure should be updated to fully correspond to the UMP Refrigerator Recycling Protocol. As a result, the 2015 TRM has been updated to fully comply with Chapter 7: Refrigerator Recycling Evaluation Protocol of the Uniform Methods Project, published April 2013. The net savings and the part-use factor are now evaluated according to the UMP. We also agree that the default values should be re-calculated using PY5 data and have updated the TRM accordingly.

### Section 2.4.9 – ENERGY STAR Water Coolers[[126]](#footnote-127)

To better accommodate the new ENERGY STAR requirements and to be more consistent with other algorithms throughout the TRM, the Commission proposed revising the algorithm to be a difference of a base value and an ENERGY STAR value rather than simply a deemed value.

 **a. Comments**

PECO states that Source 3 refers to assumptions stated in a separate TRM protocol and recommends that more details be added to Source 3 so all of the relevant information is contained within this protocol.[[127]](#footnote-128)

 **b. Disposition**

The Commission agrees with PECO’s recommendations and has updated the source with the root source from the ENERGY STAR Refrigerator protocol. However, the assumptions and the energy-to-demand factor (ETDF) in the ENERGY STAR Refrigerator protocol have been updated; therefore, the Commission has updated the Peak Demand savings equation to include the new ETDF used in the ENERGY STAR Refrigerator protocol.

### 14. Section 2.5.3 – Smart Strip Plug Outlets[[128]](#footnote-129)

The Commission proposed updating the deemed kWpeak savings for Section 2.5.3 – Smart Strip Plug Outlets based on the new CFs being updated within this TRM update.

 **a. Comments**

PPL recommends adding an ISR variable to the algorithms in order to be consistent with other kit measures.[[129]](#footnote-130)

 **b. Disposition**

The Commission agrees with the suggestion provided by PPL and has updated the TRM accordingly.

### 15. Section 2.6.3 – Residential New Construction

The Commission did not propose modifications to this measure. However, comments were received and are addressed below.

 **a. Comments**

PPL states that the SEER of the baseline unit for ASHP, SEERb, should be updated to account for a federal code change, effective January 1, 2015.[[130]](#footnote-131)

 **b. Disposition**

The Commission agrees and has adjusted the baseline SEER and all values.

### Section 2.7.1 – Pool Pump Load Shifting[[131]](#footnote-132)

The Commission did not propose modifications to this measure protocol. However, comments were received and are addressed below.

 **a. Comments**

 PPL recommends updating the default value for the electric demand of single speed pump at a given flow rate (kWpump). This value is based on the California Energy Commission's (CEC) 2008 Appliance Database; however, a more recent dataset exists.[[132]](#footnote-133)

 **b. Disposition**

The Commission disagrees with PPL’s request as the more recent dataset only includes models which meet the current efficiency standards. The default values for kWpump are supposed to represent existing equipment, not new equipment. Additionally, the newer dataset only includes pumps with nameplate horsepower up to 0.90, which would greatly restrict the default values offered and would be a less realistic representation. The Commission directs the SWE to further explore these default values and the potential applicability of EDC data from previous evaluations to calculate them. The SWE should provide recommendations on this issue for the 2016 TRM update. If it deems it appropriate, the SWE may collaborate with the PEG in developing a recommendation.

### Section 2.7.2 – Variable Speed Pool Pumps (with Load Shifting Option)[[133]](#footnote-134)

In the 2014 TRM Final Order, the Commission directed the PEG to research variable speed pool pump operating modes and consider factoring this variable into the algorithms in Section 2.7.2 – Variable Speed Pool Pumps (with Load Shifting Option).[[134]](#footnote-135) After review, the Commission proposed breaking down the electric demand of variable frequency drive pumps at a given flow rate variable (kWVFD) into the electric demand of variable frequency drive (VFD) pumps during cleaning mode (kWVFD,clean) and during filtration mode (kWVFD, filter). Additionally, we proposed breaking down the hours of operation per day for a VFD pump (HVFD) into the hours of operation per day for a VFD pump on cleaning mode (HOUVFD,clean) and filtration mode (HOUVFD, filter). These proposals accounted for the fact that variable speed pool pumps usually have multiple operating modes that each run at different speeds. In addition, the Commission proposed breaking out kWVFD into kWVFD,clean and kWVFD, filter in the ΔkWpeak algorithm, where each is multiplied by the ratio of time it is used during the PJM peak.

 **a. Comments**

PPL recommends revising the kWh terms to "kWh/yr" for both the base and VFD variables. PPL also recommends updating the default values for HOUVFD,clean, HOUVFD,filter, HOUSS, kWVFD,clean, and kWVFD, filter with EDC data collected in previous evaluations. PPL states that the sources for HOUVFD,clean, HOUpeak,clean, and HOUpeak,filter are missing. PPL recommends updating the default values for kWSS as the current value is based on CEC2008, when a more recent dataset exists.[[135]](#footnote-136)

 **b. Disposition**

The Commission agrees that the kWhbase and kWhVFD should be labeled kWh/yrbase and kWh/yrVFD and has adopted the suggested changes. The Commission has also added, per PPL’s request, sources and assumptions behind the HOUVFD,clean, HOUpeak,clean and HOUpeak,filter variables. The Commission also agrees that the use of default values based on previous EDC Data collection may be appropriate. Therefore, we direct the SWE to investigate this matter further and provide recommendations for the Commission’s consideration during the 2016 TRM update. If it deems it appropriate, the SWE may collaborate with the PEG in developing a recommendation.

The Commission disagrees with the suggestion to update the default values for kWss, as the more recent dataset only includes models which meet the current efficiency standards and the default values for kWSS are intended to represent existing equipment, not new equipment. Additionally, the newer dataset only includes pumps with nameplate horsepower up to 0.90, which would greatly restrict the default values offered and would be a less realistic representation. The Commission directs the SWE to further explore these default values and the potential applicability of EDC data from previous evaluations to calculate them. The SWE should provide recommendations on this issue for the 2016 TRM update. If it deems it appropriate, the SWE may collaborate with the PEG in developing a recommendation.

## Commercial and Industrial EE&C Measure Protocols

 The following sections describe changes to the C&I measure protocols:

### 1. Section 3.1 – Lighting[[136]](#footnote-137)

#### **a. Section 3.1.2 – New Construction Lighting: Hours of Use, Coincidence Factor and Savings Factor**

 In the Tentative Order, the Commission proposed the addition of a separate HOU and CF table, and a Savings Factor (SVG) table for new construction lighting.[[137]](#footnote-138) Because Table 3-9 of the 2014 TRM lists 24% as the SVG for both time clocks and occupancy sensors, the Commission recommended applying an SVG factor of 24% to the current HOU table for spaces where ASHRAE 90.1-2007[[138]](#footnote-139) requires the installation of lighting controls. Similarly, the Commission proposed modifications to the CF values from Table 3-6 that are used to calculate demand savings from new construction lighting.

 For additional controls above code (dimmers, wireless on-off switches, bi-level switches, etc.), the Commission proposed using the new construction SVG of 10% provided in Table G3.2 of the ASHRAE 90.1 standard. The Commission suggested removing the SVG term from the algorithm used to calculate new construction demand savings because savings from incremental lighting controls are expected to produce savings primarily during off-peak hours. The Commission also proposed removing the distinction between projects with a change in connected load above and below 20 kW.

 **i. Comments**

FirstEnergy recommends allowing other methods of calculating savings associated with controls in new construction buildings, provided the code requirements are reflected in *ex-ante* calculations. Additionally, FirstEnergy states that the 24% adjustment to reflect new building code requirements is too aggressive for entire buildings as ASHRAE 90.1-2007 requires automatic lighting shutoff in three space types and excludes 24/7 spaces.[[139]](#footnote-140) Duquesne also comments that the proposed methodology exceeds the applicable federal standard and recommends retaining the 2014 TRM approach to HOU and controls for new construction lighting.[[140]](#footnote-141)

 PECO states that, by adjusting the HOU by 24% and reducing the savings factors for all control types by 24%, the savings are underestimated. PECO recommends leaving the HOU unadjusted and instead modify the savings algorithms to include a base case SVG of 24%.[[141]](#footnote-142)

 **ii. Disposition**

 The Commission recognizes the feedback provided by FirstEnergy, Duquesne and PECO and agrees that the use of the 24% adjustment for all room types may not be appropriate. We believe this issue requires further research. Therefore, we direct the SWE to perform further review of the ASHRAE standard; any other applicable codes, standards, TRMs, etc.; and any Pennsylvania-specific metering studies and provide recommendations to the Commission for the 2016 TRM update. The 2015 TRM has been updated to reflect the values utilized in the 2014 TRM.

#### b. Source Updates

 In the Tentative Order, the Commission proposed using the Measure Life Study[[142]](#footnote-143) as the source for a measure life of 13 years for lighting fixture improvements and a measure life of 15 years for new construction measures. The Commission also suggested using GDS’s Measure Life Report[[143]](#footnote-144) as the source for a measure life of ten years for traffic lights. Finally, the Commission proposed using DEER 2008’s Effective Useful Life[[144]](#footnote-145) as a source for a measure life of eight years for lighting controls and a measure life of 16 years for LED exit signs.

 **i. Comments**

 Duquesne notes that the basis of distinction between the measure life of 13 years for retrofit lighting and 15 years for new construction is unclear. If there is a distinction, Duquesne avers that it would likely not account for the market and customer implications of assigning different measure lives to otherwise identical installations. Duquesne states that, from a customer’s perspective, differing measure lives may be confusing and perhaps frustrating. In addition, Duquesne opines that it would have to make an extensive tracking system modification to account for the two-year measure life difference. Therefore, Duquesne recommends using a consistent 15-year measure life for commercial and industrial lighting.[[145]](#footnote-146)

 **ii. Disposition**

 The Commission rejects Duquesne’s recommendation to use a measure life of 15 years for all commercial and industrial lighting protocols. These values proposed by the Commission are widely accepted in other jurisdictions, such as Massachusetts, Rhode Island, and Connecticut. Therefore the Commission adopts the proposed measure lives for the 2015 TRM.

#### c. Lighting HOU and CF

 The Commission did not propose changes to the lighting HOU and CF for the lighting fixture improvements and new construction lighting protocol. However, comments were received and are addressed below.

 **i. Comments**

 FirstEnergy recommends adopting the most current Mid-Atlantic TRM (version 4) HOU and CF values for building types. FirstEnergy notes that, while in practice these values generally apply to smaller projects, given the current thresholds for site-specific data collection, the impact could result in understatement of savings for smaller projects.[[146]](#footnote-147) PPL requests clarification on the usage groups and annual HOU of projects with connected load savings less than 20 kW.[[147]](#footnote-148)

 **ii. Disposition**

 The Commission acknowledges that updating the HOU and CF values may increase the accuracy of savings assumptions. However, these updates are substantial and may cause customer confusion. Additionally, they may require extensive changes to EDC tracking systems, CSP contracts, rebate application forms and other processes. Lastly, as the results from Pennsylvania-specific metering studies will be available during the 2016 TRM update, the Commission will not amend the values proposed. We will, however, direct the SWE to review this issue, as well as the results of Pennsylvania-specific studies, and provide recommendations during the 2016 TRM update. If it deems it appropriate, the SWE may collaborate with the PEG in developing a recommendation.

 Regarding PPL’s request for clarification, the Commission would like to note that an EDC has two options for calculating lighting savings for projects in facilities where the actual lighting hours deviate by more than 10% from default hours. One option is to use the HOU values from the “other” category. The other option is to use the facility’s actual lighting hours, as collected through posted hours, interviews or logging. However, selecting the option on a project-by-project basis is unacceptable. An EDC should select one method for the program year and apply it consistently to all projects where actual facility lighting hours deviate by more than 10% from default hours.

#### d. Lighting Controls

 The Commission did not propose changes to the default values for lighting control types. However, comments were received and are addressed below.

 **i. Comments**

 PECO recommends removing the default controlled kW values listed in Table 3-14 for three lighting control types given that all lighting control projects are required to fill out the Appendix C tables. PECO also notes that the date in Source 3 should be “2013.”[[148]](#footnote-149)

 **ii. Disposition**

 The Commission agrees with PECO’s recommendation to remove the default values from the 2015 TRM and has updated the TRM accordingly. Since the default values reference Source 3, the source has been removed, as well.

#### e. LED Channel Signage

 The Commission did not propose modifications to the description of LED channel signage colors. However, comments were received and are addressed below.

 **i. Comments**

 PECO requests an updated description of the LED channel signage colors so that the role of red LEDs is clear.[[149]](#footnote-150)

 **ii. Disposition**

 The Commission acknowledges PECO’s request and clarifies that red is the most common color and the most cost-effective to retrofit, currently comprising approximately 80% of the market. Green, blue, yellow and white LEDs are also available, but at a higher cost than red LEDs. The clarification has been added to the 2015 TRM.

### 2. Section 3.2.1 – HVAC Systems

#### a. Code Changes

The TRM currently uses International Energy Conservation Code (IECC) 2009[[150]](#footnote-151) for HVAC baseline codes unless there are more stringent federal codes. In the Tentative Order, the Commission proposed revisions to the TRM to account for federal code changes and to use IECC 2012 where federal codes do not provide a value. : Sections 3.2.1 – HVAC Systems; 3.2.3 – Water Source and Geothermal Heat Pumps;[[151]](#footnote-152) and 3.8.1 – Wall and Ceiling Insulation were impacted by these changes.

 **i. Comments**

FirstEnergy notes that the current baselines in Tables 3-22 and 3-35 do not reflect federal code changes for systems less than 65,000 Btu/h set for January 2015. FirstEnergy states that baselines will increase for ASHPs from 13 SEER to 14 SEER, increasing from 7.7 HSPF to 8.2 HSPF.[[152]](#footnote-153) PECO recommends including the measure vintage for Packaged Terminal Systems in Table 3-22.[[153]](#footnote-154)

 **ii. Disposition**

 The Commission reviewed the current federal standards for commercial ASHPs and determined that there is no recent code change. The code updates referenced by FirstEnergy only apply to residential heat pumps. Therefore, the baseline values proposed by the Commission are compliant with federal standards and will remain unadjusted. The Commission will continue to monitor changes in federal standards and propose updates accordingly. The Commission also adopts PECO’s recommendation to include measure vintages of Packaged Terminal Systems.

#### b. Update Heating and Cooling EFLH

 In the 2014 TRM update, the Commission directed the SWE to update cooling and heating EFLH values from eQuest simulations. In the Tentative Order, the Commission proposed adopting new air conditioning and heat pump EFLH values. The proposed changes also impact the values cross-referenced in the following TRM measures:

* Section 3.2.3 – Water Source and Geothermal Heat Pumps;
* Section 3.2.4 – Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons;[[154]](#footnote-155)
* Section 3.2.5 – Fuel Switching: Small Commercial Electric Heat to Natural Gas / Propane / Oil Heat;[[155]](#footnote-156)
* Section 3.2.6 – Small C/I HVAC Refrigerant Charge Correction;[[156]](#footnote-157)
* Section 3.2.7 – ENERGY STAR Room Air Conditioner;[[157]](#footnote-158) and
* Section 3.8.1 – Wall and Ceiling Insulation.

 **i. Comments**

 PPL notes that, in Table 3-23 cooling EFLH values are provided for building type “Education-Relocatable Classroom.” However, this building type does not exist in Table 3-25. PPL recommends clarifying whether heating EFLH values are available and update the table as necessary.[[158]](#footnote-159)

 **ii. Disposition**

 The Commission acknowledges PPL’s comment and has added the EFLH values for the Education-Relocatable Classroom building type to Table 3-25.

### 3. Section 3.2.2 – Electric Chillers[[159]](#footnote-160)

#### a. Update EFLH and CF Default Values

The SWE used eQuest modeling to determine more accurate and reference city-specific EFLHs and CFs for electric chiller applications. In the Tentative Order, the Commission proposed adopting the updated EFLHs and CFs for the 2015 TRM.

 **i. Comments**

 Duquesne avers that the 2014 TRM baseline EFLHs were extremely conservative, technically feasible from an engineering perspective, but very optimistic in terms of how any such baseline mechanism system should be operated. However, Duquesne notes that the proposed 2015 TRM chiller EFLH values for the office building types values are significantly lower. Duquesne recommends including an appendix with relevant input assumptions or any peer review studies or published studies that might support these reduced values.[[160]](#footnote-161)

 **ii. Disposition**

 The Commission recognizes Duquesne’s concern and clarifies that, to update the EFLH and CF values, the SWE used available DEER prototypes, updated in September 2013, to model 21 facility types. The SWE also considered several sets of representative building prototypes; the Department of Energy (DOE) reference buildings, for which there are only three vintage classifications; the 1992 Gas Research Institute prototypes, on which the DOE reference buildings are based and the DEER prototypes. The DEER prototypical buildings offer more diverse facilities, twelve different vintages of each facility, and more HVAC system-type permutations for each facility than the other prototype sets. Also, there is no known DOE2.2 version of the DOE reference buildings.

 The DEER module utilizes building prototype and measure characterization information grouped by building type, vintage and climate zone in its estimation of building energy consumption. The SWE selected the 1993 to 2001 vintage for all models and kept the building shell, schedules and loads parameters constant while altering the HVAC system type. Typical meteorological year three weather data for Allentown, Erie, Harrisburg, Philadelphia, Pittsburgh, Scranton and Williamsport were also incorporated to account for differences in climate and to create Pennsylvania-specific building prototypes.

 The eQuest simulation output files which contain annual hourly energy consumption for HVAC equipment are split into separate profiles for heating and cooling. The SWE developed a procedure to extract the data and manipulate the hourly data to calculate the EFLHs and CFs for electric chiller applications.

 Therefore, we adopt the updates to the EFLHs and CFs as they were proposed.

#### b. Additional Chiller Protocols

Additional Chiller protocols were not discussed in the Commission’s Tentative Order. However, comments were received and are addressed below.

**i. Comments**

Duquesne requests the addition of two measure protocols: 1) VFD Chillers and Adding VFDs to Existing Chillers; and 2) Multi-Chiller Plant Chiller Retrofit. Duquesne notes that Section 3.2.2 – Electric Chillers utilizes peak load kW per ton and EFLH and therefore does not quantify the savings impacts of a VFD installed on a chiller. Duquesne recommends adding a protocol to determine savings for the installation of a new chiller with a VFD or the retrofit of an existing chiller with a VFD. Duquesne also recommends the addition of a protocol to estimate the savings from installing high efficiency electric chillers, with or without VFDs, in a facility that has multiple chillers.[[161]](#footnote-162)

 **ii. Disposition**

 The Commission disagrees with Duquesne’s proposed use of full-load efficiencies for the baseline chiller’s efficiency in lieu of integrated part load values (IPLV) for savings calculations as chillers typically are not fully loaded the majority of the time. However, the Commission agrees with Duquesne on the need to clarify the coverage of the existing protocol and potentially add another protocol. The Commission believes that the existing protocol for electric chillers appropriately determines savings for all replace on burnout scenarios (regardless of whether the new chiller has a VFD or not) and early replacement scenarios where the IPLV of both the old and new chillers is known.

Conversely, the Commission clarifies that the retrofit scenario where a non-VFD chiller is retrofitted with a VFD, thereby changing the IPLV of the chiller, is not covered in the existing electric chiller protocol. In order for the TRM to include such a measure, the impact of adding a VFD to an already installed chiller must be researched. Therefore, the Commission encourages Duquesne to submit for the SWE’s review, an interim measure protocol (IMP) that quantifies the impacts, based on data from previous projects and other appropriate data sources, of adding VFDs to already-installed electric chillers.

The Commission rejects Duquesne’s suggestion to add a multi-chiller plant chiller retrofit protocol and believes that it should be considered a custom measure. There are several site-specific factors, such as geographic and climate conditions, building load characteristics, cooling system configuration, hours of operation and economizer capabilities that can affect the installation of a chiller in a multi-chiller application.

### 4. Section 3.2.4 – Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons

#### a. Algorithm Revision

In the Tentative Order, the Commission proposed revising the energy savings algorithms to remove the Load Factor term. The eQuest modeling conducted by the SWE to determine the EFLHcool and EFLHheat values for HVAC systems represents the equivalent number of hours the baseline or retrofit system would run at full capacity to satisfy the cooling needs of the space. The Commission believes that discounting these values by a load factor would underestimate energy savings.

 **i. Comments**

Mitsubishi Electric comments that, in revising the residential measure algorithms in Section 2.2.3: Ductless Mini-Split Heat Pumps, the Commission has corrected a formula that previously underestimated savings. Mitsubishi Electric feels that some of the same considerations should be made in the Commercial measure, including the addition of a Duct Loss Factor (DLF) and an Oversize Factor (OF).[[162]](#footnote-163)

 **ii. Disposition**

The Commission rejects Mitsubishi Electric’s suggestions. The Commission believes that while the technology itself may be similar, there is a significant difference in application between residential and C&I buildings. C&I buildings are more heterogeneous and tend to require more site-specific load calculations that yield more properly-sized HVAC systems. The Commission sees merit in including a duct loss factor for C&I forced air systems. However, the heterogeneous nature of C&I buildings would require further investigating and research to determine if standard loss factors can be established. Therefore, we direct the SWE to research this issue and provide recommendations, as necessary, during the 2016 TRM update. If it deems it appropriate, the SWE may collaborate with the PEG in developing a recommendation.

#### b. Code Changes

 The Commission did not propose modifications to this protocol. However, comments were received and are addressed below.

 **i. Comments**

 FirstEnergy notes that the current baselines for systems less than 65,000 Btu/h do not reflect upcoming federal code changes.[[163]](#footnote-164)

 **ii. Disposition**

 The Commission reviewed the current federal standards for commercial ASHPs and determined that there is no recent code change. The baseline values in the proposed 2015 TRM are compliant with federal standards and therefore will remain unadjusted. The Commission will continue to monitor changes in federal standards and propose updates accordingly.

### 5. Section 3.3.1 – Premium Efficiency Motors[[164]](#footnote-165) and Section 3.3.2 – Variable Frequency Drive (VFD) Improvements[[165]](#footnote-166)

 The Commission did not propose changes to the algorithms in the VFD Improvements protocol. However, comments were received and are addressed below.

 **a. Comments**

 FirstEnergy states that the algorithm for VFD savings needs to be corrected to include a 0.745 factor to convert horsepower to kW.[[166]](#footnote-167)

 **b. Disposition**

 The Commission rejects FirstEnergy’s comment as the factor is redundant. The Energy Savings Factor and Demand Savings Factor already account for the conversion factor.

### 6. Section 3.4.1 – Electric Resistance Water Heaters

 The Commission did not propose changes to the Electric Resistance Water Heaters measure protocol. However, comments were received and are addressed below.

 **a. Comments**

 PECO recommends expanding this measure to include larger commercial units in food service building types such as restaurants which often use large quantities of hot water. PECO also comments that the units in the algorithm for average annual gallons of water are not balanced and suggests including the term 1.0 $\frac{Btu}{lb∙℉}$ in the denominator. PECO notes that there is no explanation about the significance of resistive discount factor (RDF) and recommends including a brief one.[[167]](#footnote-168)

 PPL requests clarification on whether the values in the default savings algorithms in Table 3-70 should be updated to align with the proposed change to the Thot variable. PPL also notes the proposed change may affect Sections 3.4.2: Heat Pump Water Heaters, 3.4.6: Fuel Switching: Electric Resistance Water Heaters to Gas/Oil/Propane and 3.4.7: Fuel Switching: Heat Pump Water Heaters to Gas/Oil/Propane.[[168]](#footnote-169)

 **b. Disposition**

 The Commission adopts the proposed changes to the algorithm for the average annual gallons of water and has included in the TRM an explanation of the RDF. In addition, the Commission agrees with PECO’s recommendation and directs the SWE to review appropriate sources and provide recommendations, during the 2016 TRM update, regarding the expansions of the measure to include larger commercial food service buildings. If it deems it appropriate, the SWE may collaborate with the PEG in developing a recommendation.

 In response to PPL’s comments, the Commission clarifies that the proposed change in the Thot variable will not only affect the values in Table 3-70, but it will also require an update to Table 3-67. The Commission has updated these two tables and made similar updates to Sections 3.4.2 – Heat Pump Water Heaters, 3.4.5 – Fuel Switching: Electric Resistance Water Heaters to Gas/Oil/Propane and 3.4.6 – Fuel Switching: Heat Pump Water Heaters to Gas/Oil/Propane.

### 7. Section 3.4.2 – Heat Pump Water Heaters

 The Commission did not propose modifications to the Heat Pump Water Heaters measure protocol. However, comments were received and are addressed below.

 **a. Comments**

 PECO notes that this measure can be expanded to include larger commercial units in food service building types that often use large quantities of hot water. PECO also suggests adding the term 1.0 $\frac{Btu}{lb∙℉}$ in the denominator of the average annual gallons of water algorithm.[[169]](#footnote-170) PPL recommends providing a default value for the energy factor of baseline water heater (EFbase) in Table 3-73 for instances where customers do not or cannot provide this information.[[170]](#footnote-171)

 **b. Disposition**

 The Commission agrees with PECO’s suggestions and directs the SWE to review appropriate sources and provide, during the 2016 TRM update, recommendations regarding the expansion of the measure to include larger commercial food service buildings. The Commission also adopts the proposed changes to the algorithm for the average annual gallons of water. Regarding PPL’s comments on default energy factors, the Commission clarifies that the default values are already listed in Table 3-74.

### 8. Section 3.4.4 – Low Flow Pre-Rinse Sprayers for Time of Sale/Retail Programs[[171]](#footnote-172)

 In the Tentative Order, the Commission proposed using, in Section 3.4.4 – Low Flow Pre-Rinse Sprayers for Time of Sale/Retail Programs, the Engineering ToolBox[[172]](#footnote-173) as the source for specific heat of water definition and associated value of 1.0. The Commission recommended using verification measurements derived from the Impact and Process Evaluation Final Report[[173]](#footnote-174) as the source for temperatures from spray nozzles.

 **a. Comments**

 PPL notes that Table 3-76 provides a fixed value of 125.6˚F for the Th variable, but the Tentative Order states that this variable is 105.6˚F. PPL requests that the Commission clarify which value is correct and update the TRM as necessary.[[174]](#footnote-175) PECO notes that the unit for the conversion factor of 3,413 should be corrected to $\frac{Btu}{kWh}$ instead of$ \frac{Btul}{kWh}$. PECO also requests the Commission to include a detailed explanation and sources of the parameters used to calculate default savings.[[175]](#footnote-176)

 **b. Disposition**

 The Commission clarifies that the correct value for the hot water temperature variable is 125.6 ˚F. The Commission agrees with PECO that the unit for the conversion factor of 3,413 should be updated. The TRM has been updated accordingly. The Commission further notes Table 3-76 already provides the explanation and sources of the savings parameters.

### 9. Section 3.4.5 – Fuel Switching: Electric Resistance Water Heaters to Gas/Oil/Propane[[176]](#footnote-177)

 The Commission did not propose modifications to the Fuel Switching: Electric Resistance Water Heaters to Gas/Oil/Propane measure protocol. However, comments were received and are addressed below.

  **a. Comments**

 PECO requests clarification on the restriction on efficiency of a replaced electric unit. If assuming a replace-on-burnout scenario, baseline consumption can be calculated based on an energy factor of 0.904 regardless of actual old unit efficiency.[[177]](#footnote-178)

 **b. Disposition**

 The Commission agrees with PECO’s recommendation and has removed the energy factor restriction of the standard electric water heater. Similar changes have been made to the residential protocol in Section 2.3.4: Fuel Switching: Electric Resistance to Fossil Fuel Water Heater.

### 10. Section 3.5.2 – High-Efficiency Evaporator Fan Motors for Reach-in Refrigerated Cases

The Commission did not propose changes to the High-Efficiency Evaporator Fan Motors for Reach-in Refrigerated Cases measure protocol. However, comments were received and are addressed below.

**a. Comments**

FirstEnergy recommends adding a discussion to address the EISA 2007 code relative to electronically commutated motor (ECMs) in walk-in coolers. FirstEnergy states that Section 312 f.1.e of the EISA 2007 Regulation effectively makes ECMs the baseline fan motor type for walk-in coolers for new construction and removes conversion of shaded pole to permanent split capacitor (PSC) motors as a viable measure in new construction applications. As a result, FirstEnergy suggests a discussion on baseline selection in new construction applications and eligibility in retrofit applications.[[178]](#footnote-179)

 **b. Disposition**

The Commission reviewed Section 312 f.1.e of EISA 2007 and a guidance document published by DOE[[179]](#footnote-180) on the conservation standards of walk-in coolers and freezers (WICF). The guidance document states the following:

A WICF evaporator, manufactured prior to January 1, 2009, requires a replacement fan motor. If the replacement fan motor was manufactured after January 1, 2009 and is going to be used as a replacement for an existing WICF, it must be compliant with the WICF standard. Thus, the motor must be an ECM or a 3-phase motor.

The Commission notes that replacing an existing shade-pole motor with a PSC motor is no longer an applicable measure. Therefore, the Commission has removed shaded pole to PSC deemed savings from the 2015 TRM. In addition, the Commission clarifies that Section 3.5.2 – High-Efficiency Evaporator Fan Motors for Reach-in Refrigerated Cases is not applicable for new construction or replace on burnout projects. However, the existing measure will still apply to early replacement projects where PSCs or shaded-pole motors can be the baseline.

### 11. Section 3.5.3 – High-Efficiency Evaporator Fan Motors for Walk-in Refrigerated Cases

The Commission did not propose modifications to this measure protocol. However, comments were received and are addressed below.

**a. Comments**

FirstEnergy notes that the HOUs for evaporator fan motors are reduced from 8,760 in the 2014 TRM to 8,273, but that the changes are not reflected in Tables 3-100 or 3-101. FirstEnergy also comments that the 1-14W motors were eliminated from the deemed savings tables; however, 6W and 9W motors are very common in reach-in refrigeration display cases. FirstEnergy recommends reinstating the 1-14W motor categories into Tables 3-100 and 3-101.[[180]](#footnote-181)

 **b. Disposition**

The Commission rejects FirstEnergy’s suggestions. The Commission notes that the HOUs for evaporator fan motors did not change. In addition, the Commission reviewed the values in Tables 3-100 and 3-101 and concludes that no updates are required. Similarly, the 1-14W motors were already removed from the 2013 and 2014 TRMs, because the referenced source was updated. While the Commission agrees that adding the savings for 1-14W motor may be beneficial, the Commission believes this issue requires further research and, therefore, directs the SWE to develop savings value recommendations for consideration during the 2016 TRM update. If it deems it appropriate, the SWE may collaborate with the PEG in developing a recommendation.

### 12. Section 3.5.4 – Controls: Evaporator Fan Controllers

 The Commission did not propose modifications to this measure protocol. However, comments were received and are addressed below.

 **a. Comments**

 FirstEnergy notes that, if the HOU for evaporator fan motors is changed to 8,273 in Section 3.5.3, then it should also be changed for Section 3.5.4 for consistency.[[181]](#footnote-182)

 **b. Disposition**

The Commission rejects FirstEnergy’s comment because the sources referenced in the two protocols are different.

### 13. Section 3.5.12 – Door Gaskets for Walk-in and Reach-in Coolers and Freezers[[182]](#footnote-183)

 The Commission did not propose modifications to the Door Gaskets for Walk-in and Reach-in Coolers and Freezers measure protocol. However, comments were received and are addressed below.

 **a. Comments**

 FirstEnergy recommends against using the default savings in Table 3-123. FirstEnergy notes that its evaluator failed to observe any of the savings in retrofit isolation tests and traced gas tests on dozens of refrigerator and freezer cases in 2008. The evaluator was only able to observe \ 91 kWh/foot savings when the gaskets were entirely removed from doors. The resulting estimate for removed gaskets was approximately 3 kWh/ft for freezers and 1 kWh/ft for coolers.[[183]](#footnote-184)

 **b. Disposition**

The Commission believes that this issue requires further review and directs the SWE to review the default savings and provide recommendations during the 2016 TRM updates. If it deems it appropriate, the SWE may collaborate with the PEG in developing a recommendation.

### Section 3.7.1 – High-Efficiency Ice Machines

 The Commission did not propose changes to the High-Efficiency Ice Machine measure protocol. However, comments were received and are addressed below.

 **a. Comments**

 PPL requests clarification on the eligibility of ice machines as the current eligibility requirements refers to both the ENERGY STAR efficiency requirements and CEE Tier 2 specifications. PPL notes that if referring to CEE Tier 2 requirements, then the Commission should consider expanding the eligibility requirements to water-cooled machines as well, because unlike ENERGY STAR specifications, the CEE Tier 2 specifications do not exclude water-cooled equipment. In addition, PPL recommends changing the baseline equipment to be a unit with efficiency specifications less than or equal to the current federal standard instead of CEE Tier 1. Furthermore, PPL recommends updating the description in the Algorithm section to remove “machine type” and add “duty cycle.” Lastly, in the Default Savings section, the TRM states the following:

[t]he default energy consumption for the baseline ice machine (kWhbase) is calculated using the formula for CEE Tier 1 specifications, and the default energy consumption for the high-efficiency ice machine (kWhe) is calculated using the formula for CEE Tier 2 specifications.

PPL notes that, if the equipment is required to meet ENERGY STAR specifications, and there is no confirmation that the ENERGY STAR specs are equivalent to CEE Tier 2 specs, then this provision must be changed to refer to the ENERGY STAR specs.[[184]](#footnote-185)

 **b. Disposition**

 The Commission recognizes the discrepancies in the eligibility of the baseline and efficient equipment requirements. The Commission has clarified in the Eligibility section that the baseline equipment is a commercial ice machine that meets federal equipment standards and the efficient machine must conform to the minimum ENERGY STAR requirements. The Commission agrees with PPL regarding the description in the Algorithm section and has adopted the recommended language. To reflect the clarification in the Eligibility section, the Commission has adopted two tables that describe the baseline and ENERGY STAR efficiencies. As such, the Default Savings table has been removed from the measure.

### Section 3.8.1 – Wall and Ceiling Insulation

 The Commission did not propose changes to the Wall and Ceiling Insulation measure protocol. However, comments were received and are addressed below.

 **a. Comments**

 PECO recommends expanding the definition of the area of insulation installed by adding the variables Aceiling and Awall to the savings algorithm. PECO also suggests several updates to the units of the following variables: HDD [heating degree days]; CDD [cooling degree days]; R-value and EFLH. Finally, PECO notes that the EER and coefficient of performance (COP) have a high impact on the savings and the defaults are minimally code compliant. PECO recommends emphasizing that site-specific design values should be used in order to avoid overestimating the savings.[[185]](#footnote-186)

 **b. Disposition**

 The Commission agrees with PECO’s suggestions and has updated the TRM.

## Section 5.5 – Appendix E: Lighting Audit and Design Tool for C&I New Construction Projects

 In the Tentative Order, the Commission proposed updating Section 5.5 – Appendix E: Lighting Audit and Design Tool for C&I New Construction Projects[[186]](#footnote-187) to reflect the recommended improvements to the New Construction Lighting protocol.[[187]](#footnote-188) The major changes include updating the algorithms used to calculate energy savings to include new construction HOU, CF and SVG factors.

**1. Comments**

 PPL comments that there is an inconsistency between Section 3.1.2 – New Construction Lighting and Appendix E – Lighting Audit and Design Tool for C&I New Construction Projects. Section 3.1.2 states that “Within a single project, to the extent that there are different control strategies (SVG), hours of use (HOU), coincidence factors (CF) or interactive factors (IF), the ∆kW will be broken out to account for these different factors." However, Appendix E does not support different hours of use within a single project. Furthermore, PPL states that HOU should be a user populated field in Table B-i on the "Interior Lighting" tab of Appendix E.[[188]](#footnote-189)

 **2. Disposition**

 The Commission recognizes the inconsistency in the language referenced by PPL. As the Commission does not agree with the notion that the HOU should be a user populated field, the inaccurate language has been removed from the 2015 TRM with no corresponding updates to Appendix E required. The Commission feels this is accurate as building-specific operating hours are calculated averages of all space types commonly occurring within a specified building type, with weighting applied in order to account for varying proportions of varying space types. Furthermore, reductions in HOU and CF associated with required occupancy sensors in select areas have also been calculated based on weighted probabilities of given conditions existing within a building type. Therefore, the Commission feels that the calculated HOU and CF values accurately depict the average *in-situ* values across a whole building, regardless of how the space types may be configured. The building type “other” is also available for buildings with considerable deviation from the stipulated values.

## Section 5.6 – Appendix F: Eligibility Requirements for Solid State Lighting Products in Commercial and Industrial Applications

 The Commission did not propose changes to the eligibility requirements in Appendix F. However, comments were received and are addressed below.

 **1. Comments**

 Duquesne states that the ENERGY STAR specifications found in Appendix F – Eligibility Requirements for Solid State Lighting Products in Commercial and Industrial Applications of the 2015 TRM are obsolete and currently under potentially substantial revisions. Duquesne recommends that the TRM use generic references as well since there are often frequent changes to both the specifications and qualified product lists. DesignLights Consortium uses a dynamic interface where both the specifications and qualified products lists are updated frequently. Duquesne recommends that Appendix F – Eligibility Requirements for Solid State Lighting Products in Commercial and Industrial Applications be redrafted to reflect the current state of ENERGY STAR, DesignLights Consortium and Illuminating Engineering Society of North America (IESNA) specifications and standards related to LED lighting.[[189]](#footnote-190)

 **2. Disposition**

 The Commission believes that Duquesne raises a valid point and has updated Appendix F – Eligibility Requirements for Solid State Lighting Products in Commercial and Industrial Applications accordingly. Details on current specifications of ENERGY STAR and DesignLights Consortium requirements have been removed and replaced with more generic language directing users to the correct sources to find the most current requirements for Solid State Lighting products. Links to qualified products lists and general qualification requirements in the footnotes have also been updated.

## Application of the TRM

 While we did not discuss the TRM annual updating process in detail in its Tentative Order, comments were provided regarding this process and are addressed here.

 **1. Comments**

 PPL notes that while it generally agrees with most of the changes proposed in the 2015 TRM, it maintains its previously presented legal arguments relative to the Commission’s use of the TRM process to modify PPL’s approved EE&C plan and the potential effects that the TRM process could have on its cost and compliance obligations.[[190]](#footnote-191) FirstEnergy asserts that annual changes to the TRM are increasingly incremental in nature and involve costly processes to implement while having modest impacts on reported or evaluated energy and demand reduction impacts. FirstEnergy recommends that the 2016 TRM be designed to span the entirety of Phase III of Act 129, with any revisions reserved for administrative corrections or addition of measures, asserting that this will reduce implementation costs and regulatory processes related to TRM management.[[191]](#footnote-192)

 **2. Disposition**

Through the entirety of the EE&C Program, the Commission maintained its position that the TRM should be updated annually to reflect not only new protocols, but changes related to federal and state standards, code changes and technological upgrades. As such, our position has always been that the annual TRM update may include revisions to existing protocols to establish a more accurate reflection of savings values.

As we stated in our prior TRM update orders, “the TRM is merely guidance or a statement of policy that is not binding regulation.”[[192]](#footnote-193) We continued by stating that

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. Furthermore, by updating the TRM methods and values based on the most recent credible and accurate data and facts, as they become known, is likely to reduce challenges to the credibility of the energy savings attributable to the EDCs’ Plans in any future proceeding.[[193]](#footnote-194)

We stress again that while the TRM is a tool EDCs can use to estimate the amount of energy savings a program offering can potentially provide to its plan as a whole, the TRM is first and foremost a measurement tool used to determine, in a reasonably cost-effective way, the actual energy savings achieved by specific measures after they have been installed or implemented.

The Commission believes it has adequately explained its reasoning in performing annual updates to the TRM in a variety of proceedings, including past TRM updates.[[194]](#footnote-195) Specifically, in the Phase II Implementation Order, we stated the following:

In maintaining up-to-date information, the Commission assures that Act 129 monies collected from ratepayers are reflecting the truest savings possible. Additionally, while we recognize the concerns expressed by the EDCs regarding compliance, the Commission has not been provided with any arguments as to why updating the TRM any less frequently than annually is beneficial to ratepayers. To be more specific, the EDCs’ comments focus on the effects the annual TRM updating procedure has on their ability to attain their targets and in no way address the accuracy of the deemed savings values. We believe the focus should be on providing the most accurate measure of reductions in energy consumption possible and to ensure that Act 129 monies are being spent to acquire real energy savings, not fictitious savings values that only serve to protect the EDCs from potential penalties.[[195]](#footnote-196)

The Commission maintains this position in this proceeding.

# CONCLUSION

This 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. The Commission is referring several of the comments we received to the SWE to consider and provide recommendations for future TRM updates. As such, Commission staff will provide an update on the final disposition of all such comments in the next TRM update order. We extend our thanks to all who provided comments; **THEREFORE,**

 **IT IS ORDERED:**

 1. That the 2015 Technical Reference Manual update, as modified by this Order, is adopted and replaces all prior versions of the Technical Reference Manual as of June 1, 2015.

 2. That a copy of this 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 filed comments.

 3. That the Secretary shall deposit notice of this Order and the 2015 version of the Technical Reference Manual with the Legislative Reference Bureau for publication in the *Pennsylvania Bulletin*.

 4. That this Order and the 2015 Technical Reference Manual update, as well its appendices 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>.



**BY THE COMMISSION**

Rosemary Chiavetta

Secretary

(SEAL)

ORDER ADOPTED: December 18, 2014

ORDER ENTERED: December 18, 2014

1. Order entered on October 3, 2005, at Docket No. M-00051865 (October 3, 2005 Order). [↑](#footnote-ref-2)
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 4. [↑](#footnote-ref-3)
3. *See* October 3, 2005 Order at 13. [↑](#footnote-ref-4)
4. *See Energy Efficiency and Conservation Program* Implementation Order, at Docket No. M-2008-2069887, (Phase I Implementation Order), at 13, entered January 16, 2009. [↑](#footnote-ref-5)
5. *Id*. [↑](#footnote-ref-6)
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-7)
7. *Id*. at 17 and 18. [↑](#footnote-ref-8)
8. *See Energy Efficiency and Conservation Program* Implementation Order, at Docket No. M-2012-2289411, (*Phase II Implementation Order*), entered August 3, 2012, at 71. [↑](#footnote-ref-9)
9. *Id*. at 75. [↑](#footnote-ref-10)
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-11)
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-12)
12. The Commission held a TWG meeting on July 11, 2014, 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-13)
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. *See Implementation of Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2014 Update*, Final Order at Docket No. M-2012-2313373, (2014 TRM), entered December 19, 2013. [↑](#footnote-ref-14)
14. A stipulated value for a stipulated variable refers to a single input value to an algorithm. [↑](#footnote-ref-15)
15. *See* <http://energy.gov/node/773531/residential/residential_cac_hp.html>. [↑](#footnote-ref-16)
16. *See* <https://www.energystar.gov/index.cfm?c=partners.pt_products_and_program_reqs>. [↑](#footnote-ref-17)
17. *See* 2014 TRM Section 2.1 – Electric HVAC at 19. [↑](#footnote-ref-18)
18. *See* Federal Code of Regulations 10 CFR 430, which may be found at <http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75>. [↑](#footnote-ref-19)
19. *See* 2014 TRM Section 2.16 – Ductless Mini-Split Heat Pumps at 81. [↑](#footnote-ref-20)
20. *See* 2014 TRM Section 2.22 – Residential New Construction at 121. [↑](#footnote-ref-21)
21. *See* 2014 TRM Section 1.7 – Baseline Estimates at 10. [↑](#footnote-ref-22)
22. For new Federal standards that become effective on January 1st, the previous standards are considered to expire on December 31 of the prior calendar year. [↑](#footnote-ref-23)
23. For new ENERGY STAR product specifications that become effective on January 1st, the previous specifications are considered to expire on December 31 of the prior calendar year. [↑](#footnote-ref-24)
24. Duquesne Comments at 4. [↑](#footnote-ref-25)
25. Duquesne Comments at 2. [↑](#footnote-ref-26)
26. *See* 42 U.S.C.A. § 6295(g)(8). [↑](#footnote-ref-27)
27. An end-use category describes the categories of equipment that provide a service to an individual or building. [↑](#footnote-ref-28)
28. The section numbers in this column reflect the section numbers of the proposed 2015 TRM. However, some of these section numbers have been amended per this Final Order. [↑](#footnote-ref-29)
29. PECO Comments at 4. [↑](#footnote-ref-30)
30. *See* 2014 TRM Section 1.3 – Definitions at 5. [↑](#footnote-ref-31)
31. *See* 2014 TRM Section 2.25 – ENERGY STAR Clothes Washers at 134. [↑](#footnote-ref-32)
32. *See* 2014 TRM Section 2.26 – ENERGY STAR Dishwashers at 139. [↑](#footnote-ref-33)
33. *See* 2014 TRM Section 2.27 – Dehumidifiers at 142. [↑](#footnote-ref-34)
34. *See* 2014 TRM Section 2.34 – ENERGY STAR Office Equipment at 169. [↑](#footnote-ref-35)
35. PPL Comments at 6; PECO Comments at 13-15. [↑](#footnote-ref-36)
36. *See* 2014 TRM Final Order at 35 and *Request for Proposals – Act 129 Statewide Evaluator*, RFP-2012-8, Pennsylvania Public Utility Commission – Bureau of Technical Utility Services, (November 30, 2012). *See Energy Efficiency and Conservation Program Final Order*, at Docket No. M-2012-2289411, (February 20, 2014). *See also the 2014 Pennsylvania Statewide Act 129 Residential Baseline Study* and *Pennsylvania Statewide Act 129 2014 Non-Residential End Use & Saturation Study*, submitted to the Pennsylvania Public Utility Commission by GDS Associates, *et al.* (2014 Residential Baseline Study) (2014 C&I Baseline Study) Apr. 4, 2014. [↑](#footnote-ref-37)
37. *See* 2014 TRM Section 2.1.3 – Electric HVAC: Definition of Terms at 21. [↑](#footnote-ref-38)
38. *See* 2014 TRM Section 3.27 – Electric Resistance Water Heaters at 332. [↑](#footnote-ref-39)
39. *See* 2014 TRM Section 3.28 – Heat Pump Water Heaters at 337. [↑](#footnote-ref-40)
40. *See* 2014 TRM Section 3.38 – Fuel Switching: Heat Pump Water Heaters to Gas/Oil/Propane at 381. [↑](#footnote-ref-41)
41. *See* 2014 TRM Section 2.3 – Efficient Electric Water Heaters at 30. [↑](#footnote-ref-42)
42. PPL Comments at 7 and 8. [↑](#footnote-ref-43)
43. *See* 2014 TRM Section 2.6 – Heat Pump Water Heaters at 41. [↑](#footnote-ref-44)
44. *See* 2014 TRM Section 2.13 – Solar Water Heaters at 72. [↑](#footnote-ref-45)
45. *See* 2014 TRM Section 2.17 – DHW Electric to Fossil Fuel Water Heater at 87. [↑](#footnote-ref-46)
46. *See* 2014 TRM Section 2.18 – Fuel Switching: Heat Pump Water Heater to Fossil Fuel Water Heater at 93. [↑](#footnote-ref-47)
47. *See* 2014 TRM Section 2.37 – Water Heater Tank Wrap at 177. [↑](#footnote-ref-48)
48. *See* 2014 TRM Section 2.41 – Water Heater Temperature Setback at 192. [↑](#footnote-ref-49)
49. *See* 2014 TRM Section 3.22 – Refrigeration – Auto Closers at 315. [↑](#footnote-ref-50)
50. *See* 2014 TRM Section 3.24 - Refrigeration – Suction Pipes Insulation for Walk-in Coolers and Freezers at 319. [↑](#footnote-ref-51)
51. *See* 2014 TRM Section 1.17 – Impact of Weather at 15. [↑](#footnote-ref-52)
52. *See* 2014 TRM Section 1.17 – Impact of Weather at 15. [↑](#footnote-ref-53)
53. PPL Comments at 4. [↑](#footnote-ref-54)
54. *See* 2014 TRM Section 2.5 – Furnace Whistle at 36. [↑](#footnote-ref-55)
55. *See* 2014 TRM Section 3.5 – HVAC Systems at 234. [↑](#footnote-ref-56)
56. *See* 2014 TRM Section 3.8 – High-Efficiency Refrigeration/Freezer Cases at 249. [↑](#footnote-ref-57)
57. *See* 2014 TRM Section 3.9 – High-Efficiency Evaporator Fan Motors for Reach-In Refrigerated Cases at 252. [↑](#footnote-ref-58)
58. *See* 2014 TRM Section 3.10 – High-Efficiency Evaporator Fan Motors for Walk-In Refrigerated Cases at 258. [↑](#footnote-ref-59)
59. *See* 2014 TRM Section 3.13 – Beverage Machine Controls at 271. [↑](#footnote-ref-60)
60. *See* 2014 TRM Section 3.14 – High-Efficiency Ice Machines at 273. [↑](#footnote-ref-61)
61. *See* 2014 TRM Section 3.15 – Wall and Ceiling Insulation at 276. [↑](#footnote-ref-62)
62. *See* 2014 TRM Section 3.19 – ENERGY STAR Electric Steam Cooker at 306. [↑](#footnote-ref-63)
63. *See* 2014 TRM Section 3.21 – Office Equipment – Network Power Management Enabling at 312. [↑](#footnote-ref-64)
64. *See* 2014 TRM Section 3.25 – Refrigeration: Evaporator Fan Controllers at 322. [↑](#footnote-ref-65)
65. *See* 2014 TRM Section 3.26 – ENERGY STAR Clothes Washer at 325. [↑](#footnote-ref-66)
66. *See* 2014 TRM Section 4.1 – Automatic Milker Takeoffs at 398. [↑](#footnote-ref-67)
67. *See* 2014 TRM Section 4.4 – Heat Reclaimers at 409. [↑](#footnote-ref-68)
68. *See* 2014 TRM Section 4.6 – Livestock Waterer at 415. [↑](#footnote-ref-69)
69. PECO Comments at 13 and 15. [↑](#footnote-ref-70)
70. FirstEnergy Comments at 3. [↑](#footnote-ref-71)
71. *See* 2014 TRM Section 1.2.4 - Applicability of the TRM for Estimating *Ex Ante* (Claimed) Savings at 5. [↑](#footnote-ref-72)
72. PPL Comments at 3. [↑](#footnote-ref-73)
73. The section number used herein reflects the numbering of the proposed 2015 TRM. As addressed later in this Final Order, this protocol is being removed and, therefore, does not have a section number in the final 2015 TRM. [↑](#footnote-ref-74)
74. PPL Comments at 8. [↑](#footnote-ref-75)
75. PPL Comments at 12. [↑](#footnote-ref-76)
76. Duquesne Comments at 13. [↑](#footnote-ref-77)
77. *See* 2014 TRM Section 2.29 – ENERGY STAR Lighting at 158. [↑](#footnote-ref-78)
78. *See* <http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=110_cong_bills&docid=f:h6enr.txt.pdf>. [↑](#footnote-ref-79)
79. *See* 2014 TRM Final Order at 70. [↑](#footnote-ref-80)
80. *See* <http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/general_service_incandescent_factsheet.pdf>. [↑](#footnote-ref-81)
81. PPL Comments at 4 and 5. [↑](#footnote-ref-82)
82. PECO Comments at 6- 7 and 10. [↑](#footnote-ref-83)
83. FirstEnergy Reply Comments at 2 and 3. [↑](#footnote-ref-84)
84. FirstEnergy Reply Comments at 4. [↑](#footnote-ref-85)
85. *See* 2014 TRM Section 2.35 – Residential Occupancy Sensors at 173. [↑](#footnote-ref-86)
86. PECO Comments at 11. [↑](#footnote-ref-87)
87. *See* 2014 TRM Section 2.4 – Electroluminescent Nightlight at 34. [↑](#footnote-ref-88)
88. *See* 2014 TRM Section 2.7 – LED Nightlight at 46. [↑](#footnote-ref-89)
89. PECO Comments at 11. [↑](#footnote-ref-90)
90. *See* 2014 TRM Section 2.36 – Holiday Lights at 174. [↑](#footnote-ref-91)
91. PECO Comments at 12. [↑](#footnote-ref-92)
92. PECO Comments at 12. [↑](#footnote-ref-93)
93. PECO Comments at 12. [↑](#footnote-ref-94)
94. *See* 2014 TRM Final Order at 56. [↑](#footnote-ref-95)
95. PPL Comments at 6. [↑](#footnote-ref-96)
96. PECO Comments at 13. [↑](#footnote-ref-97)
97. *See EM&V Forum: Primary Research ‒ Ductless Heat Pumps*, prepared by Northeast Energy Efficiency Partnerships, April 2014. Available at <http://neep.org/Assets/uploads/files/emv/emv-library/NEEP%20DHP%20Report%20Final%205-28-14%20and%20Appendices.pdf>. [↑](#footnote-ref-98)
98. *See Energy Savings Potential from Addressing Residential Air Conditioner and Heat Pump Installation Problems*, by C. Neme, J. Proctor and S. Nadel, American Council for an Energy-Efficient Economy, Report No. A992, Feb. 1999. Confirmed by Central Air Conditioning in Wisconsin, a compilation of recent field research, Energy Center of Wisconsin, May 2008, Amended Dec. 2010 and *Verifying ACCA Manual S Procedures*, ACCA. Available at <http://www.acca.org/Files/?id=67>. [↑](#footnote-ref-99)
99. Assumption used in Illinois 2014 TRM, Ductless Heat Pumps Measure, pg. 531. [↑](#footnote-ref-100)
100. PECO Comments at 14. [↑](#footnote-ref-101)
101. Mitsubishi Comments at 1. [↑](#footnote-ref-102)
102. *See* 66 Pa. C.S. § 2806.1(m). [↑](#footnote-ref-103)
103. *See* 2014 TRM Section 2.11 – Room AC (RAC) Retirement at 63. [↑](#footnote-ref-104)
104. PPL Comments at 6. [↑](#footnote-ref-105)
105. PECO Comments at 14. [↑](#footnote-ref-106)
106. FirstEnergy Comments at 4. [↑](#footnote-ref-107)
107. PPL Comments at 7. [↑](#footnote-ref-108)
108. *See* pages 93 and 94 of the 2014 TRM Final Order. [↑](#footnote-ref-109)
109. *See NEEA Heat Pump Water Heater Field Study Report*, Prepared by Fluid Market Strategies, (NEEA HPWH field study) Oct. 22, 2013. <http://neea.org/docs/default-source/reports/heat-pump-water-heater-field-study-report.pdf?sfvrsn=5>. [↑](#footnote-ref-110)
110. Based on average weather data from [www.weatherbase.com](http://www.weatherbase.com) for the seven Pennsylvania cities referenced elsewhere in this TRM (Allentown, Erie, Harrisburg, Philadelphia, Pittsburgh, Scranton, and Williamsport). [↑](#footnote-ref-111)
111. PPL Comments at 7. [↑](#footnote-ref-112)
112. FirstEnergy Comments at 4. [↑](#footnote-ref-113)
113. *See* 2014 TRM Section 2.23 – ENERGY STAR Refrigerators at 129. [↑](#footnote-ref-114)
114. *See Federal Standards for Residential Refrigerators and Fre*ezers, Effective Sept. 2014. <http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43>. [↑](#footnote-ref-115)
115. *See ENERGY STAR Program Requirements Product Specifications for Residential Refrigerators and Freezers*, Version 5.0, Effective Sept. 2014. Available at <https://www.energystar.gov/products/specs/residential_refrigerators_and_freezers_specification_version_5_0_pd>. [↑](#footnote-ref-116)
116. *See ENERGY STAR Recognition Criteria for Most Efficient Refrigerator-Freezers,* Table 2. Available at <http://www.energystar.gov/ia/partners/downloads/most_efficient/final_criteria/Refrigerator-Freezers.pdf?6a37-2bde>. [↑](#footnote-ref-117)
117. PECO Comments at 17. [↑](#footnote-ref-118)
118. *See* 2014 TRM Section 2.24 – ENERGY STAR Freezers at 134. [↑](#footnote-ref-119)
119. *See Federal Standards for Residential Refrigerators and Freezers*, Effective Sept. 2014. Available at <http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43>. [↑](#footnote-ref-120)
120. *See ENERGY STAR Program Requirements Product Specifications for Residential Refrigerators and Freezers*, Version 5.0. Effective Sept. 2014. Available at <http://www.energystar.gov/products/specs/system/files/ENERGY%20STAR%20Final%20Version%205.0%20Residential%20Refrigerators%20and%20Freezers%20Program%20Requirements.pdf>. [↑](#footnote-ref-121)
121. *See ENERGY STAR Recognition Criteria for Most Efficient Refrigerator-Freezers*, Table 2. Available at <http://www.energystar.gov/ia/partners/downloads/most_efficient/final_criteria/Refrigerator-Freezers.pdf?6a37-2bde>. [↑](#footnote-ref-122)
122. PECO Comments at 17. [↑](#footnote-ref-123)
123. *See* 2014 TRM Section 2.21 – Refrigerator/Freezer Recycling with and without Replacement at 113. [↑](#footnote-ref-124)
124. PPL Comments at 9-10, PECO Comments at 18 and Duquesne Comments at 11. [↑](#footnote-ref-125)
125. PPL Comments at 9-10. [↑](#footnote-ref-126)
126. *See* 2014 TRM Section 2.42 – ENERGY STAR Water Coolers at 201. [↑](#footnote-ref-127)
127. PECO Comments at 19. [↑](#footnote-ref-128)
128. *See* 2014 TRM Section 2.12 – Smart Strip Plug Outlets at 69. [↑](#footnote-ref-129)
129. PPL Comments at 11. [↑](#footnote-ref-130)
130. PPL Comments at 11. [↑](#footnote-ref-131)
131. *See* 2014 TRM Section 2.38 – Pool Pump Load Shifting at 183. [↑](#footnote-ref-132)
132. PPL Comments at 12. [↑](#footnote-ref-133)
133. *See* 2014 TRM Section 2.39 - Variable Speed Pool Pumps (with Load Shifting Option) at 186. [↑](#footnote-ref-134)
134. *See* 2014 TRM Final Order at 110 and 111. [↑](#footnote-ref-135)
135. PPL Comments at 12-13. [↑](#footnote-ref-136)
136. *See* 2014 TRM Section 3.2 – Lighting Equipment Improvements at 2015. [↑](#footnote-ref-137)
137. *See* 2014 TRM Section 3.1.2 – New Construction Lighting at 219. [↑](#footnote-ref-138)
138. The ASHRAE 90.1 Standard is available at: <https://law.resource.org/pub/us/code/ibr/ashrae.90.1.2007.pdf> [↑](#footnote-ref-139)
139. FirstEnergy Comments at 9 and 10. [↑](#footnote-ref-140)
140. Duquesne Comments at 6 and 7. [↑](#footnote-ref-141)
141. PECO Comments at 22 and 23. [↑](#footnote-ref-142)
142. *See Measure Life Study*, prepared for the Massachusetts Joint Utilities, by Energy and Resource Solutions, (Measure Life Study), Nov. 2005. Available at <http://rtf.nwcouncil.org/subcommittees/nonreslighting/Measure%20Life%20Study_MA%20Joint%20Utilities_2005_ERS-1.pdf>. [↑](#footnote-ref-143)
143. *See Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures*, prepared for the New England State Program Working Group, prepared by GDS Associates, Inc. (GDS’s Measure Life Report) June 2007. Available at <http://neep.org/Assets/uploads/files/emv/emv-library/measure_life_GDS%5B1%5D.pdf>. [↑](#footnote-ref-144)
144. *See* DEER 2008 Effective Useful Life. Available at <http://www.deeresources.com/>. [↑](#footnote-ref-145)
145. Duquesne Comments at 6. [↑](#footnote-ref-146)
146. FirstEnergy Comments at 7 and 9. [↑](#footnote-ref-147)
147. PPL Comments at 15. [↑](#footnote-ref-148)
148. PECO Comments at 23. [↑](#footnote-ref-149)
149. PECO Comments at 23. [↑](#footnote-ref-150)
150. Available at <http://publicecodes.cyberregs.com/icod/iecc/2009/>. [↑](#footnote-ref-151)
151. *See* 2014 TRM Section 3.17 – Water Source and Geothermal Heat Pumps at 291. [↑](#footnote-ref-152)
152. FirstEnergy Comments at 10. [↑](#footnote-ref-153)
153. PECO Comments at 23. [↑](#footnote-ref-154)
154. *See* 2014 TRM Section 3.18 - Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons at 102. [↑](#footnote-ref-155)
155. *See* 2014 TRM Section 3.39 - Fuel Switching: Small Commercial Electric Heat to Natural gas/Propane/Oil Heat at 393. [↑](#footnote-ref-156)
156. *See* 2014 TRM Section 3.32 – Small C/I HVAC Refrigerant Charge Correction at 362. [↑](#footnote-ref-157)
157. *See* 2014 TRM Section 3.34 – ENERGY STAR Room Air Conditioner at 369. [↑](#footnote-ref-158)
158. PPL Comments at 15. [↑](#footnote-ref-159)
159. *See* 2014 TRM Section 3.6 – Electric Chillers at 244. [↑](#footnote-ref-160)
160. Duquesne Comment at 14. [↑](#footnote-ref-161)
161. Duquesne Comments at 7 and 10. [↑](#footnote-ref-162)
162. Mitsubishi Electric Comments at 1. [↑](#footnote-ref-163)
163. FirstEnergy Comments at 10. [↑](#footnote-ref-164)
164. *See* 2014 TRM Section 3.3 – Premium Efficiency Motors at 226. [↑](#footnote-ref-165)
165. *See* 2014 TRM Section 3.4 – Variable Frequency Drive (VFD) Improvements at 234. [↑](#footnote-ref-166)
166. FirstEnergy Comments at 10. [↑](#footnote-ref-167)
167. PECO Comments at 24 and 25. [↑](#footnote-ref-168)
168. PPL Comments at 16. [↑](#footnote-ref-169)
169. PECO Comments at 25. [↑](#footnote-ref-170)
170. PPL Comments at 16. [↑](#footnote-ref-171)
171. *See* 2014 TRM Section 3.31 – Low Flow Pre-Rinse Sprayers for Time of Sale/Retail Programs at 353. [↑](#footnote-ref-172)
172. *See Water- Thermal Properties*, The Engineering Toolbox (The Engineering Toolbox). Available at <http://www.engineeringtoolbox.com/water-thermal-properties-d_162.html>. [↑](#footnote-ref-173)
173. *See Impact and Process Evaluation Final Report for California Urban Water Conservation Council: 2004-5 Pre-Rinse Spray Valve Installation Program (Phase 2)*, submitted to California Public Utilities Commission, prepared by SBW Consulting, Inc. *et al.* (Impact and Process Evaluation Final Report) Feb. 2007. Available at <http://www.allianceforwaterefficiency.org/WorkArea/DownloadAsset.aspx?id=976>. [↑](#footnote-ref-174)
174. PPL Comments at 17. [↑](#footnote-ref-175)
175. PECO Comments at 26. [↑](#footnote-ref-176)
176. *See* 2014 TRM Section 3.37 - Fuel Switching: Domestic Hot Water Electric to Gas/Oil/Propane at 378. [↑](#footnote-ref-177)
177. PECO Comments at 26. [↑](#footnote-ref-178)
178. FirstEnergy Reply Comments at 4. [↑](#footnote-ref-179)
179. <http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/wicf_faq_2012-01-20.pdf> [↑](#footnote-ref-180)
180. FirstEnergy Comments at 10. [↑](#footnote-ref-181)
181. FirstEnergy Comments at 10. [↑](#footnote-ref-182)
182. *See* 2014 TRM Section 3.23 – Refrigeration – Door Gaskets for Walk-In and Reach-In Coolers and Freezers, at 320. [↑](#footnote-ref-183)
183. FirstEnergy Comments at 11. [↑](#footnote-ref-184)
184. PPL Comments at 17 and 18. [↑](#footnote-ref-185)
185. PECO Comments at 28. [↑](#footnote-ref-186)
186. *See* 2014 TRM Section 5.5 – Appendix E: Lighting Audit and Design Tool for C&I New Construction Projects at 434. [↑](#footnote-ref-187)
187. *See* 2014 TRM Section 3.1.2 – New Construction Lighting at 222. [↑](#footnote-ref-188)
188. PPL Comments at 15. [↑](#footnote-ref-189)
189. Duquesne Comments at 6. [↑](#footnote-ref-190)
190. PPL Comments at 1 and 2. [↑](#footnote-ref-191)
191. FirstEnergy Comments at 2. [↑](#footnote-ref-192)
192. *See* 2011 TRM Final Order at 49,2012 TRM Final Order at 72, 2013 TRM Final Order at 118 and 2014 TRM Final Order at 178. [↑](#footnote-ref-193)
193. *See* 2011 TRM Final Order at 49 and 50, 2012 TRM Final Order at 72, 2013 TRM Final Order at 118 and 119 and 2014 TRM Final Order at 178 and 179. [↑](#footnote-ref-194)
194. *See* Phase II Implementation Order at 75; 2014 TRM Final Order at 179; 2013 TRM Final Order at 118-120; 2012 TRM Final Order at 71-73; 2011 TRM Update Order at 47-50. [↑](#footnote-ref-195)
195. *See* Phase II Implementation Order at 75. [↑](#footnote-ref-196)