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

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|  | Public Meeting held December 20, 2012 |
| Commissioners Present: |  |

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| Robert F. Powelson, Chairman |  |
| John F. Coleman, Jr., Vice ChairmanWayne E. Gardner, Commissioner |  |
| James H. Cawley, Commissioner |  |
| Pamela A. Witmer, Commissioner |  |
|  |  |
| Implementation of the Alternative Energy PortfolioStandards Act of 2004: Standards for the Participationof Demand Side Management Resources – TechnicalReference Manual 2013 Update | Docket No. M-2012-2313373 M-00051865 |

**2013 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), as amended,[[1]](#footnote-1)this Commission had adopted an *Energy‑Efficiency and DSM Rules for Pennsylvania’s Alternative Energy Portfolio Standard, Technical Reference Manual* (TRM).[[2]](#footnote-2) In adopting the original version of the TRM, this Commission directed its Bureau of Conservation, Economics and Energy Planning (CEEP)[[3]](#footnote-3) to oversee the implementation, maintenance and periodic updating of the TRM.[[4]](#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,[[5]](#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.”[[6]](#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.[[7]](#footnote-7) In adopting the 2009 TRM, the Commission recognized the importance of updating the TRM on an annual basis.[[8]](#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.[[9]](#footnote-9) The Phase II Implementation Order also recognized the importance of the continued use of an annual updating process for the TRM for Phase II.[[10]](#footnote-10) With this Order, the Commission completes the fifth annual update of the TRM to be applied beginning with the 2013‑2014 AEPS Act and Act 129 EE&C Program Phase II compliance year from June 1, 2013 to May 31, 2014.

**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, 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 (TRC) Manual and to provide suggestions for possible revisions and additions to these manuals. A program evaluation group (PEG)[[11]](#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)[[12]](#footnote-12) meeting to discuss the proposed 2013 TRM updates.[[13]](#footnote-13)

The Commission, in a Tentative Order adopted on January 28, 2010, sought comments on a proposed 2010 TRM annual update.[[14]](#footnote-14) In an Order, adopted June 3, 2010, the Commission promulgated the 2010 TRM.[[15]](#footnote-15)

The Commission, in a Tentative Order adopted on November 19, 2010, sought comments on a proposed 2011 TRM annual update.[[16]](#footnote-16) In an Order, adopted February 24, 2011, the Commission promulgated the 2011 TRM.[[17]](#footnote-17)

The Commission in a Tentative Order adopted on September 22, 2011, sought comments on a proposed 2012 TRM annual update.[[18]](#footnote-18) In an Order, adopted December 15, 2011, the Commission promulgated the 2012 TRM.[[19]](#footnote-19)

The Commission, in collaboration with the SWE and the PEG, with input from the TWG, reviewed the 2012 TRM and proposed several changes and additions that were released for comment with the Commission’s adoption of a Tentative Order on September 13, 2012.[[20]](#footnote-20) A Notice of the Tentative Order and proposed 2013 TRM update was published in the Pennsylvania Bulletin on September 29, 2012.[[21]](#footnote-21) Comments were due on October 29, 2012. Due to State Office closings on both October 29, 2012, and October 30, 2012, the due date for comments was extended to October 31, 2012. Reply comments were due November 8, 2012. Due to the State Office closings previously referenced, the due date for reply comments was extended through November 15, 2012.[[22]](#footnote-22)

The following parties filed comments to the proposed 2013 TRM update: CLEAResult Consulting, Inc. (CLEAResult); Duquesne Light Co. (Duquesne); the Energy Association of Pennsylvania (EAP); Metropolitan Edison Co., Pennsylvania Electric Co., Pennsylvania Power Co. and West Penn Power Co. (collectively, FirstEnergy); the Keystone Energy Efficiency Alliance (KEEA); the National Housing Trust and the Pennsylvania Housing Financing Agency (collectively, NHT/PHFA); PECO Energy Co. (PECO); and PPL Electric Utilities Corp. (PPL). The following parties filed reply comments to the proposed 2013 TRM update: EAP, FirstEnergy and PECO.

**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. The EDCs provided, through the SWE evaluation and verification process, much of the data that forms the basis of the changes and improvements being adopted in the 2013 version of the TRM. Specifically, the current proposed improvements were the result of SWE site inspections, and conservation service provider (CSP) and EDC independent evaluator comments. The adopted changes focus on improving assumptions for key parameters, algorithms, deemed savings values and accounting for new codes and standards for existing 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. The major goals of the proposed modifications are as follows:

1. To appropriately balance the integrity and accuracy of claimed energy savings estimates with costs incurred to measure and verify the claimed energy savings;
2. To clarify existing calculation methods;
3. To minimize the number of EE&C measures that must be evaluated through custom protocols; and
4. To provide additional reasonable methods for measurement and verification of incremental energy savings associated with EE&C measures without unduly burdening EDC EE&C program and evaluation staff.

A summary of the changes adopted for the 2013 TRM update follows:

1. General Improvements to the TRM
	* 1. Clarification of Coincident Peak Window;
		2. Applicability of Residential and C&I Protocols for Multifamily Buildings;
		3. Clarification of Weather Mapping (Section 1.16);
		4. Organization of the TRM;
		5. Addition of New Protocols to the TRM for Residential and C&I Measures;
		6. Correction of Measure Lives in Appendix A; and
		7. Clarification of definition of Custom Measure Protocols in Appendix B.
2. Clarification of the following residential EE&C measure deemed protocols:
	* 1. Modification of Heating, Ventilation, and Air Conditioning (HVAC) Equivalent Full Load Hours (EFLH) and the addition of a proper sizing savings algorithm;
		2. Clarification of lighting protocols regarding the hours of usage (HOU) of compact fluorescent light bulbs (CFL), updates to the algorithms for ENERGY STAR lighting, clarification regarding the implementation of federal legislation and regulations;
		3. Clarification of ENERGY STAR Appliances protocol, including new protocols for each appliance, updated baseline assumptions, and inclusion of new and future standards;
		4. Update of Refrigerator/Freezer Replacement and Recycling protocols based on the latest available program data;
		5. Modification of electric hot water heater daily water usage assumption;
		6. Modification of low flow showerhead and faucet aerator assumptions;
		7. Clarification of Residential New Construction protocols;
		8. Clarification of the sources used for Furnace Whistle savings estimation;
		9. Removal of evaluation protocols for Heat Pump Water Heaters;
		10. Discussion of Home Audit Conservation Kit protocols;
		11. Clarification of the Programmable Thermostat protocols;
		12. Discussion of Smart Strip Plug Outlets protocols;
		13. Discussion of Room AC Retirement protocols;
		14. Clarification of Solar Water Heaters protocols;
		15. Clarification of Electric Water Heater Pipe Insulation savings estimates;
		16. Discussion of Residential Whole House Fans protocols;
		17. Discussion of Ductless Mini-Split Heat Pumps protocols
		18. Update of Fuel Switching: Electric Heat to Gas Heat baseline efficiency standards;
		19. Discussion of Ceiling/Attic and Wall Insulation protocols;
		20. Discussion of Water Heater Tank Wrap protocols;
		21. Update of ENERGY STAR Televisions protocol;
		22. Discussion of Electric Clothes Dryer with Moisture Sensor measure life;
		23. Modification of the LED Nightlight algorithm to be consistent with other residential lighting protocols;
		24. Modification and discussion of Residential Occupancy Sensors protocol; and
		25. Clarification of Holiday Lights terms.
3. Clarification of the following C&I EE&C measure deemed protocols:
	* 1. Clarification of lighting protocols regarding the HOU and coincidence factors (CF), building types, control technologies and savings factors, implementation of federal legislation and regulations, new construction calculator, and temperature ranges for interactive factor values;
		2. Clarification of HVAC protocols regarding EFLH;
		3. Clarification of Motors and Variable Frequency Drive (VFD) protocols regarding energy savings and demand savings factors, as well as operating hours;
		4. Clarification of Office Equipment Network Power Management Systems protocols regarding deemed savings values;
		5. Clarification of Light-Emitting Diode (LED) Channel Signage protocol regarding savings algorithm, and assumptions table;
		6. Clarification of refrigeration protocols regarding EFLH;
		7. Clarification of Low Flow Pre-Rinse Sprayers protocol regarding minimum code requirement for time of sale/retail program type;
		8. Clarification of Refrigeration – Evaporator Fan Controllers protocol regarding savings algorithm, definitions, and assumptions table;
		9. Clarification of Geothermal Heat Pumps protocol regarding language and definitions;
		10. To improve the functionality and scope of the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool);
		11. Clarification of Ductless Mini Split Heat Pumps protocol regarding use of efficiency ratings and Load Factor;
		12. Clarification of ENERGY STAR Clothes Washers regarding new Federal standards and ENERGY STAR requirements, assumptions, algorithms, deemed savings, and measure lives;
		13. Correction of algorithms for Electric Resistance Water Heaters and Heat Pump Water Heaters protocols;
		14. Clarification of Small C/I HVAC Refrigerant Charge Correction regarding use of efficiency ratings; and
		15. Recommendation to add new Interim Measure Protocols for 2014 TRM.
4. Removal of the Demand Response Section; and
5. Application of the TRM.

Below, we will discuss in more detail the more significant TRM changes and updates that are being adopted. Minor administrative and uncontested changes will not be discussed. We accept the changes proposed in the following sections of our Tentative Order, for which we received no comments: 1) Clarification of Coincident Peak Window; 2) CFL Hours of Operation per Day; 3) ENERGY STAR Torchieres, Indoor Fixtures, Outdoor Fixtures and Ceiling Fan Algorithms; 4) ENERGY STAR LEDs; 5) ENERGY STAR Most Efficient Appliances; 6) Low Flow Faucet Aerator and Showerhead – Recovery Efficiency; 7) Single Family and Multifamily Low Flow Showerheads; 8) Low Flow Showerhead Temperature Assumptions; 9) Temperature Ranges of Space Types for Interactive Factor Values; 10) HVAC Protocols; and 11) Geothermal Heat Pumps.

1. **General Improvements**

* 1. **Applicability of Residential and C&I Protocols for Multifamily Buildings**

 The applicability of residential and C&I protocols for air sealing and insulation measures in the TRM to multifamily housing was not discussed in the Tentative Order. We did, however, receive comments on these protocols and will address those comments here.

1. **Comments**

 NHT/PHFA raises the question of whether the air sealing and ceiling/attic and wall insulation measures can be used to estimate savings in residential units and common areas in multifamily buildings as the TRM does not explicitly state that the measure can be applied to multifamily residential homes.[[23]](#footnote-23) NHT/PHFA also requests that the Commission provide clarity regarding the applicability of these protocols in master-metered multifamily buildings with commercial customer accounts.

 FirstEnergy, replies that the TRM does not specify deemed savings processes for estimation of seal-up or whole-building impacts, consistent with the ENERGY STAR protocol for home performance programs. Rather than adopting new savings protocols, FirstEnergy recommends the continued estimation of savings using applicable protocols and standards pending the development of supported deemed savings values through the PEG process.[[24]](#footnote-24)

1. **Disposition**

 The Commission recognizes the need for more clarity in the TRM regarding the applicability of residential and C&I air sealing and insulation protocols for multifamily housing. The Commission also agrees that the air sealing and insulation residential protocols and standards may be used for multifamily – units, whereas air sealing and insulation C&I protocols and standards may be used for multifamily – common areas. As such, the Commission added the following language to Section 1.17[[25]](#footnote-25) in the TRM to provide the requested clarification:

Protocols in the residential and C&I sections describe measure savings based on the application or usage characteristics of the measure rather than how the measure is metered. For example, if a measure is found in a residential environment but is metered under a commercial meter, the residential sector protocol is used. On the other hand, if a measure is found in a commercial environment but is metered under a residential meter, the commercial sector protocol is used.

* 1. **Impact of Weather – Section 1.16**

 Few protocols in the TRM (for example, Section 3.24[[26]](#footnote-26)) rely on the work and analysis completed in California, where savings values are adjusted for climate. There are sixteen California climate zones. Each of the seven reference cities are mapped to a California climate zone as shown in Table1-2[[27]](#footnote-27) based on comparable number of cooling degree days (CDD) and average dry bulb temperatures. Any weather-dependent protocol using California-based models follows this mapping table in the TRM. The methodology of mapping Pennsylvania cities to California climate zones to account for differences in weather was not discussed in the Tentative Order, however, we received some comments on these climate zones and will address those comments here.

**a. Comments**

 KEEA states that it is not appropriate to map Pennsylvania cities to California climate zones as shown in Table 1-2 of 2013 TRM because the climates in California and Pennsylvania are very different. Specifically, KEEA points out that Table 1-2 maps Philadelphia to the California Climate Zone 13, but Climate Zone 13 has only about half the heating degree days (HDD) of Philadelphia and has about 50% more CDD. KEEA states that the simple mapping in Table 1-2 should not be used because CDD are generally a poor way to estimate cooling load in relatively mild cooling climates and, in fact, matching cooling degree hours would be a better metric on which to base cooling season assignments.[[28]](#footnote-28)

 In their reply comments, FirstEnergy and PECO state that they agree with KEEA regarding the applicability of mapping Pennsylvania cities to California climate zones as demonstrated in Table 1-2. FirstEnergy and PECO state that it is unclear where and how Table 1-2 was used to develop savings estimates based on their review of the TRM. FirstEnergy and PECO suggest that the Commission direct the SWE and PEG to: 1) review how Table 1-2 is used; 2) justify appropriate mapping of California climate zones and studies to Pennsylvania; 3) support adjustment to factors impacted by Table 1-2 as appropriate; and 4) if used in the TRM, include references for its use. FirstEnergy recommends that the Commission resolve these issues prior to adopting changes impacted by Table 1-2.[[29]](#footnote-29)

**b. Disposition**

 The Commission agrees with KEEA, PECO and FirstEnergy that it may be worthwhile to investigate alternatives to mapping Pennsylvania cities to California climate zones based on CDD and HDD to account for differences in climate as shown in Table 1-2 of TRM. The Commission also agrees with KEEA that cooling and heating degree hours would be a better metric rather than CDD and HDD, for mapping purposes. The Commission clarifies that the source equations, values for input parameters, and deemed savings values for few C&I refrigeration measures (for example, Section 3.24) in the TRM that are weather-sensitive were adopted from the California work papers. Therefore, the values for each Pennsylvania reference city were taken from the associated California climate zones listed in the California work paper. Due to the relatively small contribution of savings toward EDC portfolios as a whole and lack of Pennsylvania-specific data, the ex-ante savings[[30]](#footnote-30) based on the California work paper will be used until further research is conducted. The Commission directs the PEG to review the mapping of California climate zones and any applicable studies to Pennsylvania for the measures impacted and provide recommendations for future TRM updates.

* 1. **Addition of New Protocols to the TRM for Residential and C&I Measures**

No new protocols were proposed in the Tentative Order. CLEAResult and KEEA, however, suggested new measures in their comments, which we will address here.

**a. Comments**

 CLEAResult suggests that the Commission consider the addition of a residential measure to the TRM for the conversion from electric resistance heat to heat pumps for residential buildings and multifamily dwelling units to strengthen the TRM.[[31]](#footnote-31) In addition, CLEAResult recommends that the Commission add the following C&I measures to the TRM:

* ENERGY STAR Data Storage Servers;
* ENERGY STAR Servers;
* Server Virtualization;
* Variable Frequency Drives on Fan Motors for Computer Room Air Conditioning (CRAC) units;
* Variable Frequency Drives on Chilled Water Pumps serving;
* Refrigeration Tune-Up;
* Industrial Nozzles; and
* Faucet Aerators (in commercial facilities).[[32]](#footnote-32)

 KEEA agrees with CLEAResult’s suggestion to add the additional residential measure but suggest the addition of the words “high efficiency” to heat pumps and to include solar thermal heating. KEEA also agrees with CLEAResult on the inclusion of the above-mentioned C&I measures.[[33]](#footnote-33)

**b. Disposition**

 The Commission rejects CLEAResult’s and KEEA’s requests to add protocols for additional residential and C&I measures to the TRM at this time, as neither party has provided supporting documentation for consideration, including, but not limited to, algorithms, potential deemed savings values and associated measure lives. We, however, support the expansion of the TRM. As such, we suggest that CLEAResult and KEEA work with the EDCs and the SWE to develop such protocols for discussion within the PEG and TWG for consideration in future TRM updates.

* 1. **Appendix A: Measure Lives**

 Appendix A[[34]](#footnote-34) of the TRM defines the measure lives used for cost-effectiveness screening. Measure lives were not discussed in the Tentative Order, however, we received comments related to measure lives, which we will discuss here.

**a. Comments**

 PPL recommends aligning the measure lives in Appendix A with those provided in corresponding protocols, where appropriate. PPL states that there are inconsistent measure lives provided in TRM protocols and Appendix A for measures including, but not limited to ENERGY STAR Refrigerator 2001 and ENERGY STAR Room Air Conditioners.[[35]](#footnote-35)

 In addition, PPL suggests that the Commission consider revising the measure lives for those measures which have had their operating hours decreased in the proposed 2013 TRM. PPL notes that this change would affect CFLs, residential HVAC equipment and commercial lighting measures that have lives tied to hours of use.[[36]](#footnote-36)

**b. Disposition**

 The Commission recognizes PPL’s comments regarding the consistency of measure lives and believes this issue warrants further review. As such, the measure lives in Appendix A will be adopted. The Commission, however, directs the PEG to review this issue and provide recommendations for future TRM updates.

 In addition, the Commission revises the measure life of a CFL to 6.8 years due to the decrease in daily operating hours from 3.0 to 2.8, in Section 2.30[[37]](#footnote-37) of the TRM. The Commission retains the measure lives set forth in Appendix A for residential HVAC but directs the PEG to review this issue and provide recommendations future TRM updates.

 The Commission retains the measure lives set forth in Appendix A for C&I lighting, motors and VFD measures. The Commission clarifies that the measure lives for commercial lighting (non-solid-state lighting) and industrial lighting for both new and remodel/replacement scenarios is 15 years. Similarly, the measure lives for motors and VFDs is 20 years and 15 years, respectively. Therefore, the Commission believes that the operating hours that were revised for C&I lighting, motors and VFD measures in the 2013 TRM do not affect the TRC Test calculations for Act 129 because the measure life cannot claim savings for more than fifteen years.[[38]](#footnote-38) The Commission directs the PEG to investigate the measure lives and provide recommendations for future TRM updates.

* 1. **Appendix B: Relationship between Program Savings and Evaluation Savings**

 Appendix B[[39]](#footnote-39) was not discussed in the Tentative Order. We, however, received several comments related to Appendix B, which we will discuss here. Initially, we point out that there is a distinction between activities required to conduct measurement and verification of savings at the program participant level and the activities conducted by program evaluators and the SWE to validate those savings. The underlying standard for the measurement of savings for both of these activities is the measurement and verification protocols approved by the Commission.

**a. Comments**

 PPL recommends that the following language be removed from Appendix B: “Custom Measure Protocols reviewed and recommended by the SWE and approved for use by the Director of CEEP.” PPL states that the formal Custom Measure Protocol process was eliminated near the end of Program Year 2. PPL proposes to add text stating that “there could occasionally be a need for EDCs to draft Custom Measure Protocols for measures that are not covered by TRM or Interim TRM protocols.”[[40]](#footnote-40)

**b. Disposition**

 The Commission accepts PPL’s request to remove the sentence “Custom Measure Protocols reviewed and recommended by the SWE and approved for use by the Director of CEEP” from Appendix B in the TRM. The Commission has added text stating that “There could occasionally be a need for EDCs to draft Custom Measure Protocols for measures that are not covered by the TRM or Interim TRM protocols.”

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

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

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

 Due to the over-sizing of HVAC equipment that often occurs in residential homes, the Commission believed that the EFLH for cooling and heating in the 2012 TRM[[41]](#footnote-41) may need updating. An over-sized HVAC unit will run fewer hours than a perfectly-sized unit installed in the same home. As such, the Commission proposed that the EFLH be updated, using REM/Rate modeling, to account for such over-sizing. Based on the above methodology, the Commission proposed adjusting the cooling and heating EFLH values. These new EFLH values would affect the following sections of the 2012 TRM: Section 2.1 – Electric HVAC,[[42]](#footnote-42) Section 2.5 – Furnace Whistle,[[43]](#footnote-43) Section 2.11 – Programmable Thermostat,[[44]](#footnote-44) Section 2.17 – Ductless Mini-Split Heat Pumps,[[45]](#footnote-45) Section 2.20 – Fuel Switching: Electric Heat to Gas Heat,[[46]](#footnote-46) and Section 2.21 – Ceiling, Wall, and Attic Insulation.[[47]](#footnote-47) The Commission also proposed that an EDC be allowed to develop its own EFLH estimates based on billing data analysis from residential customers as an alternative, if they believe that billing data analysis will provide more accurate EFLH estimates than the REM/Rate modeling and assumed over-sizing factors.

**i. Comments**

 KEEA suggests that the EFLH developed based on generic modeling runs multiplied by guessed-at over-sizing factors are inferior to the “optional” method of billing data analysis, concluding that the billing data analysis should be the primary methodology listed in the TRM for many of the sections that currently use EFLH. KEEA also suggests that if site-specific billing analysis estimate is unavailable, utility-specific average cooling and heating loads should be used in favor of the EFLH methodology.[[48]](#footnote-48)

 FirstEnergy comments that using billing analysis, as KEEA suggests, increases the barriers to participation in Act 129 programs by increasing information needed to estimate savings, in turn increasing the time needed to complete applications and the time needed to review applications for incentives. FirstEnergy additionally points out that KEEA has not demonstrated that expanding program process will improve the accuracy of the savings estimates. FirstEnergy believes, therefore, that in balancing the interest of having customers participate in user-friendly programs with the small improvement that may occur in savings estimates, the procedures should not be expanded.[[49]](#footnote-49)

 PECO also disagrees with KEEA regarding billing analysis being listed as the preferred method for savings estimation. While PECO agrees that billing analysis is a more accurate method for individual customers, it notes that it is also costly and burdensome and would significantly hinder the implementation of HVAC measures in Pennsylvania. PECO further comments that the TRM represents the average savings that a population of participants would achieve for a given measure, not the actual savings of a single participant. This method sacrifices individual accuracy for the cost-effectiveness and reliability of the average result of the population. PECO additionally comments that the proposed changes to the EFLH make significant reductions to reduce the potential for overstating savings on average.[[50]](#footnote-50)

 PECO agrees with the concept of revising the EFLH, but is concerned over the weighting methodology used to determine cooling and heating EFLH for each location. The current methodology weights home characteristics across the state rather than for cities specific to each EDC. For PECO, which would only use Philadelphia EFLH, this methodology causes a reduction in the EFLH values from the values solely for Philadelphia. PECO therefore recommends reconsideration of the weighting methodology and its specific effect on PECO.[[51]](#footnote-51)

**ii. Disposition**

 The Commission rejects KEEA’s suggestion that billing analysis be the primary methodology for determining savings for many of the HVAC measures in the TRM. While billing analysis may be more accurate for a single participant, the purpose of the TRM is to represent the average savings of the population in the interest of cost-effectiveness for running the programs and reducing barriers for participation and implementation for customers and EDCs. By using billing analysis as the primary methodology for estimating savings, the costs of, and barriers to, implementing programs will increase. Therefore, we believe the current approach, using EFLH, should remain as the primary methodology.

 The Commission agrees with PECO’s concern regarding the weighting methodology used for EFLH estimation. Given the potential impact of a change to EFLH values and the complexity of the methodology, the Commission directs the PEG to consider PECO’s suggested modification to methodology used for EFLH estimation and provide recommendations for future TRM updates.

* + - 1. **Sizing Algorithm**

 The 2011 TRM contained an algorithm for savings associated with the installation of a properly-sized air conditioner, which was removed in the 2012 TRM update.[[52]](#footnote-52) Since the new cooling EFLH values proposed would account for over-sizing and because the 2012 TRM did not contain an algorithm for the proper sizing of air conditioners, the Commission proposed reinserting the proper-sizing savings algorithm for cooling HVAC equipment to allow EDCs to claim savings for a properly-sized HVAC system and continue offering programs that require proper sizing as a condition to receive rebates.

**i. Comments**

 PPL supports the addition of the proper-sizing savings algorithm for cooling HVAC. PPL also requests that a comparable algorithm be added, or the proposed algorithm be adjusted, to allow for savings from the proper sizing of air-source heat pumps.[[53]](#footnote-53) KEEA states that the proposed proper sizing factor, in addition to the duct sealing factor and maintenance factor, does not accurately reflect variations in conditions across homes.[[54]](#footnote-54)

**ii. Disposition**

The Commission rejects PPL’s request to add an algorithm for savings from properly-sized heat pumps. While the cooling EFLH inherently assumes that the cooling equipment is over-sized, the heating EFLH assumes that the equipment is properly sized, based on the Air Conditioning Contractors of America Manual S procedures.[[55]](#footnote-55) Additionally, as determined by the Commission in the 2012 TRM Final Order, “maintenance and duct sealing are the only electric HVAC system improvement measures included in the protocol to which heating savings could apply.”[[56]](#footnote-56)

While the Commission agrees with KEEA’s comments, the purpose of the HVAC proper-sizing, duct sealing, and HVAC maintenance savings algorithms is to represent the average conditions across all homes in PA. Therefore, any inaccuracy in the proper-sizing factor, duct sealing factor and maintenance factor in reflecting variations across individual homes is not significant as long as the values for the factors used in the TRM reflect the average of the population as a whole.

* + - 1. **Central Air Conditioning and Air-Source Heat Pump (Maintenance)**

**i. Comments**

 KEEA comments that the central air conditioner (A/C) and air-source heat pump (ASHP) maintenance savings factor of 10% is considerably higher than has been found in recent results in Nevada and California. In addition, KEEA comments that the savings factor fails to differentiate between state-of-the-art diagnostic approaches targeted to homes to likely have system problems and regular routine maintenance. KEEA further comments that the citation for the maintenance factor has nothing to do with system maintenance and that the intended source, possibly the next listed source in the TRM, is vague at best.[[57]](#footnote-57)

**ii. Disposition**

 The Commission agrees with KEEA’s comment that the source cited for the central air conditioner and air source heat pump maintenance savings factor is out of order. The TRM has been amended accordingly. The Commission acknowledges KEEA’s comments regarding the overstating of savings and lack of differentiation within the algorithms. The Commission directs the PEG to discuss these issues and provide recommendations future updates to the TRM.

* + - 1. **Central A/C and ASHP (Duct Sealing)**

**i. Comments**

 KEEA comments that the duct sealing savings factor of 18% may be feasible for leaky ducts located entirely in attics, but that many homes in Pennsylvania have ducts in basements, where savings are likely closer to 2%, or in crawl spaces, where savings are likely closer to 8%. KEEA additionally comments that the current protocol does not reward better designed programs, and that the source, listed as “VEIC Estimate based on PEPCO assumptions,” is not a vetted source.[[58]](#footnote-58)

**ii. Disposition**

The Commission agrees with KEEA for the need for a proper source supporting this protocol. The Commission refers to the New Jersey TRM,[[59]](#footnote-59) which uses the same duct sealing factor as the proposed 2013 TRM and cites a 2006 Northeast Energy Efficiency Partnerships, Inc. study.[[60]](#footnote-60) The TRM has been revised to cite to this study in support of the duct sealing savings factor.

We also acknowledge KEEA’s comment that the current protocol design may overestimate savings and that it does not reward better designed programs. The Commission directs this issue to the PEG for discussion and to provide recommendations for future TRM updates.

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

**i. Comments**

 KEEA comments that the Air-Conditioning, Heating and Refrigeration Institute (AHRI) rating for ground source heat pumps (GSHP) is inadequate because it does not account for the external fans or pumping energy required to actually run the system. KEEA further comments that the Residential Energy Services Network (RESNET) has addressed this issue by establishing default adjustments to the rated coefficient of performance (COP) and energy efficiency ratio (EER) of ground-source heat pumps and recommends that either the RESNET or similar adjustments be included in the GSHP protocols.[[61]](#footnote-61)

 KEEA also comments that the assumed savings per desuperheater is too high, stating that, as typically installed, a desuperheater would provide less than a typical home’s hot water needs, but the value shown is more than 50% of a typical homes annual water heating load. KEEA cites a study from 1998 by the New England Electric System, now National Grid, that found desuperheater operation displaced between 4% and 32% of water heating energy at the best sites studied.[[62]](#footnote-62)

**ii. Disposition**

The Commission agrees with KEEA’s comment that the auxiliary electrical use of ground-source heat pumps should be considered when estimating savings. The Commission directs the PEG to determine possible methods of adjusting the AHRI ratings and provide recommendations for future TRM updates. We also believe that the assumed savings per desuperheater warrants more discussion. As such, the Commission directs the PEG to review the assumed savings per desuperheater and provide recommendations for future TRM updates.

1. **Lighting Protocols**

**a. Federal Legislation and Regulations**

 The Energy Independence and Security Act of 2007 (EISA 2007)[[63]](#footnote-63) introduced new minimum efficacy standards for general service bulbs, effectively phasing out current incandescent bulbs between 2012 and 2014. New standards become effective January 1st of each of the associated years, starting with the 100-watt bulb in 2012, 75-watt bulb in 2013, and 60-watt and 40-watt bulbs in 2014. This effectively reduces the energy consumption of a standard incandescent bulb and the energy savings of any measure using the incandescent bulb as the baseline.

 The Commission proposed that the baseline for Indoor Fixtures, Outdoor Fixtures, and ENERGY STAR Ceiling Fans[[64]](#footnote-64) be updated per the EISA 2007 standards. The default savings adjustment for Indoor Fixtures and Outdoor Fixtures would occur at the midpoint of the EISA 2007 phase-in schedule, namely the 2013 TRM. The rationale was that the source of the default delta watts value does not define the mix of 100-watt, 75-watt, 60-watt and 40-watt bulbs that were used to calculate the value. Therefore, applying the average EISA 2007 baseline adjustment factor at the midpoint of the EISA 2007 three-year phase-in was recommended and supported by the method used in the 2011 Mid-Atlantic TRM.[[65]](#footnote-65)

 The Commission also proposed adjusting the ENERGY STAR Ceiling Fans baseline to reflect the EISA 2007 standards. The baseline assumption for this measure is a 60-watt incandescent bulb. Therefore, the Commission proposed that beginning on June 1, 2014, the default energy and demand savings for ENERGY STAR Ceiling Fans reflect a 43-watt baseline.

 The Commission proposed that the baseline for CFLs in Section 2.7 - Home Energy Conservation Kits[[66]](#footnote-66) and Section 2.35 - Low Income Lighting[[67]](#footnote-67) of the 2012 TRM also be updated per the EISA 2007 standards.

**i. Comments**

 In its comments, PECO states that there is not complete agreement in the evaluation field as to the best government source for establishing baseline wattage. PECO suggests differentiating lumen bins for directional versus non-directional bulbs to better establish incandescent equivalent baselines for the two lamp types.[[68]](#footnote-68)

 With regard to incandescent baseline changes due to EISA 2007, PECO recommends using the EPA’s Next Generation Lighting report[[69]](#footnote-69) to establish the baseline. PECO notes that the transition will be smoother due to bin jumping, hoarding, time delay for manufacturers and retailers to sell product after it is no longer manufactured, and switching to EISA-exempted incandescent bulb types. PECO proposes that the baselines defined in the EPA report be adopted in the TRM.[[70]](#footnote-70)

**ii. Disposition**

 The Commission acknowledges PECO’s comments regarding the lack of agreement in the evaluation community as to the best government source for establishing baseline wattage. The Commission, therefore, directs the PEG to develop applicable and appropriate support for the sources for baseline wattage and the proposal to differentiate lumen bins for directional versus non-directional bulbs. The PEG’s findings and recommendations will be considered for future TRM updates.

 The Commission rejects PECO’s request regarding a transition for incandescent baseline changes. In the 2012 TRM Final Order, the Commission stated that “baseline changes are implemented six months after the effective date of the EISA 2007 standards, accounting, to some degree, the effect of stockpiling.”[[71]](#footnote-71) The Commission retains this aspect of the protocol for the 2013 TRM.

**b. Coincidence Factor**

 The coincidence factor (CF) is defined as the fraction of the total technology demand that is coincident with the utility system summer peak, as defined by Act 129.

**i. Comments**

 FirstEnergy recommends research and analysis of the ENERGY STAR Lighting CFs for future updates of the TRM. FirstEnergy’s comments cite two other sources with higher CFs, but recommend that the Commission adopt the 5% CF, with the provision that this value understates peak load impacts and should be subject to future adjustment, for the 2013 TRM since updates to this value have not been adequately vetted through the PEG.[[72]](#footnote-72)

**ii. Disposition**

 The Commission agrees with FirstEnergy’s recommendation to research the CF and assess the need to update this value. The Commission also concurs with FirstEnergy regarding the fact that any update to this value should be vetted through the PEG. The Commission directs the PEG to undertake this research and provide recommendations during the update for future TRM updates. The Commission adopts the 5 percent CF as recommended by FirstEnergy and the TRM has been updated accordingly.

**c. In-Service Rate**

 The ENERGY STAR Lighting Protocol defines the in-service rate (ISR) as a factor used to reflect that not all lighting products purchased are actually installed.

**i. Comments**

 PECO comments that the ISR is not sufficiently well defined and that the definition should be expanded to address whether bulbs that leaked out of a service territory, bulbs that ended up in commercial sockets, and past years’ stored bulbs that have been installed in the current program year are accounted for in the ISR value.[[73]](#footnote-73)

**ii. Disposition**

 The Commission concurs with PECO’s recommendation that the definition of the ISR needs clarification. The source of the residential lighting ISRs is based on actual installations and the percentage of units planned to be installed within one year. The source does not explicitly confirm nor deny that the effects described by PECO are included in the definition and values or to what extent. The Commission directs the PEG to research possible definitions for the ISR and provide recommendations for future TRM updates.

**d. Lighting-HVAC Interactive Effects**

**i. Comments**

 PECO comments that there is not a lighting-HVAC interactive effects term or discussion for any of the residential lighting measures in the proposed 2013 TRM. PECO contends that, since these effects are accounted for in the C&I Lighting Equipment Improvements section of the TRM and a growing number of TRMs account for residential lighting-HVAC interactive effects, a discussion of residential lighting-HVAC interactive effects should be included in the TRM.[[74]](#footnote-74)

**ii. Disposition**

 The Commission acknowledges PECO’s comment regarding the inclusion of lighting-HVAC interactive effects as part of the residential lighting protocols. The Commission directs the PEG to investigate and evaluate residential lighting-HVAC interactive effects for consideration in future TRM updates.

1. **ENERGY STAR Appliances**
2. **Protocols**

 The 2012 TRM provided deemed energy and demand savings for all ENERGY STAR appliances in one protocol.[[75]](#footnote-75) The protocol did not provide the underlying algorithms or assumptions for the baseline and efficient appliances. As such, the protocol did allow EDCs the opportunity to calculate model-specific savings if model information was known.

 The Commission proposed to divide the existing protocol into individual protocols for each ENERGY STAR appliance, which include algorithms and underlying assumptions to calculate savings, if appliance information is known. The change to the ENERGY STAR appliance protocols would provide transparency and flexibility, which will aid in planning for future code and standards changes. If appliance information is not tracked, default energy and demand savings are proposed in each protocol.

**i. Comments**

 PECO comments that there is an error with an algorithm in Table 2-48[[76]](#footnote-76) relating to Compact Refrigerator-Freezers. The algorithm, as currently written, is for a bottom-mounted freezer with an icemaker but PECO states that the algorithm should be revised to be consistent with a bottom-mounted freezer that does not include an icemaker. PECO states that the correct algorithm for a compact refrigerator-freezer with a bottom-mounted freezer is 11.80 \* AV +339.2.[[77]](#footnote-77) PECO recommends that the ENERGY STAR Dishwasher qualifications for compact units should be included in the protocol.[[78]](#footnote-78)

 PECO comments that the savings values for ENERGY STAR Dehumidifiers should be adjusted downward because the dehumidifier capacity listed in the proposed TRM significantly exceeds the bucket capacity for portable dehumidifiers. According to PECO, the energy savings will be overstated for units that do not have a continuous drain if the annual hours do not account for the unit shutting down due to a full bucket.[[79]](#footnote-79) PECO recommends revising the annual operating hours for ENERGY STAR dehumidifiers from 1,620 to 1,095. PECO contends that the annual hours of operation should not include the amount of time that the unit spends in off-cycle because the ambient humidity has reached its set point. PECO states that the 1,620 annual operating hours in the proposed TRM are from a 1998 study and that data submitted for a 2006 U.S. Department of Energy (US DOE) analysis indicate an average of 1,095 annual operating hours.[[80]](#footnote-80) PECO also recommends that Table 2-59[[81]](#footnote-81) be revised such that the highest dehumidifier capacity product class is not limited to a maximum of 185 pints per day. PECO notes that the Federal standards for dehumidifiers in the highest capacity class apply to all units with a capacity of greater than 75 pints per day with no maximum restriction.[[82]](#footnote-82)

 PECO also comments that, with respect to room air conditioner per-unit energy savings, the cooling capacity is erroneously described as having units Btuh and advises correction of this error to Btu/h.[[83]](#footnote-83)

**ii. Disposition**

 The Commission agrees with PECO’s suggested revision to Table 2-48 and has adopted the algorithm 11.80 \*AV + 339.2 as the correct algorithm for “Compact Refrigerator – Freezers – automatic defrost with bottom-mounted freezer.” The Commission, however, rejects inclusion of the Federal standards for compact dishwashers in the TRM since the Federal standards are identical to the ENERGY STAR standards as of May 30, 2012, and therefore no energy savings result from this measure. The Commission has modified the language in the TRM to state that only standard size units are included in the TRM for calculating energy savings.

 The Commission believes that PECO’s comments regarding dehumidifier annual operating hours have merit. The annual operating hours may require revision to account for factors such as shutting down due to a full bucket or the time spent in off-cycle. The Commission directs the PEG to investigate possible updates to the annual operating hours and provide recommendations for future TRM updates. The Commission, however, rejects PECO’s request to modify Table 2-59 such that the highest dehumidifier capacity class is not limited to a maximum of 185 pints per day. We find that, while Federal standards do not limit the maximum capacity at 185 pints per day, Version 3.0 of the ENERGY STAR Program Requirements for dehumidifiers does limit eligibility to units with capacity of 185 pints per day. Therefore energy savings can only be claimed for residential dehumidifiers with capacities of 185 pints per day or less. The Commission has modified the sentence preceding Table 2-59 to indicate that Federal standards do not limit the capacity of dehumidifiers but the table truncates at 185 pints per day since this is the capacity limit for which energy savings can be claimed.

 The Commission also rejects PECO’s recommendation to modify the ENERGY STAR Room Air Conditioner cooling capacity units from Btuh to Btu/h. We note that the units are equivalent, but in order to be consistent with the Room Air Conditioner Retirement protocol (Section 2.12 of the TRM), capacity units stated as Btuh are retained.

1. **Baselines and Deemed Values**

 The 2012 TRM energy savings for ENERGY STAR Appliances were derived from the ENERGY STAR Savings Calculator.[[84]](#footnote-84) The ENERGY STAR Savings Calculators are typically updated every two to four years and are therefore not necessarily representative of the most current available models likely to be purchased by consumers.

 The Commission proposed that the ENERGY STAR default values be updated during each TRM update to reflect the energy usage of the ENERGY STAR models, and their equivalent baselines, available at the time of the TRM update. ENERGY STAR periodically updates its qualified products list for each appliance, which contains information such as annual energy usage and equivalent federal baselines. Averaging the annual energy usage of ENERGY STAR products available to consumers and their equivalent federal baselines will produce a credible estimation of savings that can be updated annually. This method is also preferred as federal and ENERGY STAR standards for several appliances will change over the course of the next three years.

**i. Comments**

 PECO comments that the values derived in Tables 2-45,[[85]](#footnote-85) 2-47[[86]](#footnote-86) and 2-50[[87]](#footnote-87) for ENERGY STAR Refrigerators and ENERGY STAR Freezers are derived from a simple average of consumption estimates for each refrigerator and freezer configuration from the ENERGY STAR Qualified Products List, and that giving equal weighting to all products on the list, regardless of size, skews the average consumption to some extent to lower-saturation refrigerator sizes. PECO recommends that, if available, program or market data should be used to develop weighted-average adjusted volume inputs for each refrigerator and freezer configuration because this method would be more representative of actual market conditions. If such data cannot be obtained, PECO recommends adopting the method outlined in the Tentative Order.[[88]](#footnote-88)

**ii. Disposition**

 The Commission is not aware of the availability of refrigerator and/or freezer sales data to develop sales-weighted consumption estimates. If such data has been or can be developed, the Commission directs the PEG to review such data, evaluate its feasibility and appropriateness and provide recommendations for future TRM updates.

1. **Future Federal and ENERGY STAR Standards**

There are several federal minimum efficiency and ENERGY STAR standards updates that will be occurring over the course of the next three years. The Commission proposed changes to the baseline and efficient appliances and their effective date, which would coincide with the beginning of the appropriate program year, for each appliance’s respective protocol. The change in baseline or ENERGY STAR standard would coincide with the beginning of the appropriate program year in order to prevent implementation and evaluation problems relating to changing deemed savings over the course of a program year. The federal standard changes affect dehumidifiers and dishwashers as of June 1, 2013. Because the federal standards changes would affect room air conditioners in 2014 and refrigerators, freezers and clothes washers in 2015, the Commission proposed that these protocols be reviewed during future TRM updates in order to incorporate the changes at a more appropriate point in time.

**i. Comments**

 PECO comments that the date that future Federal standards for clothes washers take effect is March 7, 2015 and not January 1, 2015. Additionally, PECO requests that language be added to the TRM to indicate that the 2015 standards for front-loading and compact clothes washers will continue to be applicable when the 2018 top-loading standards go into effect, and that a standard sized clothes washer is defined to have a capacity of 1.6 cubic feet or greater.[[89]](#footnote-89)

 PECO requests the new metrics for clothes washers in the 2015 Federal standards be adopted in the TRM, namely, the Integrated Modified Energy Factor and the Integrated Water Factor. The values in the proposed 2013 TRM correspond to the currently-used Modified Energy Factor and Water Factor.[[90]](#footnote-90)

 PECO requests that additional language be included in the ENERGY STAR Dishwasher protocol to state that the percentages of energy use for machine operation and water heating may be available in the May 2012 US DOE analysis supporting its Direct Final Rule for residential dishwasher products. PECO also states that a note should be added to clarify that the new Federal standards apply to dishwashers manufactured on or after May 30, 2013.[[91]](#footnote-91)

 PECO indicates that the future Federal standards for room air conditioners become effective April 21, 2014. The comments also state that, while these standards require ENERGY STAR Room Air Conditioners to be 10% more efficient than the minimum federal standards, the statement does not hold true for reverse-cycle room air conditioners under the 2014 federal standards.[[92]](#footnote-92)

 PECO asserts that Tables 2-65[[93]](#footnote-93) through 2-67[[94]](#footnote-94) should be adjusted to reflect the fact that the 2014 Federal room air conditioner standards are based on a new metric named Combined Energy Efficiency Ratio (CEER), which is comparable to the currently used EER, but includes standby and off mode energy use in addition to the active cooling mode energy use. The comments also note that five EER values in Table 2-67 require revision because the standards are incorrectly listed in the proposed TRM.[[95]](#footnote-95)

**ii. Disposition**

 The Commission has revised the compliance date that future clothes washer Federal standards take effect from January 1, 2015, to March 7, 2015, as set forth in DOE’s Direct Final Rule.[[96]](#footnote-96) We also have included language in the TRM to indicate that 2015 Federal standards for front-loading and compact washers will continue to be applicable when the 2018 top-loading standards go into effect. Lastly, to incorporate PECO’s recommendation to define the volume requirements of a standard-sized clothes washer, the Commission has added clarifying definitions for compact- and standard-sized clothes washers preceding Table 2-54. The volume definition of a compact-sized clothes washer in Table 2-54 has been removed to avoid repetition.

 The Commission accepts PECO’s request to adopt the new clothes washer efficiency metrics that will take effect in 2015. Table 2-54 has been adjusted accordingly and the Integrated Modified Energy Factor and the Integrated Water Factor have been defined in the protocol preceding Table 2-54. PECO’s request for inclusion of additional language about percentages of energy use for machine operation and water heating in the May 2012 US DOE analysis supporting its Direct Final Rule is not appropriate since no values or definitions in the TRM protocol are based on the Direct Final Rule analysis. The Commission has adopted PECO’s recommendation to include language to state May 30, 2012, as the effective date of the new Federal standards for dishwashers.

 PECO’s request to modify the effective date of the Federal standards for room air conditioners is rejected. The Final Rule (Amending Compliance Dates) states that the effective date of the standard is June 1, 2014.[[97]](#footnote-97) The Commission, however, has removed from the TRM the sentence stating the requirement that ENERGY STAR Room Air Conditioners to be 10% more efficient than the minimum Federal standards because the referenced Federal standards are explicit with regard to the applicability of the requirements to room air conditioner types. The Commission also adopts PECO’s recommendation to use the CEER to define the 2014 room air conditioner standards. The metric has been defined preceding Table 2-65. The values in Table 2-67 have been corrected to match the values in the room air conditioners Final Rule[[98]](#footnote-98) and Version 3.0 of the ENERGY STAR Program Requirements.[[99]](#footnote-99)

1. **Measure Life**

 The measure life defines the period over which savings can be claimed for the installation of a measure.

**i. Comments**

 PECO proposes modifying the measure life assumptions for the ENERGY STAR Clothes Washers,[[100]](#footnote-100) Dishwashers,[[101]](#footnote-101) Dehumidifiers[[102]](#footnote-102) and Room Air Conditioners.[[103]](#footnote-103) The basis for the revisions is an analysis performed by the US DOE for each respective appliance’s Direct Final Rule. The average lifetime estimate from the analysis is 14.2 years for clothes washers, 15.4 years for dishwashers, 11 years for dehumidifiers, and 10.5 years for room air conditioners.[[104]](#footnote-104)

**ii. Disposition**

 The Commission recognizes PECO’s comments regarding the consistency of measure lives and believes this issue warrants further review. As such, the measure lives in Appendix A will be adopted, however the Commission directs the PEG to review this issue and provide recommendations for future TRM updates.

1. **Refrigerator/Freezer Replacement and Recycling Protocols**

Per the directive in the Commission’s 2012 TRM Final Order, the PEG investigated and evaluated alternative savings protocols for refrigerator/freezer recycling and replacement used in other jurisdictions. Specifically, the Commission directed the PEG to evaluate the applicability of the California regression model[[105]](#footnote-105) to Pennsylvania to improve savings estimates and propose any applicable changes for future TRM updates.[[106]](#footnote-106)

Commission Staff and the PEG reviewed three alternative methods for calculating the annual kWh savings relating to removal and/or replacement of refrigerators and freezers. The three methods are as follows:

1. Calculation based on the US Environmental Protection Agency (US EPA) ENERGY STAR calculator for removed refrigerators and freezers;
2. Calculation based on regression analysis of metered data on kWh consumption from other states; and
3. Calculation based on an in situ metering study conducted in Pennsylvania.

After reviewing feedback from the PEG and the advantages and disadvantages of these three methods, the Commission proposed use of the second method, a regression analysis of metered data from other states, to determine deemed kWh savings for removed and/or replaced refrigerators and freezers.

The Commission proposed to report deemed energy savings for refrigerators/freezers for the following three scenarios:

1. Refrigerator/freezer removed but not replaced;
2. Refrigerator/freezer removed and replaced with an ENERGY STAR unit; and
3. Refrigerator/freezer removed and replaced with a non-ENERGY STAR unit.

**a. Refrigerator Deemed Savings**

Commission Staff and the SWE reviewed multiple documents and data sources[[107]](#footnote-107) to obtain the regression equation used to develop the proposed deemed savings[[108]](#footnote-108) for removal and/or replacement of a refrigerator in Pennsylvania. After reviewing approaches by other jurisdictions, the Commission proposed to use the regression equation from the US DOE’s Uniform Methods Project for the 2013 TRM as the basis for deemed savings for refrigerator removal/replacement.

**i. Refrigerators Removed but not Replaced**

Using a regression analysis, the Commission proposed a unit energy consumption (UEC) of 967 kWh[[109]](#footnote-109) for refrigerators removed through the Act 129 refrigerator removal program, before adjustment with the part-use factor. The Commission proposed a part-use factor of 96.9%.[[110]](#footnote-110) After adjustment for part use, the proposed deemed kWh savings per refrigerator are 937 kWh annually for a refrigerator that is removed but not replaced. The refrigerator summer peak demand deemed savings is 0.116 kW.

The following methodology was used to calculate the proposed deemed energy savings value of 937 kWh annually:

DEEMED\_kWhsaved Per Unit = EXISTING\_UEC \* PART\_USE

Where:

DEEMED\_kWhsaved = Annual electricity savings per unit measured in kilowatt hours after adjustment for part-use factor.

EXISTING\_UEC = The average annual unit energy consumption of participating refrigerators. The PY3 value is 966.996 kWh.

PART\_USE = The portion of the year the average refrigerator would likely have operated if not recycled through the program. For PY3, the average refrigerator was plugged in 96.9% of the year.

For removed refrigerators, the annual UEC was based upon a regression analysis of data from 452 refrigerators metered and recycled through five utilities:[[111]](#footnote-111)

Existing UEC

 = 365.25 \* [0.487 + 0.015 \* (26.617 years) + 0.782

 \* (65.8% manufactured before 1990) + 0.084 \* (17.870 ft3) – 1.442

\* (9.25% single door units) + 1.090 \* (16.1% side – by – side) + 0.544 \* (22.6% primary usage) + 0.02 \* (3.347 unconditioned CDDs) – 0.045 \* (10.791 unconditioned HDDs)] = 966.996

The Commission proposed using the above regression equation based on in situ metering study results from these five other utilities as an in situ metering study for Pennsylvania is not currently available. The Commission computed the values that are needed as inputs to the regression equation based on Act 129 Program Year Three (PY3) data for removed refrigerators. Once these input values were determined, they were substituted into the above equation in order to estimate the UEC for removed refrigerators. The details related to equation inputs and values[[112]](#footnote-112) used to calculate the UEC for removed refrigerators are described in more detail in the approved 2013 TRM.

When calculating per-unit deemed kWh savings for a removed refrigerator, it is necessary to calculate and apply a “part-use” factor. Part-use is an appliance recycling-specific adjustment factor used to convert the UEC (determined through the methods detailed above) into an average per-unit deemed savings value. The UEC itself is not equal to the deemed savings value, because the UEC model yields an estimate of annual consumption and not all recycled refrigerators would have operated year-round.

In PY3, the Commission determined that the average removed refrigerator was plugged in and used 96.9% of the year. Thus, the deemed value the Commission proposed for the part-use factor is 96.9% based on PY3 data for all EDCs. The Commission proposed that EDCs be allowed the option of calculating their own territory-specific part-use factor. In the event an EDC desires to calculate an EDC-specific part-use factor, the Commission proposed using participant surveys to determine the amount of time a removed refrigerator was plugged in before the unit was recycled.

**ii. Refrigerators Removed and Replaced**

If a refrigerator is removed and replaced with a new ENERGY STAR unit, the proposed deemed annual savings are 533 kWh. If a refrigerator is removed and replaced with a new non-ENERGY STAR unit, the proposed deemed annual savings are 417 kWh. The following methodology was used to calculate an energy savings value of 533 kWh for refrigerators that are removed and replaced with new ENERGY STAR refrigerators and an energy savings value of 417 kWh for refrigerators that are removed and replaced with new non-ENERGY STAR refrigerators:

NET\_kWhsaved Per Unit = DEEMED kWhsaved Per Unit – (REPLACEMENTUEC \* PART\_USE)

Where:

REPLACEMENTUEC = The annual unit energy consumption of the average replacement unit. This comes from the ENERGY STAR calculator and is equal to 416.600 kWh for a new ENERGY STAR refrigerator, and 536.600 for a new non-ENERGY STAR refrigerator.

PART\_USE = The portion of the year the average replacement refrigerator is likely to operate. For PY3, the average refrigerator was plugged in 96.9% of the time.

**b. Freezer Deemed Savings Values**

Commission staff and the SWE reviewed multiple documents and data sources to obtain the regression equation proposed to develop deemed savings[[113]](#footnote-113) for removal and/or replacement of a freezer in Pennsylvania.[[114]](#footnote-114) After reviewing approaches by other jurisdictions, the Commission proposed to use the regression equation from the Cadmus Memo for the 2013 TRM as the basis for deemed savings for freezer removal/replacement.

##### **i. Freezers Removed but not Replaced**

The Commission proposed a UEC for freezers removed through the Act 129 freezer removal program of 1,188 kWh, before adjustment by the part-use factor. The Commission proposed a part-use factor of 98.5%.[[115]](#footnote-115) After adjustment using a part-use factor, the deemed kWh savings per freezer is 1,170 kWh annually for a freezer that is removed but not replaced. The freezer summer peak demand deemed savings is 0.145 kW.

The following methodology was used to calculate the proposed deemed energy savings value of 1,170 kWh annually for a freezer that is removed but not replaced:

DEEMED\_kWhsaved Per Unit = EXISTING\_UEC \* PART\_USE

Where:

DEEMED\_kWhsaved = Annual electricity savings measured in kilowatt hours after adjustment for part-use factor.

EXISTING\_UEC = The average annual unit energy consumption of participating freezers. The PY3 value is 1,187.475 kWh.

PART\_USE = The portion of the year the average freezer would likely have operated if not recycled through the program. For PY3, the average freezer was plugged in 98.5% of the year.

For removed freezers, the annual UEC was based on the following proposed regression equation:[[116]](#footnote-116)

Freezer UEC

 = 365.25 days \* [-2.297 + 0.067 \* (31.300 years old) + 0.401 \* (81.8% units manufactured pre-1993) + 0.150 \* (16.030 ft3) + 0.854 \* (35.0% units that are chest freezers) + 0.1046 \* [4.010 CDDs)] = 1,187.475 kWh

The Commission computed the values that were needed as inputs to the regression equation based on Act 129 PY3 data for removed freezers. Once these input values were determined, they were substituted into the above equation in order to estimate the UEC for removed freezers. Information related to equation inputs and values[[117]](#footnote-117) used to calculate the UEC for removed refrigerators is described in more detail in the proposed 2013 TRM.

As with refrigerators, when calculating deemed per-unit kWh savings for a removed freezer, it is necessary to calculate and apply a part-use factor. In PY3, the Commission determined that the average removed freezer was plugged in and used 98.5% of the year. Thus, the proposed deemed value for the part-use factor was 98.5% based on PY3 data for all EDCs. The Commission proposed that the EDCs be allowed the option of calculating their own territory-specific part-use factor. In the event an EDC desires to calculate an EDC-specific part-use factor, the Commission proposed that, using participant surveys, EDC evaluators should determine the amount of time a removed freezer was plugged in before the unit was recycled.

##### **ii. Freezers Removed and Replaced**

If a freezer is removed and replaced with a new ENERGY STAR unit, the proposed annual savings were 753 kWh. If a freezer is removed and replaced with a new non-ENERGY STAR unit, the proposed annual savings were 667 kWh. The following methodology was used to calculate energy savings value of 753 kWh for freezers that are removed and replaced with new ENERGY STAR freezers and energy savings value of 667 kWh for freezers that are removed and replaced with new non-ENERGY STAR freezers:

NET\_kWhsaved Per Unit = DEEMED kWhsaved Per Unit - (REPLACEMENTUEC \* PART\_USE)

Where:

REPLACEMENTUEC = The annual unit energy consumption of the average replacement unit. This comes from the ENERGY STAR calculator and is equal to 423.000 kWh for a new ENERGY STAR freezer, and 510.000 for a new non-ENERGY STAR freezer.

PART\_USE = The portion of the year the average replacement freezer is likely to operate. For PY3, the average freezer was plugged in 98.5% of the time.

**c. Comments**

PPL comments that the PY3 data that the Commission proposed to use in the regression analysis is unverified, raw data provided by the appliance recycling contractor. Based on preliminary results of the PY3 impact evaluation, PPL avers that the raw data provided by the recycling contractor to PPL (which the Commission proposed to use for the 2013 TRM regression equation) for replacement rates, for determining primary/secondary status of the units, and for the location of the unit at time of pick-up are not reliable. PPL states that the PY3 data does not represent where the unit was kept and used because the homeowner often moves the unit to a different location to accommodate pickup. Therefore, PPL recommends that the Commission use evaluator-collected data, as PPL believes it to be more accurate.[[118]](#footnote-118)

PPL also comments that the Commission’s proposed adjustment to kWh savings when a recycled refrigerator is replaced with a new unit should not be applied. PPL states that the Commission used the portion of the DOE UMP that applies to net savings, when it should have used the portion of the protocol that applies to gross savings.[[119]](#footnote-119) PPL states that, if the Commission decides to use the DOE UMP regression model, the values that are input to the regression equation should be updated, at a minimum, after each program year across all EDCs. However, PPL prefers that, if the DOE UMP model is used, the values be updated per EDC after each program year. PPL states that the coefficients for the DOE UMP regression model for estimating the annual kWh savings for recycled refrigerators and freezers have been updated for the UMP, providing the updated coefficients. PPL comments that, while the updated regression equation coefficients are part of the latest draft version of the DOE UMP, it may be appropriate for the Commission to defer their use in Pennsylvania until the final version is available.[[120]](#footnote-120)

PECO recommends that this algorithm include an additional term to the replaced kWh calculation to incorporate the Induced Replacement Ratio. This ratio is the proportion of participants reporting that they purchased a replacement refrigerator as a result of participation in the program and would make this algorithm fully consistent with the protocols of the DOE UMP. The algorithm, as stated, is only partially consistent with the DOE UMP.[[121]](#footnote-121) KEEA states that it would be more accurate to base the existing unit UEC on short-term metered data, if available, or a label-rated usage input rather than rely on regression models developed elsewhere.[[122]](#footnote-122)

**d. Disposition**

While the Commission recognizes the accuracy that evaluator-collected data may provide, such data is not available at this time. Furthermore, no party has provided evaluator-collected data, with PPL being the only party to aver that the contractor-supplied data may not be reliable. Additionally, JACO, the refrigerator/freezer collection contractor utilized by all seven EDCs for these programs, collected data in PY3 on 36,629 refrigerators and 8,525 freezers. Due to the extent of the information collected by JACO and the lack of evaluator-collected data at this time, the Commission does not accept PPL’s request to change the model to include evaluator-collected data and maintains its proposed methodology, utilizing contractor-supplied data. However, the Commission encourages those EDCs desiring to use evaluator-collected data to collect such data for discussion within the PEG and potential inclusion in future TRM updates.

Data collected by the SWE in the 2012 Residential Baseline Study show that about 35% of households have removed a refrigerator and 15% have removed a freezer in the past five years.[[123]](#footnote-123) The 2012 Residential Baseline Study also collected information on what actually happened to the refrigerators and freezers that were removed. The results of this research show that 64% of the refrigerators and 46% of the freezers removed were either hauled away by a big box store for recycling, were recycled by the utility or were disposed of at a waste transfer station. According to the 2012 Residential Baseline Study, less than 20% of refrigerators and 40% of freezers were donated or sold and were eligible to be reconnected to the electric grid in Pennsylvania.[[124]](#footnote-124) This data indicates that the majority of refrigerators and freezers removed by customers during the five-year period from 2008 to 2012 were not reconnected to the grid in Pennsylvania. These findings refute PPL’s assertion that the majority of removed refrigerators and freezers would be reconnected to the grid in the absence of the utility-sponsored appliance recycling program. For this reason the Commission finds that it is appropriate to adjust the gross savings for recycled refrigerators and freezers in those instances where a unit is removed and then replaced with a new unit. This adjustment is accomplished by reducing the total gross energy savings for a recycled unit by the amount of energy consumed by the new appliance. As such, the Commission maintains its proposed methodology, which includes an adjustment to gross savings for scenarios in which a unit is removed and then replaced with a new unit.

Additionally, the disposal process for old refrigerators and freezers has changed significantly since 2006. In 2006, the United States Environmental Protection Agency (EPA) launched its Responsible Appliance Disposal (RAD) Program, which is a partnership between a variety of entities, such as utilities and retailers, which aims to protect the ozone layer, reduce emissions of greenhouse gases and benefit communities. RAD partners collect old refrigerant-containing appliances from consumers and responsibly dispose of them with the help of an appliance recycler. Some RAD partners also reduce energy consumption by encouraging appliance owners to permanently retire old, inefficient units. Current participants in this program include Home Depot, Best Buy, Sears and Appliance Smart. According to the RAD Program’s 2011 Annual Report, many large, big box retailers are now recycling old refrigerators that they collect. The report also states that 802,712 refrigerators and 81,630 stand-alone freezers were recycled by the program in 2011.[[125]](#footnote-125) Thus, a significant amount of refrigerators and freezers that are removed are not re-connected to the grid.

The Commission agrees with PPL that the input data for the regression equations should be updated annually to reflect actual data for the most recent program year. However, we do not believe this should be done on an EDC-specific basis. As discussed with other measures within this Order, the TRM is meant to be used on a statewide basis, thus the inclusion of statewide average values.

The Commission agrees with PPL that the coefficients for the model should be updated due to updates to the DOE UMP itself. We accept those coefficients as listed in PPL’s comments and the updated calculations have been provided below:

* For refrigerators removed but not replaced:
	+ The calculation for the existing UEC is as follows:

Existing UEC

 = 365.25 \* [0.582 + 0.027 \* (26.617 years) + 1.055 \* (65.8% manufactured before 1990) + 0.067 \* (17.870 ft3) – 1.997 \* (9.25% single door units) + 1.071 \* (16.1% side – by – side) + 0.6054 \* (22.6% primary usage) + 0.02 \* (3.347 unconditioned CDDs) – 0.045 \* (10.791 unconditioned HDDs)] = 1058.825

* The existing UEC of 1058.825 is multiplied by the part use factor of 96.9% to get a savings per refrigerator of 1,026 kWh annually.
* For refrigerators removed but not replaced, the peak demand savings of 0.116 kW remain the same as proposed.
* For refrigerators removed and then replaced:
	+ The replacement UEC comes from the ENERGY STAR calculator and is equal to 416.600 kWh for a new ENERGY STAR refrigerator, and 536.600 for a new non-ENERGY STAR refrigerator.
	+ The replacement UEC is multiplied by the part use factor of 96.9% and then subtracted from the deemed kWh savings to obtain the following annual savings values:
		- 1026 kWh – (416.600 \* 96.9%) = 622 kWh for a refrigerator removed and replaced with an ENERGY STAR unit; and
		- 1026 kWh – (536.600 \* 96.9%) = 506 kWh for a refrigerator removed and replaced with a non-ENERGY STAR unit.

While the Commission recognizes that the DOE UMP may still be in draft form, we will not defer the use of the methodology until the DOE finalizes its protocol. As stated previously, JACO has collected data on thousands of units across the state, allowing for a more Pennsylvania-specific data to be utilized within this methodology. As such, while the DOE’s version of the UMP may still be in draft form, the methodology included herein is specific to Pennsylvania and the Commission finds it to be the most appropriate methodology for determining savings for refrigerators and freezers.

The Commission rejects PECO’s request to include an Induced Replacement Ratio. The Induced Replacement Ratio is the proportion of customers who replace an appliance due to the program. We believe an Induced Replacement Ratio would be appropriate if EDC compliance with reduction goals was based on net verified savings. However, EDC compliance is based on gross verified savings, as defined in the Phase II Implementation Order.[[126]](#footnote-126) The TRM is meant to provide guidance to the EDCs on determining their compliance, so the inclusion of a ratio related to net verified savings is not appropriate.

The Commission rejects KEEA’s request to utilize short-term metered data or label-rated usage input for the existing UEC calculations. The DOE’s UMP was based on end-use metering studies that included random samples of hundreds of refrigerators and freezers. Additionally, the data utilized within the protocol came directly from JACO, the recycling contractor used by all the EDCs. Thus the methodology is based on Pennsylvania-specific input data, as well as metering results on hundreds of refrigerators and freezers.

1. **Electric Hot Water Heater Protocols**

The 2012 TRM assumed a daily hot water usage per household of 64.3 gallons per day, taken from the 1998 electric water heater testing protocols,[[127]](#footnote-127) which are currently still in effect. This same document, however, stated that, while 64.3 gallons per day is the testing standard, it is most likely too high of an assumption and the actual usage of a household is closer to 50 gallons per day.[[128]](#footnote-128)

Other studies confirm that 50 gallons per day is a more accurate assumption. In a 1998 sub-group analysis of the Retail Energy Consumption Survey (RECS) data for residential hot water heaters, the average hot water usage per day was found to be 46.9 gallons.[[129]](#footnote-129) A 2001 water heater technical support document using the Lawrence Berkeley National Laboratory draw model estimated daily consumption ranging from 45.3-49.9 gallons.[[130]](#footnote-130) Additionally, Natural Resources Canada, the organization that provided the background for the initial 64.3 gallons per day standard, recently found that daily hot water usage has decreased to an average of 49 gallons per day.[[131]](#footnote-131)

The Commission, therefore, proposed the use of the DOE-supported assumption of 50 gallons per day as the hot water usage assumption per household. This change would affect the following 2012 TRM sections: Section 2.3 – Efficient Electric Water Heaters,[[132]](#footnote-132) Section 2.6 – Heat Pump Water Heaters,[[133]](#footnote-133) Section 2.14 – Solar Water Heaters,[[134]](#footnote-134) Section 2.15 – Electric Water Heater Pipe Insulation,[[135]](#footnote-135) Section 2.18 – Fuel Switching: Domestic Hot Water Electric to Gas,[[136]](#footnote-136) and Section 2.19 – Fuel Switching: Heat Pump Water Heater to Gas Water Heater.[[137]](#footnote-137)

**a. Comments**

 PECO comments that, for an electric water heater with an energy factor of 0.95, the deemed savings should be 155 kWh, not 154 kWh.[[138]](#footnote-138) Additionally, PECO comments that the average water main temperatures in Philadelphia are closer to 57°F and that the assumption for incoming cold water in the TRM should be updated from 55°F to 57°F.[[139]](#footnote-139)

**b. Disposition**

 The Commission agrees with PECO that the deemed savings for an electric hot water heater with an energy factor of 0.95 should be 155 kWh, not 154 kWh, and the TRM has been revised accordingly. The Commission, however, rejects PECO’s recommendation to revise the assumed cold water inlet temperature from 55°F to 57°F. The Commission does not find it appropriate to change this assumption in the TRM, which is applicable throughout the state, based on the average water main temperatures in Philadelphia.

1. **Low Flow Faucet Aerator Algorithm and Assumptions**

 To take into account faucet throttling and the actual flow of water that passes through an aerator, the Commission proposed adjusting the baseline and low flow aerator flow rates. The new values, from the 2012 Illinois TRM,[[140]](#footnote-140) take throttling into account and are confirmed by multiple sources. As such, the Commission proposed the adoption of the daily faucet water usage assumption from the 2012 Illinois TRM of 9.85 minutes per person per day,[[141]](#footnote-141) an increase from the current assumption of 4.95 minutes per person per day.[[142]](#footnote-142) The new value is consistent with the range of values cited in Illinois TRM from multiple sources. In addition, the Commission proposed adding a “Drain Factor” of 79.5% to account for the fact that not all water that flows through an aerator goes down the drain.[[143]](#footnote-143) Finally, the Commission proposed updating the definition for “ΔT” to the “average temperature differential between outgoing mixed faucet water and supply water” and updating the value to 35°F to reflect this change in definition.[[144]](#footnote-144) The existing definition was incorrect because the water that flows through the aerator is a mix of both hot and cold water, not solely hot water.

**a. Comments**

 PECO comments that the deemed savings values based on the measure inputs should be 48 kWh, not 44kWh as listed, and 0.0044 kW, not 0.0040 kW, as listed.[[145]](#footnote-145)

**b. Disposition**

 The Commission agrees with PECO. The deemed savings values have been revised to 48 kWh and 0.0044 kW based on the algorithm inputs.

1. **Residential New Construction Protocols**

The Residential New Construction section of the 2012 TRM was comprised of three sections: 1) Insulation Up-Grades, Efficient Windows, Air Sealing, Efficient HVAC Equipment and Duct Sealing; 2) Lighting and Appliances; and 3) Ventilation Equipment.[[146]](#footnote-146) The section for Insulation Up-Grades, Efficient Windows, Air Sealing, Efficient HVAC Equipment and Duct Sealing stated that energy savings for these measures shall be a direct output of the Home Energy Ratings (HERS) software, while demand savings will be estimated using algorithms presented in the section. The algorithms for demand savings estimation included the use of the Seasonal Energy Efficiency Ratio (SEER) of the HVAC unit for the baseline home multiplied by a Baseline Energy Efficiency Ratio (BLEER) factor, which converts SEER to EER, and the use of the EER of the HVAC unit for the qualifying home.

The Lighting and Appliances section stated that all additional savings due to the addition of high-efficiency lighting and clothes washers[[147]](#footnote-147) would be based on the algorithms for each appliance in the ENERGY STAR Appliances section of the TRM. The Ventilation Equipment section added 175 kWh and 0.060 kW of savings to each home to account for the installation of high-efficiency ventilation equipment.[[148]](#footnote-148)

 First, the Commission proposed to refer to the Insulation Up-Grades, Efficient Windows, Air Sealing, Efficient HVAC Equipment and Duct Sealing as “Weather-Sensitive Measures” and Lighting and Appliances as “Non-Weather-Sensitive Measures.” This would help prevent confusion between the methodologies used for estimating savings for the two different categories of measures. We also proposed that the algorithm for Weather-Sensitive Measures be modified to allow for the use of either the unit’s actual EER or the product of SEER multiplied by BLEER, a method of estimating the EER when only the SEER is known, for both the baseline and qualifying homes. This would make the algorithm consistent between the baseline and qualifying home.

 Second, the Commission proposed to make the Non-Weather-Sensitive Measures section more general to allow for the inclusion of all appliances, rather than specifically listing only high-efficiency lighting and clothes washers. This would allow EDCs to claim savings for all high-efficiency non-weather-sensitive appliances installed in a new home.

 Lastly, the Commission proposed the removal of the Ventilation Equipment section. The modeling software already takes into account mechanical ventilation equipment, and therefore, the addition of kWh and kW savings leads to double-counting of savings for homes that have mechanical ventilation and overstatement of savings for homes which do not have mechanical ventilation.

**a. Comments**

 KEEA comments that the residential new construction protocols lack specifics. KEEA states that, for example, it is implied, but not explicitly stated, that accredited modeling software other than REM/Rate may be used to estimate savings. KEEA would like clarification that the TWG is the proper place to raise other issues not vetted at this time as this TRM section evolves over time.[[149]](#footnote-149)

 PECO comments that the current protocols assume that the CF is constant regardless of the amount of over-sizing of the system, when in reality, there is an inverse relationship. PECO recommends that further work be done to relate the level of over-sizing with the probability that an air conditioning system is running at any given point during the peak period and that the value for CF should be “variable” instead of constant at 0.7. PECO additionally cites many studies which show varying values for over-sizing in both existing and new construction homes, ranging from 16%-70%, stating that, in general, there does not appear to be consensus. PECO further comments that the assumption for 15% over-sizing in the ENERGY STAR-qualified home compared to Manual J calculations does not account for the differences between standard Manual J calculations and best practice Manual J calculations, which can produce 10-12% differences in sizing. Overall, PECO recommends that, until concrete evidence that the ENERGY STAR New Homes Program reduces over-sizing and that the reduced over-sizing produces demand savings, the baseline and qualifying over-sizing factors should be equal. PECO additionally recommends that the over-sizing factor for the qualifying home should be calculated from the size of the HVAC unit installed and the peak load of the baseline home estimated by modeling software.[[150]](#footnote-150)

**b. Disposition**

 Regarding KEEA’s comments, the Commission states that the TWG is the appropriate place to raise issues as the TRM evolves over time. Additionally, while not explicitly stated in the TRM, the Commission agrees with KEEA that modeling software other than REM/Rate may be used to estimate savings following the protocols set forth in the TRM section.

 The Commission agrees with PECO’s comment regarding the inverse relationship between over-sizing factor and CF and that further work should to be done to calculate the probability that an over-sized air conditioner is running at any given point during the peak period. The Commission also agrees with PECO that the over-sizing of each qualifying home can be calculated on a per-home basis. This can be done in evaluation and verification activities performed by the EDCs to determine the accuracy of the current assumptions. While PECO has provided evidence that there is no consensus in over-sizing factors among existing and new homes, PECO has not provided evidence that the values are equal. Therefore, the Commission believes that further discussion and research is warranted, and directs the PEG to investigate and determine the amount by which the ENERGY STAR new homes program reduces over-sizing in residential homes and how the CF is affected and provide recommendations for consideration in a future update to the TRM.

1. **Furnace Whistle**

This section relates to the residential furnace whistle protocols contained in Section 2.5 of the 2013 Tentative TRM. These protocols contain savings algorithms installing furnace whistles in residential homes.

**a. Comments**

 KEEA comments that the savings estimates are not based on any measured results and do not adequately represent how air handler systems work. KEEA further comments that, while the TRM states savings are based on reduced furnace blower fan motor power requirements from changing filters more frequently, in reality motor power requirements will most likely increase when a clean filter is used for permanent split capacitor (PSC) motors. Additionally, KEEA comments that, even ignoring the fact that power requirements may increase, the 30% assumed savings is not realistic. KEEA suggests that there are little to no savings associated with this measure.[[151]](#footnote-151)

 PECO disagrees with KEEA’s comments that furnace whistles are associated with little to no savings. While PECO acknowledges that KEEA’s comment about minimal efficiency improvements is true, what is not mentioned is the reduction in EFLH of the blower fan motor due to increased airflow associated with cleaner filters, which is where primary savings are achieved.[[152]](#footnote-152) PECO comments that the EFLH values appear to be out of order in Table 2-6,[[153]](#footnote-153) that the example in source one includes an erroneous calculation, and that both should be considered for revision.[[154]](#footnote-154)

**b. Disposition**

 The Commission agrees with PECO that the main source of savings associated with furnace whistles is the reduced fan motor EFLH. Therefore, no change is warranted at this time. The Commission also agrees with PECO’s comments that the EFLH are out of order and that there is an erroneous calculation in source one. The EFLH ordering has been corrected and the erroneous calculation has been removed.

1. **Heat Pump Water Heaters**

This section relates to the protocols contained in Section 2.6[[155]](#footnote-155) regarding installation of heat pump water heaters. These protocols estimate the savings from using a heat pump water heater instead of a standard-efficiency electric water heater.

**a. Comments**

 KEEA comments that the adjustment used to de-rate the COP of a heat pump water heater should be dropped because it assumes that the heat pump water heater is installed in a garage or attic when it is more typical to install a water heater in a basement or conditioned space. KEEA further comments that an adjustment should be included for the potentially significant heating and cooling interactions between a heat pump water heater and the conditioned space it is located in, as it acts like an air conditioner – reducing cooling loads and increasing heating loads. KEEA also disagrees with Section 2.6.7, which indicates that deemed savings is the appropriate evaluation methodology, stating that billing data analysis and perhaps additional field performance assessments may be warranted.[[156]](#footnote-156)

 PECO disagrees with KEEA’s assumption that the majority of water heaters are installed in conditioned space, citing its own baseline study which found that 79% of electric water heaters in PECO’s territory are installed in unconditioned spaces. PECO additionally believes that it is reasonable to add interactive effects for measures installed in conditioned spaces as long as algorithms for proper estimation for measures installed in unconditioned space are still present. PECO agrees with KEEA that Section 2.6.7 should be removed from the TRM because it is not consistent with other sections and the TRM should not limit how the evaluation should verify a measure.[[157]](#footnote-157)

**b. Disposition**

 The Commission believes that this TRM section should be able to accurately estimate savings whether a heat pump water heat is installed in either conditioned space or unconditioned space. When installed in conditioned space, the de-rate factor is not necessary, as pointed out by KEEA, but the interaction effects should be considered and included in the algorithm as both KEEA and PECO have suggested. When a heat pump water heater is installed in unconditioned space, the de-rate factor should be included, and interactive effects can be ignored. The Commission directs the PEG to evaluate these revisions to the algorithms to develop the best possible protocols for consideration in future TRM updates. The Commission agrees with both KEEA and PECO that Section 2.6.7 is unnecessary because the TRM should not limit how to verify a measure. This section has been removed.

1. **Home Audit Conservation Kits**

This section includes protocols for estimating the savings associated with kits consisting of CFLs, faucet aerators, and smart power strips.

**a. Comments**

 KEEA comments that the deemed savings estimate for smart power strips likely is too high. KEEA also comments that the idea that the second smart power strip installed would have the same savings as the first power strip is questionable because it is reasonable to assume the first power strip would be targeted at the cluster of highest potential savings.[[158]](#footnote-158)

 PECO comments that the “SavingsAerator” term is listed distinctly from the “ISRAerator” term, but in the Faucet Aerator section of the TRM,[[159]](#footnote-159) the ISRAerator term is included in the savings term. PECO recommends revising this protocol for consistency between the two sections. PECO further comments that the deemed savings values for faucet aerators should be 48 kWh and 0.0044 kW, not 44 kWh and 0.0040 kW.[[160]](#footnote-160)

**b. Disposition**

 The Commission agrees with KEEA that it may be questionable that the second power strip installed in home audit conservation kit will generate the same savings as the first installed power strip. The Commission directs the PEG to investigate and evaluate whether a second power strip generates less savings and whether a revision to the deemed savings estimate for smart power strips is warranted and provide recommendations for future updates to the TRM.

 The Commission agrees with PECO that deemed savings should be adjusted to the correct values of 48 kWh and 0.0044 kW. This revision has been made to the TRM. The Commission, however, disagrees with PECO’s suggestion that the “SavingsAerator” term should be made consistent with the faucet aerator section of the TRM. This would create an inconsistency between the measures in the savings calculations for the Home Audit Conservation Kit section.

1. **Programmable Thermostat**

This section includes algorithms for the heating and cooling savings associated with the installation of a programmable thermostat in a residential home.

**a. Comments**

 KEEA comments that this section uses an elaborate approach to estimating savings and should use a billing analysis approach instead.[[161]](#footnote-161) PECO disagrees, stating that the algorithm for this section is simple and consistent with several other TRMs and HVAC algorithms. PECO further notes that to use billing analysis for all programmable thermostats is an impossible proposition, as many of them are implemented as an upstream buy-down at the retail level.[[162]](#footnote-162) PECO also discusses the verification timing issues that use of a billing analysis approach would cause.[[163]](#footnote-163)

 KEEA comments that the cooling savings are based on a climate zone in California which is a high, mountainous and semiarid region above 5,000 feet in elevation and that the sources for the heating savings estimate origin is vague and to what climate and housing stock it applies. KEEA further comments that the 40% over-sizing assumed for air-source heat pumps is likely inaccurate because heat pumps are typically sized for cooling, and the remaining heating capacity is covered by auxiliary heat.[[164]](#footnote-164)

 KEEA also recommends that the measure description make it clear that only programmable thermostats that are intended for use with heat pumps should be included, since conventional programmable thermostats can increase auxiliary heating use in heat pump homes.[[165]](#footnote-165) PECO agrees that language should be added limiting programmable thermostats to electric resistance heating and direct expansion (DX) cooling systems, as standard programmable thermostats could have negative energy consequences when installed on a heat pump system. PECO also recommends waiting for the completion of an Illinois programmable thermostat study, which has recently been proposed, before making any changes to this section of the TRM.[[166]](#footnote-166) PECO further recommends that the heating EFLH for Philadelphia should be 1,060.[[167]](#footnote-167)

**b. Disposition**

 The Commission agrees with PECO regarding the algorithm used in this section, as it is relatively simple and consistent with various other HVAC-related TRM sections. As such, we deny KEEA’s request to utilize billing analysis data.

 The Commission agrees that the programmable thermostat study being performed in Illinois should be reviewed prior to making any changes to citations and values in this TRM section. The Commission also agrees with both KEEA and PECO that language should be added to this TRM section limiting programmable thermostats to electric resistance heating and DX cooling systems, as installing a programmable thermostat on a heat pump may have negative energy consequences. The TRM has been updated accordingly. The Commission agrees with PECO that the heating EFLH for Philadelphia should be 1,060 and has updated the TRM accordingly.

1. **Smart Strip Plug Outlets**

This section provides algorithms to estimate savings for the installation of smart strip plugs in residential homes.

**a. Comments**

 KEEA comments that the deemed value of 184 kWh is much larger than the estimated 25 kWh savings from a detailed field study of plug load savings opportunities performed by the Energy Center of Wisconsin (ECW).[[168]](#footnote-168) KEEA asserts that the ECW study found lower standby power draws than are assumed in the TRM.[[169]](#footnote-169)

**b. Disposition**

 The Commission agrees with KEEA that, compared to the values found in the ECW study, the TRM deemed savings values seem high. The Commission directs the PEG to review the appropriate savings value for this protocol and provide recommendations for future TRM updates.

1. **Room AC Retirement**

This section estimates savings from the retirement of room air-conditioner units from residential homes without replacement.

**a. Comments**

 KEEA recommends that a direct billing analysis or an estimated typical kWh usage per customer should be substituted for the EFLH approach.[[170]](#footnote-170) PECO disagrees, commenting that it is not feasible under Act 129’s programs reporting structure to use a billing analysis, noting that savings estimates and verified savings would not be available until the following program year’s evaluation. PECO further comments that it is unclear if a billing analysis would result in significant improvements to savings estimates.[[171]](#footnote-171)

**b. Disposition**

 The Commission agrees with PECO. Under the reporting structure for Act 129 programs, a billing analysis approach for estimating savings for room air conditioner retirement is not feasible. Additionally, without proof of a significant improvement in savings estimates, a change to a more burdensome savings estimation methodology is not warranted.

1. **Solar Water Heaters**

This section of the TRM provides algorithms for estimating the savings associated with installing a solar water heater in a residential home.

**a. Comments**

 PECO comments that the unit peak demand reduction for this measure incorrectly uses the measure energy savings rather than the base energy usage to calculate savings. PECO recommends that the demand savings value be updated under the assumption that solar power is expected to fuel the hot water heater entirely during the peak period.[[172]](#footnote-172)

**b. Disposition**

 The Commission agrees with PECO’s comment that the demand savings incorrectly uses the energy savings rather than the baseline energy usage. This value has been updated to reflect the correct usage of the baseline energy use.

1. **Electric Water Heater Pipe Insulation**

This section estimates the savings associated with installing foam pipe insulation on electric water heater pipes and reducing the water heating set-point by 3-4°F.

**a. Comments**

 PECO recommends that the definition for kWh savings be changed from a per fixture installed to a per 10 feet of installed insulation.[[173]](#footnote-173)

**b. Disposition**

 The Commission agrees with PECO that the phrase “per fixture” should be changed to “per 10 feet of insulation,” as the savings estimate is on a basis of 10 feet of insulation. The TRM has been updated accordingly.

1. **Residential Whole House Fans**

This TRM section provides protocols to estimate the savings associated with installing a whole house fan to offset air condition load by drawing in cool outside air through open windows and exhausting warm air through attic vents when it is cool outside.

**a. Comments**

 KEEA comments that the application of REM/Rate modeled savings “as-is” to all houses is likely to over-predict the savings for this measure. KEEA states that the REM/Rate model assumes that, when a home is air conditioned, the air conditioner is left on at the selected thermostat set-point all cooling season, which is likely not true, especially given the mild cooling climate in Pennsylvania. KEEA further suggests that customers willing to offset cooling load with a whole-house fan are likely to attempt to reduce air conditioner usage even without the fan, and further suggests that not all customers who install a whole house fan will use it properly.[[174]](#footnote-174) PECO agrees with KEEA, commenting that the TRM does not supply explicit details on how savings are calculated. PECO recommends providing more details on these savings estimates in future TRM updates.[[175]](#footnote-175)

**b. Disposition**

 The Commission agrees with both KEEA and PECO. More details should be provided to explain the basis of the savings estimates. Additionally, the savings estimates may warrant revision based on the issues raised by KEEA. The Commission directs the PEG to investigate and evaluate this protocol in accordance with KEEA’s and PECO’s comments and provide recommendations for future TRM updates.

1. **Ductless Mini-Split Heat Pumps**

This TRM section provides protocols to estimate the savings associated with the installation of ductless mini-split heat pumps in residential homes.

**a. Comments**

 KEEA comments that a direct billing analysis or an estimated typical cooling kWh usage per customer should be substituted for the EFLH approach currently used in the TRM. Additionally, KEEA comments that the load factor seems to be applied incorrectly. KEEA recommends that the load factor be adjusted based on the degree to which the ductless mini-split heat pumps are sized to meet the entire heating load of the house rather than simply supplementing the existing heating load.[[176]](#footnote-176) PECO agrees with KEEA that the load factor is incorrectly applied in this TRM algorithm and suggests that a more detailed review of the measure may be warranted.[[177]](#footnote-177)

**b. Disposition**

 The Commission rejects KEEA’s recommendation that billing analysis be used instead of the EFLH methodology for the same reasons stated above in Section B.1.a of this Order. The Commission agrees with PECO that a more detailed review of application of the load factor in the algorithm is warranted. The Commission directs the PEG to review this measure and provide recommendations for future TRM updates.

1. **Fuel Switching: Electric Heat to Gas Heat**

This TRM section estimates savings associated with converting an existing electric heating system to a new natural gas furnace in a residential home.

**a. Comments**

 KEEA recommends that this measure require at least a 90% annual fuel utilization efficiency (AFUE) furnace to be installed instead of the current 78% requirement because 78% AFUE furnaces are no longer manufactured. KEEA notes that the 90% AFUE furnaces will be required by National Appliance Energy Conservation Act code for 2013 for all northern climates. KEEA further comments that given the large cost and savings of this measure, savings should be based on pre-retrofit billing data analysis instead of the EFLH multiplied by capacity, since the EFLH would be inherently different for an installed furnace than a heat pump and the EFLH are inappropriate for electric resistance heating.[[178]](#footnote-178)

**b. Disposition**

 The Commission agrees with KEEA that, given the changing standards in gas furnaces, the base furnace efficiency warrants updating. The TRM has been revised to reflect the rule change in the efficiency baseline effective May 1, 2013. By rule, it takes effect on May 1, 2013, for non-weatherized furnaces and January 15, 2015, for weatherized furnaces. For the reasons stated previously in this Order, the Commission disagrees with KEEA that billing analysis be used in place of an EFLH methodology. The Commission believes the current EFLH methodology, on average, represents the population, and thus shall remain the primary methodology for savings estimation. The Commission does agree, however, that the current EFLH estimates used for electric resistance heating may not be appropriate. The Commission directs the PEG to investigate and evaluate the ELFH estimates used in connection with electric resistance heating and recommend revisions, if applicable, for future TRM updates.

1. **Ceiling/Attic and Wall Insulation**

This TRM section provides algorithms to estimate savings for new or additional ceiling/attic or wall insulation to a residential home.

**a. Comments**

 NHT/PHFA raise the question of whether this measure can be used to estimate savings in residential units in multifamily buildings because the TRM, as written, does not explicitly state that the measure can be applied to multifamily residential homes.[[179]](#footnote-179) In response, FirstEnergy states that the TRM does not specify deemed savings processes for estimation of seal-up or whole building impacts, consistent with the ENERGY STAR protocols for home performance programs. Rather than adopting new savings protocols, FirstEnergy recommends the continued estimation of savings using applicable protocols and standards pending the development of supported deemed savings values through the TWG.[[180]](#footnote-180)

 KEEA comments that the cooling savings estimates should be greater than the current estimates because attics are often significantly hotter than outdoor temperatures during the cooling season.[[181]](#footnote-181) KEEA further comments that the use of HDD65 leads to systematic over-estimation of savings, and that use of HDD60 would be more appropriate.[[182]](#footnote-182) PECO disagrees with KEEA because many studies have shown that 65°F is a reasonable base temperature for residential analysis.[[183]](#footnote-183)

 KEEA also comments that the assumption that an un-insulated wall behaves at R-3 yields savings estimates that are too large, citing a recent National Renewable Energy Laboratory (NREL) study and other recent evaluation work that show savings more consistent with an un-insulated wall behaving at R-5 or R-6.[[184]](#footnote-184) PECO believes this is reasonable but that there would be similar increases in assumptions for other wall R-values, causing minimal change in savings.[[185]](#footnote-185) Finally, KEEA comments that the R-9 default for the insulated wall is too low as it is virtually unheard of to add R-6 insulation to a wall, stating that the stud space is filled by high density blow insulation.[[186]](#footnote-186) PECO believes that KEEA’s comment regarding the addition of R-6 insulation as being unheard of is based on a misunderstanding of the measure. PECO comments that while a higher R-value than R-6 is added, the overall effect on the wall R-value is less than the R-value added between each stud.[[187]](#footnote-187) PECO further comments that the CDD method may underestimate cooling savings and should be investigated further.[[188]](#footnote-188)

**b. Disposition**

 The Commission agrees with FirstEnergy regarding the application of currently used protocols in the TRM for estimating deemed savings for ceiling/attic and wall insulation in multifamily residences. The Commission also agrees with KEEA and PECO regarding the underestimation of cooling savings due to the high temperature of residential attics. The Commission directs the PEG to investigate cooling savings values and provide recommendations for future TRM updates.

 The Commission believes KEEA and PECO comments regarding an un-insulated wall behaving at R-5 or R-6 insulation value have merit based on recent study results. As PECO commented, however, this change would not have an effect on savings values. Thus, we do not recommend any changes to the protocol at this time, but direct the PEG to investigate and provide recommendations, if applicable, for future TRM updates. The Commission does, however, agree with PECO that KEEA’s reading of the addition of R-6 insulation is based on a misunderstanding of the protocols and thus a revision to the TRM is not necessary. The Commission also agrees with PECO that HDD65 is an appropriate base temperature for estimating savings from ceiling/attic and wall insulation measures.

1. **Water Heater Tank Wrap**

This section of the TRM provides protocols to estimate savings for installing insulated tank wrap, or a blanket, to existing residential electric water heaters.

**a. Comments**

 KEEA comments that few electric water heaters are as poorly insulated as what the TRM’s base case assumes. KEEA states that the TRM should require EDCs to collect make and model numbers to check this assumption, with an adjustment factor for post-installation analysis, similar to the ISR found in other TRM sections.[[189]](#footnote-189)

**b. Disposition**

 The Commission believes that requiring collection of make and model data for installed water heaters to ensure the accuracy of water heater tank wrap savings estimates may have merit. It may, however, be difficult and costly for the EDCs to obtain such data. The Commission directs the PEG to investigate the feasibility and cost impacts to collect make and model data for installed water heaters and provide recommendations during future TRM updates.

1. **ENERGY STAR Televisions**

This section provides protocols to estimate savings associated with installation of an ENERGY STAR or ENERGY STAR Most Efficient Television.

**a. Comments**

 In its comments, PPL notes an inconsistency in the sentence preceding Table 2-76 and the language in Table 2-76, where the former reference Version 5.1 of the ENERGY STAR Program Requirements for Televisions and the latter references Version 5.3. PPL recommends adjusting the version numbers to be consistent.[[190]](#footnote-190) PECO recommends that references to Version 4.1 or Version 5.1 in the footer and the references in Tables 2-76 and 2-77 be updated to Version 5.3.[[191]](#footnote-191)

 PECO requests that the terms “On Mode” rather than “Active Mode” and “Sleep Mode” rather than “Standby Mode” be used to be consistent with the Version 5.3 ENERGY STAR Program Requirements for Televisions.[[192]](#footnote-192) PECO notes that Version 6.0 of the ENERGY STAR Program Requirements for Televisions was released on September 9, 2012, and that the reference to the ENERGY STAR website should be updated to reflect this date. PECO recommends that the TRM reflect the qualification that limits the scope of Version 6.0 to a product with a diagonal screen size of 15 inches or greater.[[193]](#footnote-193) PECO further recommends that in Table 2-74 the term PON\_MAX be used instead of PMAX, with PON\_MAX defined as the maximum allowable On Mode power consumption in watts.[[194]](#footnote-194)

**b. Disposition**

 The Commission agrees with the PPL and PECO comments to revise references to Versions 4.1 or 5.1 of the ENERGY STAR Program Requirements for Televisions to Version 5.3 in the footer, Table 2-76 and Table 2-77. The TRM has been updated accordingly.

 The Commission agrees with PECO’s recommendation to use the terms “On Mode” and “Sleep Mode” in order to be consistent with the terms in Version 5.3 of the ENERGY STAR Program Requirements. We, however, retained in the protocol terms “Active Mode” and “Standby Mode,” in order to be consistent with language in prior TRMs and because the definitions of the terms “On Mode” and “Sleep Mode” in the Version 5.3 Program Requirements list “Active Mode” and “Standby Mode” as respective alternate names.

 The Commission rejects PECO’s request to update the date the ENERGY STAR website was accessed and to include language to indicate that Version 6.0 of the ENERGY STAR Program Requirements for Televisions limits eligibility to televisions with a diagonal screen size of 15 inches or greater. Version 6.0 was not finalized and released until shortly before the Tentative Order was adopted and, therefore, time did not allow for inclusion of the Version 6.0 eligibility criteria in the proposed TRM. While intending to comment on Version 6.0, PECO appears to have referenced the ENERGY STAR Most Efficient Televisions section that was included in the proposed TRM. In order to allow parties to comment, inclusion of Version 6.0 will have to be deferred to future TRM updates. As such, we direct the PEG to review the appropriateness of including Version 6.0 and provide recommendations for future TRM updates.

 The Commission adopts PECO’s recommendation to use the term PON\_MAX rather than PMAX in order to be consistent with language used in Version 5.3 of the ENERGY STAR Program Requirements. We define this term above Table 2-74. In addition, the term PMAX used to define the additional requirement to qualify for ENERGY STAR Most Efficient was modified to PON\_MAX since the term has the same meaning as the PON\_MAX in Table 2-74 and therefore the intent is to have one term to mitigate confusion.

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

This section provides protocols to estimate the savings associated with installing an electric clothes dryer with a moisture sensor. Clothes dryers with drum moisture sensors and associated moisture-sensing controls achieve energy savings over clothes dryers that do not have moisture sensors.

**a. Comments**

 PECO comments that the deemed life for an electric clothes dryer under this measure should be taken from the 2010 US DOE analysis, rather than the 11 years currently used in the proposed TRM.[[195]](#footnote-195)

**b. Disposition**

The Commission finds merit in PECO’s comments, but wants further analysis and review before any revisions to the TRM are made. The Commission, therefore, directs the PEG to investigate and evaluate the analyses from DOE and other sources on the average life of an electric clothes dryer and recommend if appropriate a revision for the future TRM updates.

1. **Electroluminescent Nightlight**

This section provides protocols to estimate savings associated with installing a plug-in electroluminescent nightlight.

**a. Comments**

PECO comments that the ISR for nightlights is taken from the ISR for CFLs, but that this is not appropriate since the main factor driving the ISR for CFLs is people putting them in storage. PECO believes applying the ISR from residential lighting fixtures would be more appropriate for this measure, but also recommends further research to derive an appropriate value for electroluminescent nightlights.[[196]](#footnote-196)

**b. Disposition**

 The Commission rejects PECO’s request to revise the ISR to that of residential lighting fixtures. The protocol for this measure indicates that the value can be revised through surveys and we believe this offers flexibility to revise the deemed value if appropriate.

1. **LED Nightlight**

This section provides protocols to estimate savings associated with the installation of an LED nightlight.

**a. Comments**

 PECO recommends, for consistency, that watts differential be expressed as a base watts term minus an efficient watts terms.[[197]](#footnote-197)

**b. Disposition**

 The Commission agrees with PECO’s recommendation to revise the LED Nightlight algorithm to a form that is consistent with other residential lighting protocols, specifically a base watts term minus an efficient watts term. The source of both the base watts and efficient watts is EDC data. The Commission has retained in the TRM a default savings value for this measure.

1. **Residential Occupancy Sensors**

This section is for the installation of occupancy sensors inside residential homes or common areas.

**a. Comments**

PECO comments that the peak demand savings are assumed to be zero and recommends providing justification for this assumption.[[198]](#footnote-198) PPL comments that the value for RHnew should be updated since it is defined as 70% of RHold and RHold was updated to 2.8 to reflect the change in residential lighting hours but RHnew was not.[[199]](#footnote-199)

**b. Disposition**

The Commission retains the assumed peak savings demand value of zero for residential occupancy sensors as no party has proposed an alternative. The Commission agrees with PPL recommendation to adjust RHnew to be consistent with the change in the Residential ENERGY STAR CFL hours of use and the definition of RHnew, which is 70 percent of RHold. The RHnew value has been revised to 2.0 hours.

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

1. **Lighting Protocols**

**a. Hours of Use and Coincidence Factor Values**

 The HOU and CF values for the different building types listed in Table 3-4 of 2012 TRM[[200]](#footnote-200) were reviewed, with some appearing to be outdated. Commission Staff and the SWE did further research aimed at improving current assumptions based on more recent evaluations, metering studies and TRMs from other states, including Pennsylvania-specific data collected by the EDCs and their evaluators, that were not available during previous TRM update cycles. The primary data collected by the EDC evaluators through the normal evaluation process was used as an indicator to identify measure assumptions that need updating.

 Commission Staff and the SWE conducted a cross-sectional study to compare HOU and CF values by building type found in the 2012 TRM with TRMs used in other states. After its review, the Commission considered the 2011 Mid-Atlantic TRM as the most applicable source for Pennsylvania in the absence of Pennsylvania-specific primary data. As such, the Commission proposed to use the 2011 Mid-Atlantic TRM as the primary source for reporting HOU and CF values in the 2013 TRM. The HOU and CF values reported in the 2011 Mid-Atlantic TRM were based on a secondary research study conducted by Itron, Inc. in December, 2010, entitled Development of Interior Lighting Hours of Use and Coincidence Factor Values for EmPOWER Maryland Commercial Lighting Program Evaluations, which was presented to the Maryland Public Service Commission. The results reported in the study were derived from the California 2006-2008 Commercial Lighting Study[[201]](#footnote-201) supplemented by the California Database for Energy Efficiency Resources (DEER) 2008 Database.[[202]](#footnote-202)

The Commission proposed using the 2011 Mid-Atlantic TRM values for the following reasons:

* The California lighting study is the largest and most comprehensive study of lighting use ever conducted with a random sample of 6,774 loggers installed in over 1,202 sites for two to three months each;
* The metered data is considered more accurate and valuable compared to estimates derived based on simulation modeling, customer surveys or averages taken from different sources;
* The study provides HOU estimates for almost all of the 12 critical building types with high precision and confidence;
* The data sources and methods are well documented and are less than five years old, compared to the 2012 TRM where HOU values for the majority of the building types are based on the 1999 PG&E study; and
* Methods used in the study to develop these estimates are not only transparent but the result of eight months of vigorous review by stakeholders in California.

 The Commission realized that there may be differences between California and Pennsylvania lighting conditions that could affect annual HOU for some building types. These values, however, represented the best available information based on a comprehensive metering study and would be an improvement over the 2009 New Jersey TRM, which was used as the source for a number of building types in the 2012 TRM. The Commission clarified that these values may be supplemented by Pennsylvania-specific primary logged data obtained from evaluations, where possible, during future TRM updates. In addition, the Commission proposed that the EDCs also be allowed to calculate and use site-specific CFs using the non-weather-dependent peak demand calculator in lieu of the recommended CFs, if the operating schedules are known with reasonable certainty.

 The 2011 Mid-Atlantic TRM was the proposed source to update HOU values for the 11 existing building types in 2012 TRM that used the 2009 New Jersey TRM as the source. For existing building types where the 2011 Mid-Atlantic TRM does not report HOU values and where the 2012 TRM source was the 2009 New Jersey TRM, the Commission proposed using values from the California DEER 2011 database,[[203]](#footnote-203) 2012 Illinois TRM, 2010 Ohio TRM, 2010 Wisconsin Deemed Savings Manual and 2012 Connecticut TRM to update the HOU values. Sources other than the 2011 Mid-Atlantic TRM listed above were proposed for six building types. Of these, three were existing building types in 2012 TRM and three were new building types proposed for 2013 TRM. For the building types where CF values were not available in the 2011 Mid-Atlantic TRM, the Commission proposed to use a calculated average of CF values available for all building types in the 2011 Mid-Atlantic TRM.

 In addition, the Commission proposed to use the same reference document to report HOU values listed in the 2012 TRM for 11 existing building types until better data is available. The Commission proposed to use a calculated average of CF values available for all building types in the 2011 Mid-Atlantic TRM and apply it to these 11 existing building types.

 In sum, the Commission-proposed list for the 2013 TRM included a total of 28 building types. The 2011 Mid-Atlantic TRM was the proposed source for 11 building types; the same reference document listed in the 2012 TRM was the proposed source for 11 existing building types (no changes were made to the HOU values); and other sources (California DEER 2011 database, 2012 Illinois TRM, 2010 Ohio TRM and 2010 Wisconsin Deemed Savings Manual) were proposed for 6 building types (of these, three are new building types).

**i. Comments**

 PECO recommends that the assumptions for C&I lighting HOU values should be made more robust in the future using results from a lighting metering study.[[204]](#footnote-204) PPL suggests that the Commission maintain the C&I lighting HOU values as stated in the 2012 TRM until Pennsylvania-specific primary data is determined from a metering study. PPL asserts that there is no evidence that the existing HOU values for Pennsylvania are inaccurate. Specifically, PPL asserts that the 2013 Tentative TRM reported HOU values are significantly lower than those in the 2012 TRM, which would under-report the true savings, result in additional light logging costs for the EDC, take time which could delay a customer’s project for pre-metering and customer’s rebate for post-metering, cause inconvenience for customers, reduce customer incentives, and could discourage customer participation.[[205]](#footnote-205) PPL further asserts that there is no evidence that the HOU values in the Mid-Atlantic TRM or TRMs from other regions or secondary research are more accurate or more representative of Pennsylvania buildings than the values in the PA 2012 TRM.[[206]](#footnote-206) Finally, PPL asserts that the Commission’s research points out that HOU values for a specific building type vary significantly between different states. Specifically, PPL asserts that this provides further evidence that it is not appropriate, nor more accurate, to adopt HOU or CF values from another state.[[207]](#footnote-207)

FirstEnergy agrees with PPL and also recommends that the Commission maintain the HOU values for C&I lighting from 2012 TRM. FirstEnergy and PPL also assert that their evaluations to-date support high realization rates for lighting and, as such, do not support the need for a change in average values or building type classifications for C&I lighting.[[208]](#footnote-208)

**ii. Disposition**

The Commission agrees with PECO’s recommendation that the HOU values for C&I lighting should be made more robust in the future using results from a lighting metering study. The Commission, however, rejects the suggestion by PPL and FirstEnergy to maintain the HOU values as stated in the 2012 TRM until Pennsylvania-specific primary data is determined from a lighting metering study. The Commission considers the 2011 Mid-Atlantic TRM to be the most applicable source for Pennsylvania in the absence of Pennsylvania-specific primary data. The Commission, for the following reasons, believes that HOU values reported in 2013 TRM are more accurate compared to those in 2012 TRM:[[209]](#footnote-209)

* The California lighting study,[[210]](#footnote-210) which is the basis for HOU values in 2013 TRM, is the largest and most comprehensive study of lighting use ever conducted with a random sample of 6,774 loggers installed in over 1,202 sites for two to three months each;
* The metered data is considered more accurate and valuable compared to estimates derived based on simulation modeling, customer surveys or averages taken from different sources;
* The study provides HOU estimates for almost all of the 12 critical building types with high precision and confidence;
* The data sources and methods are well-documented and are less than five years old, compared to the 2012 TRM, where HOU values for the majority of the building types are based on the 1999 PG&E study; and
* Methods used in the study to develop these estimates are not only transparent but the result of eight months of vigorous review by stakeholders in California.

 The Commission agrees with PPL that there may be differences between California and Pennsylvania lighting conditions that could affect annual HOU for some building types. The Commission believes that these values, however, represent the best available information based on a comprehensive metering study and would be an improvement over the 2009 New Jersey TRM, which was used as the source for a number of building types in the 2012 TRM. In addition, the Commission clarifies that these values may be supplemented by Pennsylvania-specific primary logged data obtained from evaluations, where possible, during future TRM updates.

**b. Building Types**

 The Commission proposed to add three new building types to Table 3-4 of the 2012 TRM to provide additional granularity to the stipulated measure assumptions resulting in reduced uncertainty from averaged values. The proposed list included public assembly (one shift), public services (nonfood), and multifamily (common areas) building types. The Commission elected to minimize the number of additional building types to reduce administrative burden on the EDCs.

**i. Comments**

 PPL recommends not consolidating building types and recommends further granularity. PPL states that consolidating building types results in average default HOU values that may be significantly different from the buildings actual HOU. PPL also asserts that the difference in HOU values will cause an EDC to conduct light logging. PPL suggests expanding warehouse to warehouses based on shifts; expanding retail to retail based on time open per year; expanding restaurant to restaurant based on time open per year; expanding education to primary and secondary; expanding public safety to separate building types.[[211]](#footnote-211) FirstEnergy also asserts that its evaluations to-date support high realization rates for lighting and, as such, do not support the need for a change in average values or building type classifications for C&I lighting.[[212]](#footnote-212)

**ii. Disposition**

 The Commission rejects the suggestion by PPL and FirstEnergy to add more categories for building types. The Commission consolidated building types and adopted HOU values from the 2011 Mid-Atlantic TRM, which we consider to be the most applicable source for Pennsylvania in the absence of Pennsylvania-specific primary data. The Commission will use the 2011 Mid-Atlantic TRM as the primary source for reporting HOU and CF values in the 2013 TRM. The Commission, however, supports the need for a Pennsylvania-specific lighting metering study and the expansion of the building types based on HOU values determined from the metering study.

**c. Lighting Control Technologies**

 The Commission proposed to add 13 lighting control technologies with savings factors to Table 3-6[[213]](#footnote-213) of the 2012 TRM based on a more recent comprehensive study conducted by the Lawrence Berkeley National Laboratory in September 2011, entitled A Meta-Analysis of Energy Savings from Lighting Controls in Commercial Buildings.[[214]](#footnote-214) The lighting controls measures were divided into five major strategies: occupancy, day lighting, personal tuning, institutional tuning and multiple types. Each of these strategies may have one or more technologies. These strategies would replace the lighting control technologies and the corresponding savings factors in the 2012 TRM. The Commission clarified that the EDC evaluators would be allowed to use site-specific HOU values or control savings factors based on actual metering results for all projects.

 In addition, the lighting protocol was constructed in such a way to account for energy savings only for lighting control retrofits. The savings algorithms[[215]](#footnote-215) did not account for demand savings. The Commission proposed to modify the savings algorithms to allow the EDCs to claim demand savings for lighting control retrofits in addition to the energy savings.

**i. Comments**

 PECO and PPL recommend that the C&I lighting protocol be revised such that the EDCs are allowed to claim demand savings from lighting control retrofits. PECO and PPL point out that, while the Commission proposed to modify the savings algorithm in the Tentative Order, the draft 2013 TRM and its Appendix C do not appear to reflect these proposed changes.[[216]](#footnote-216)

**ii. Disposition**

 The Commission unintentionally pointed out in the Tentative Order that the TRM would be revised to allow EDCs to claim demand savings for lighting control adjustments. The Commission supports the suggestion by PECO and PPL Electric to revise the algorithms to allow for demand savings claims for control retrofits. The Commission believes, however, that the C&I protocol requires further development and review to determine how to revise the algorithms and assumptions to accurately account for the demand savings. Therefore, the Commission recommends that this topic be referred to and considered by the PEG for subsequent TRM updates.

**d. New Construction Calculator**

 Based on feedback from the EDCs, the Commission proposed the inclusion of a New Construction calculator (Appendix E) to calculate the savings impacts for new construction lighting projects as an optional tool for the EDCs. The Commission believes this would help EDCs by simplify the lighting application forms.

**i. Comments**

 PPL supports the addition of the New Construction Calculator as an optional tool for EDCs.[[217]](#footnote-217)

**ii. Disposition**

 The Commission appreciates PPL’s support regarding the addition of New Construction Calculator to the TRM. The Commission notes that the EDCs may use the calculator as an option to calculate the savings impacts for new construction lighting projects.

**e. Federal Legislation and Regulations**

In the 2012 TRM Final Order, the Commission directed the TWG to investigate the impacts of new lighting standards and recommend future adjustments to the TRM when necessary.[[218]](#footnote-218) The Energy Policy Act of 2005 (EPAct 2005)[[219]](#footnote-219) and EISA 2007 standards introduced new efficiency standards for linear fluorescent bulbs and ballasts, effectively phasing out magnetic ballasts effective October 1, 2010, and T-12 bulbs effective July 14, 2012. This induces a shift in what a participant would have purchased in the absence of the program because T-12 bulbs on magnetic ballasts would no longer be viable options and, therefore, adjusts the baseline assumption. Leftover retail stock may sustain sales for T-12 bulbs and use of T-12 systems for a period, but its market share is expected to decrease naturally as T-8 systems are adopted and the existing stock of T-12s is exhausted. In addition, C&I lighting retrofit projects for Act 129 are all considered early replacement scenarios, i.e. the baseline is defined as what was previously in place rather than minimally code compliant equipment.

Commission Staff and the SWE conducted research of existing energy efficiency programs from various jurisdictions to understand the full impact of these upcoming regulatory changes in order to make reasonable modifications regarding savings values achieved by C&I lighting measures when the existing lighting system contains T12 lamps and/or magnetic ballast. After reviewing approaches by other jurisdictions, the Commission believed that the assumptions made by the 2012 Illinois TRM were reasonable and that the same methodology could be used in future TRM updates to account for new code changes. The baseline for a lighting retrofit project would be the existing lighting system until 2016. This would reflect the time required for the market to adjust to the new code standards, taking into account the fact that end-users may have an existing stock of T-12s and do not need to purchase new replacement lamps for several years. For Phase II, Program Year 1, we assume the baseline is the T-12 system, but this assumption would be revisited in subsequent TRMs. With this understanding, the Commission believed that there was no immediate need to incorporate these new code standards into the 2013 TRM. As such, the Commission proposed that these new code standards be reviewed during future TRM updates in order to incorporate the changes at a more appropriate point in time.

**i. Comments**

PPL agrees with the Commission’s proposal to maintain the existing definition of the baseline for lighting retrofit projects until 2016. PPL, however, requests that the Commission clarify that the use of the year 2016 is intended to mean the Act 129 EE&C program year that begins June 1, 2016, not the calendar year starting January 1, 2016. PPL recommends maintaining the baselines until the end of the program year and making potential revisions thereafter to be consistent with the Commission’s treatment of other proposed baseline changes.[[220]](#footnote-220) In addition, PPL requests that the Commission clarify that it will assume the baseline as the T-12 system until May 31, 2016, and that the baseline condition will not be revisited in subsequent TRM updates. PPL asserts that maintaining T-12 fixtures as the baseline for the entire Phase II period is important because the definition of the baseline directly impacts an EDC's program design, specifically the minimum eligibility requirements for measures.[[221]](#footnote-221)

**ii. Disposition**

The Commission recognizes PPL’s need for clarification. The existing definition of the baseline will be maintained through May 31, 2016, the end of the last program year in Phase II. In doing so, the C&I lighting protocol will be consistent with the Commission’s treatment of proposed baseline changes for other measures. The Commission, however, rejects PPL’s proposal to maintain the T-12 system as the baseline until May 31, 2016, and not to revisit the baseline condition in subsequent TRM updates. The Commission believes that the definition of baseline in the 2013 TRM is reasonable based on limited information available from secondary research. The Commission notes, however, that this assumption should be revisited in subsequent TRMs and directs the PEG to continue to review these new code standards and to conduct research of existing energy efficiency programs from other jurisdictions to understand the full impact of these regulatory changes thereby improving assumptions in future TRM updates.

**2. Motor and Variable Frequency Drive Protocols**

 The Commission proposed to update the Energy Savings Factor (ESF) and Demand Savings Factor (DSF) values for VFDs using the 2012 Connecticut TRM as the primary source. The ESF and DSF values listed in Table 3-17[[222]](#footnote-222) of the 2012 TRM were taken from the 2011 Mid-Atlantic TRM, which references the 2009 Connecticut TRM[[223]](#footnote-223) as the source document. These values, however, do not match the 2009 Connecticut manual. In addition, the algorithms used in the 2011 Mid-Atlantic TRM do not include a load factor to calculate savings in contrast to the 2012 TRM or 2009 Connecticut TRM.

 The Commission also proposed to use the 2012 Connecticut TRM to update the motor and VFD operating hours listed in Table 3-14[[224]](#footnote-224) of the 2012 TRM, similar to the source used for ESF and DSF values to accurately estimate savings. Furthermore, the Commission proposed running computer simulation models to determine ESF and DSF values for VFD protocols and operating hours for motor and VFD protocols using eQUEST software for future TRM updates. This would provide state-specific values, which are considered to be the most credible information after metered data.

**a. Comments**

PPL requests that the Commission confirm the accuracy of motor operating hours for heating pumps reported in 2013 TRM. Specifically, PPL states that the operating hours for heating pumps are the same for all building types in the TRM with the actual hours varying significantly depending on the facility type.[[225]](#footnote-225) PPL also recommends that a sentence in the definition of Load Factor (LF) in Section 3.4 of the TRM, applicable to VFDs, be removed. PPL states that motors on which VFDs are installed are almost always variable-loaded and removing this restriction would clarify the protocol.[[226]](#footnote-226)

**b. Disposition**

The Commission confirms the use of motor operating hours from secondary sources and adopts the values in Table 3-15[[227]](#footnote-227) in 2013 TRM for motor and VFD measures. Several TRMs from other states, including the Mid-Atlantic, Delaware, New York, and Ohio manuals use motor operating hours reported in the 2012 Connecticut manual, which is the source used for the 2013 TRM. The Commission agrees with PPL’s suggestion to revise the definition of Load Factor in Section 3.4 of the TRM.

**3. Office Equipment Network Power Management Systems**

 The 2012 TRM[[228]](#footnote-228) deemed savings for the Office Equipment Network Power Management System measure were 148 kWh per unit and 0.020 kW per unit. The energy savings were based on actual field measurements for a single project in Duquesne’s service territory. The demand savings were taken from a study conducted by Southern California Edison over a period of one month. The Commission proposed to update the deemed savings to 135 kWh per unit and 0.0078 kW per unit based on a recent evaluation study conducted in Pacific Northwest.[[229]](#footnote-229) This study contains a broader sample and investigated a variety of applications that are more representative of this technology.

**a. Comments**

PECO suggests that the HVAC interactive effects be included in the TRM for the Office Equipment – Network Power Management Enabling measure. PECO states that the workstations controlled by this measure are usually located in conditioned spaces resulting in additional impacts due to changes in HVAC equipment operation as a result of this measure that must be quantified, where possible.[[230]](#footnote-230) In addition, PECO agrees that use of Pacific Northwest’s Non-Res Network Power Management System study seems appropriate as it is more recent than most of the studies cited in the 2012 TRM and is based on measured data. PECO, however, suggests that the TRM may require further updates because the study has an expiration date of July 1, 2013, due to the variable nature of technology evolution.[[231]](#footnote-231) PPL supports the Commission’s proposal to update the deemed savings for this measure. PPL recommends that the Commission clarify that the qualifying software is not limited to the Verdiem Surveyor software that was used to determine the deemed savings estimates in Section 3.22[[232]](#footnote-232) of the 2013 TRM.[[233]](#footnote-233)

**b. Disposition**

The Commission supports PECO’s suggestion to include HVAC interactive effects in the TRM to accurately represent savings. The Commission clarifies that the HVAC interactive effects were already taken into account while developing deemed savings values for the Office Equipment – Network Power Management Enabling protocol. [[234]](#footnote-234) In addition, the Commission agrees with PECO’s suggestion to update the TRM in the future with latest information available due to the variable nature of technology evolution. The Commission directs the PEG to monitor this issue and provide recommendations for consideration during future TRM updates.

The Commission also accepts PPL’s request to provide additional clarification in the TRM regarding the applicability of the deemed savings values for qualified controls. The Commission clarifies that the deemed savings in the TRM are not applicable only to Verdiem Surveyor software, but also applicable to any other software that meets the Pacific Northwest Regional Technical Forum's (RTF) Networked Computer Power Management Control software specifications. The following software specifications[[235]](#footnote-235) for eligible software will be added to the TRM:

Workstation is defined as the computer monitor and the PC box;

The software shall have wake-on-local area network capability to allow networked workstations to be remotely wakened from or placed into any power-saving mode and to remotely boot or shut down Advanced Configuration and Power Interface-compliant workstations;

The software shall give the information technology administrator easily-accessible central control over the power management settings of networked workstations that optionally overrides settings made by users;

The software shall be capable of applying specific power management policies to network groups, utilizing existing network grouping capabilities;

The software shall be compatible with multiple operating systems and hardware configurations on the same network; and

The software shall monitor workstation keyboard, mouse, central processing unit and disk activity in determining workstation idleness.

**4. LED Channel Signage**

 The Commission proposed to update the savings algorithms and assumptions table for the LED Channel Signage measure. The algorithm in the 2012 TRM[[236]](#footnote-236) used kW = kW/foot \* Q \* N. Q represented average stroke length per letter width and N represented the number of letters in the sign, which is equal to L, the total length of the sign. The Commission proposed to revise the algorithm to kW = kW/foot \* L. This would allow the EDCs’ independent evaluators to calculate savings based on actual total length for installed channel signs, resulting in more accurate savings estimates. In addition, the Commission proposed to add a reference for the SVG factor[[237]](#footnote-237) in Table 3-93 of the 2012 TRM.[[238]](#footnote-238)

**a. Comments**

PECO states that the proposed algorithm for LED Channel Signage measure does not significantly improve the accuracy of the savings estimates. PECO asserts that the algorithm may be more straightforward for customers, assuming they know the exact length of the lighting modules in the sign. PECO notes, however, that if they do not, there is no added benefit to changing the algorithm and it may actually detract from the accuracy of the savings estimates.[[239]](#footnote-239) PPL agrees with the proposed revisions to this protocol. PPL requests that the first source listed in Section 3.30 be removed as the variable to which it refers (Q, or Average Stroke Length/Letter Width) is no longer applicable to the protocol.[[240]](#footnote-240)

**b. Disposition**

The Commission agrees with PECO to the extent that the algorithm for LED Channel Signage measure in 2013 TRM[[241]](#footnote-241) will not significantly improve the accuracy of the savings estimates. The Commission, however, clarifies that the algorithm in 2012 TRM was revised based on PECO’s recommendations received during PEG discussions. We believe that retaining this more simplified approach is desirable. While we believe that splitting the savings for this measure into two categories: channel signs greater than two feet tall and those two feet or less may improve savings estimates, current savings documentation does not provide a distinction between sign heights. The Commission believes that this change requires further research and, as such, we direct the PEG to discuss this measure and provide recommendations for future TRM updates. The Commission accepts PPL’s request to remove the first source listed in Section 3.30 and has updated the TRM accordingly.

**5. Refrigeration**

 Commission Staff and the SWE reviewed all of the refrigeration measures in the 2012 TRM to ensure that the methods used to determine the EFLH values were consistent. The refrigeration measures were found in Sections 3.8, 3.9, 3.10, 3.11, 3.17, 3.21, 3.23, 3.24, 3.25, 3.26, and 3.33,with only Sections 3.26 and 3.33 using EFLH values for calculating savings. Measure 3.26 - Evaporator Fan Controllers - used a variable Hours CP listed in Table 3-83[[242]](#footnote-242) of the 2012 TRM, which represented the EFLH of compressor operation. There was no default value provided for this variable in the assumptions table. As such, the EDCs had to collect this information. Measure 3.33 - Special Doors with Low or No Anti-Sweat Heat for Low Temp Case - included a variable EFLH whose default value was 5,700 and was found in Table 3-97[[243]](#footnote-243) of the 2012 TRM. This value was determined by multiplying annual available operation hours of 8,760 by overall duty cycle factors. Duty cycle is a function of compressor capacity, defrost and weather. The Commission proposed a default value of 5,700 for EFLH for Measure 3.26 to be consistent with Measure 3.33.

**a. Comments**

PECO suggests that the TRM provide justification for the annual full loads hours for compressor Hours CP. Specifically, PECO states that the current value assumes significant average oversizing, weather, load and other factors.[[244]](#footnote-244) PPL agrees with the revision proposed by the Commission for the Evaporator Fan Controllers measure.[[245]](#footnote-245)

**b. Disposition**

The Commission accepts PECO’s request to provide justification for the annual full loads hours for compressor Hours CP for Evaporator Fan Controllers measure. The Commission also agrees that the current value of 5,700 hours assumes average values for appropriate factors and has revised the hours for compressor operation from 5,700 to 4,072, estimated based on 15 years of National Resource Management field observations and experience as reported in the Rhode Island TRM.[[246]](#footnote-246)

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

 The Low Flow Pre-Rinse Sprayer protocol in the 2012 TRM assumed a baseline flow rate of 2.25 gallons per minute (GPM)[[247]](#footnote-247) and 2.15 GPM[[248]](#footnote-248) for non-grocery and grocery applications, respectively, as listed in Table 3-94.[[249]](#footnote-249) These flow rates, however, only applied to retrofit applications. The Commission proposed to add an additional option for a Time of Sale (TOS)/Retail program protocol, with a baseline flow rate of 1.6 GPM[[250]](#footnote-250) to incorporate the current minimum code requirement.

**a. Comments**

PECO agrees with the Commission’s proposal to add an additional option for a TOS/Retail program for Low Flow Pre-Rinse Sprayers measure. PECO recommends, however, that a market baseline adjustment factor be added to the algorithm to adjust the Federal standard of 1.6 GPM to a lower and more likely value for market baseline in the absence of a program to accurately represent savings for a TOS/Retail program. PECO proposes an adjustment factor of 0.95 that will yield a market baseline of 1.52 GPM. PECO noted that their recommendation was based on performance rating results of 29 models listed on the Food Service Technology Center Website, which showed that the highest flow rate was 1.51 GPM[[251]](#footnote-251) and the manufacturer on-line product catalogs[[252]](#footnote-252) that did not uncover a model rated higher than 1.51 GPM. PECO further recommends that the market baseline adjustment factor be reviewed and updated annually.[[253]](#footnote-253)

In addition, PECO recommends that a TOS/Retail program include a requirement for cleanability performance of 26 seconds per plate, or less, based on Federal Energy Management Program (FEMP) guidelines.[[254]](#footnote-254) Specifically, PECO asserts that the pre-rinse sprayer models with cleanability performance that does not meet the 26-second requirement create a risk that post-measure sprayer usage time will increase relative to better performing models and the pre-retrofit conditions, reducing anticipated savings.[[255]](#footnote-255)

CLEAResult suggests that the commercial low flow pre-rinse sprayer efficient specification of 1.6 GPM be lowered to 1.25 GPM or less. CLEAResult requests that additional low flow specifications of 1.125 GPM and 0.65 GPM and deemed savings for these specifications be added to the TRM.[[256]](#footnote-256)

**b. Disposition**

The Commission accepts PECO’s suggestion to take into account the market baseline adjustment factor of 0.95 in order to adjust the Federal standard of 1.6 GPM to 1.52 GPM for a TOS/Retail program. The Commission reviewed secondary sources and believes that the recommendation made by PECO is reasonable. The Commission also agrees with PECO that the market baseline adjustment factor should be reviewed and directs the PEG to provide recommendations for future TRM updates. The Commission also accepts PECO’s suggestion to include a requirement for cleanability performance of 26 seconds per plate or less based on FEMP guidelines[[257]](#footnote-257) for the TOS/Retail program for clarity. The Commission notes that the values for pre- and post-flow rates for spray heads, daily hours of spray head use, and mixed water temperatures for the Low Flow Pre-Rinse Sprayers protocol in the TRM are taken from a study of the Impact and Process Evaluation Final Report for California Urban Water Conservation Council (CUWCC) 2004-2005 Pre-Rinse Spray Valve Installation Program. The results of this study, however, are determined based on the retrofit or direct installation programs only, i.e. old heads were replaced with a high-efficiency unit. The Commission believes that it is not reasonable to apply the same assumptions to the retail program type to estimate deemed savings because these values may misrepresent savings. The Commission, therefore, has added a separate section for the Low Flow Pre-Rinse Sprayers protocol for TOS/Retail program. The Commission adopts the methodology, algorithms, and assumptions from the 2012 Illinois TRM[[258]](#footnote-258) to estimate deemed savings. The Commission directs the PEG to further review these protocols and provide recommendations for future TRM updates.

 The Commission rejects the suggestion from CLEAResult to add additional low flow specifications of 1.125 GPM and 0.65 GPM and deemed savings for these flow rates to the TRM. The Commission, however, will add a user input data field for the post-measure flow rate of sprayers in Table 3-94,[[259]](#footnote-259) thereby allowing the EDCs to calculate savings in cases where post-measure flow rates are lower than 1.12 GPM. In addition, the Commission clarifies that the low flow pre-rinse sprayer efficient specification in the TRM is 1.12 GPM, and the low flow pre-rinse sprayer baseline specification is 1.6 GPM.

**7.** **Refrigeration – Evaporator Fan Controllers**

 The Refrigeration – Evaporator Fan Controller protocol in the 2012 TRM[[260]](#footnote-260) was taken from the 2011 Massachusetts TRM. This protocol, however, did not clearly define how to determine the power demand for the evaporator fan kW Fan or the compressor motor kW CP. The Commission proposed the following as acceptable methods for determining the kW Fan and kW CP variables:

1. Calculate using the nameplate horsepower and load factor
* kW Fan, CP = [(Motor HP \* LF \* 0.746 kW/HP) / Motor efficiency] where the HP and efficiency are taken from the nameplate and the load factor is assumed.
1. Calculate using the nameplate amps and volts and a power factor
* kW Fan, CP = [V \* A \* PF motor \* LF] where the volts and the amps are taken from the nameplate, the power factor and load factor is assumed.
1. Measure the input kW Fan, CP using a power meter reading true RMS power.

 In addition, the Commission proposed to update the assumptions table and amend the definitions for this measure accordingly.

**a. Comments**

PECO recommends that the Commission change the Load Factor value from 0.9 to either 0.80 or 0.85 based on the PSC of Wisconsin, Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0, p. 4-103 to 4-106.[[261]](#footnote-261) PECO also recommends that the Commission adopt a Power Factor value between 0.75 and 0.9 instead of 0.6 based on 15 years of NRM field observations and experience.[[262]](#footnote-262) Finally, PECO recommends that the Commission reconsider the value for % off variable (percent of annual hours that the evaporator is turned off) because 46% seems very high. PECO asserts that they would expect a time percentage of reduced fan operation for half or third run speed at around 15% to 30%, depending on load, based on the Select Energy (2004). Analysis of Cooler Control Energy Conservation Measures - Prepared for NSTAR study.[[263]](#footnote-263) PPL appreciates the clarifications by the Commission for calculating power demand for compressors and fans.[[264]](#footnote-264)

**b. Disposition**

The Commission rejects PECO’s request to change the Load Factor value from 0.9 to either 0.80 or 0.85. PECO’s recommendation is based on the PSC of Wisconsin, Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0, p. 4-103 to 4-106. The Commission confirmed the value from the same source, which is listed as 0.9. We also reject PECO’s suggestion to adopt a Power Factor value between 0.75 and 0.9 instead of 0.6 for fan motors in Table 3-83.[[265]](#footnote-265) The Commission clarifies that the proposed value was based on PECO’s recommendations received during PEG discussions. PECO was incorrect in its assertion that the NRM field observations and experience show a value between 0.75 and 0.9, as the value, in fact, is listed as 0.55 in the Massachusetts TRM,[[266]](#footnote-266) which references the same source document. The Commission, however, believes that PECO’s suggestion requires further research and input from EDCs before it can be incorporated into the TRM. Therefore, we direct the PEG to discuss this modification and provide recommendations during future TRM updates.

In addition, the Commission rejects PECO’s recommendation to revise the value for % off variable (percent of annual hours that the evaporator is turned off). The value listed as 46%, whereas PECO recommends using a value at around 15% to 30% based on the Select Energy (2004). Analysis of Cooler Control Energy Conservation Measures - Prepared for NSTAR study . The Commission confirmed the value from the same source, which is listed as 46%, and is consistent with the TRM.

**8. Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool)**

 The proposed expansion and improvements to the C&I Lighting protocols are captured in Appendix C - Lighting Inventory Tool. The major changes proposed include updating the list of building types, HOU and CF values, control technologies, and savings factors. The Commission also proposed minor edits to Appendix D - Motor and Variable Frequency Drive Inventory Tool - to be consistent with the TRM protocol. In addition, the TRM[[267]](#footnote-267) requires that the wattages in the Wattage Table in Appendix C are to be used unless the actual fixture wattages, as determined from cut-sheets, differ by more than 10% from the nearest matching Appendix C fixture. While the threshold requirement for fixture wattages was not discussed in the Tentative Order, the comments were deemed to be important enough to be addressed in this Order

**a. Comments**

FirstEnergy recommends that the 10% threshold requirement in the TRM regarding fixture wattages be reduced to 4% or recast as 10% of the delta-watts. FirstEnergy notes that the TRM requires EDCs to use wattages from Appendix C unless the actual fixture wattages, as determined from cut-sheets, differ by more than 10% from the nearest matching Appendix C fixture. FirstEnergy asserts that, in cases where efficient T8 lamps replace relatively efficient T12 or standard T8 lamps, a 10% difference in the wattage of the efficient fixture may amount to a much larger difference in the savings.[[268]](#footnote-268)

PPL recommends correcting the Appendix C lookup reference for lighting control adjustments. PPL notes that, in rows 12 – 50 of Appendix C, an error appears in the columns for Controls Factor and Annual kWh Saved when controls are selected. In addition, PPL agrees with the Commission’s proposal to revise Appendix D to reflect the separate protocols for Motors and VFDs.[[269]](#footnote-269)

**b. Disposition**

The Commission adopts the revised and updated C&I lighting protocol in the TRM, Appendix C - Lighting Audit and Design Tool, and Appendix E – New Construction Calculator to address the concerns expressed by the EDCs. Specifically, the Commission agrees with FirstEnergy’s suggestion to change the 10% threshold requirement regarding fixture wattages to a 10% threshold requirement of the difference in delta-watts of fixture wattages. As such, the actual efficient fixture wattage is to be used to calculate savings. The Commission believes this change will allow EDCs to claim more accurate savings. The Commission also accepts PPL’s request to correct the Appendix C lookup reference for lighting control adjustments to eliminate the errors.

**9. Ductless Mini Split Heat Pumps – Commercial <5.4 Tons**

The Ductless Mini Split Heat Pumps measure was not discussed in the Tentative Order, however, comments related to this protocol are addressed below. This protocol documents the energy savings attributed to ENERGY STAR ductless mini-split heat pumps.

**a. Comments**

PECO recommends using SEER instead of EER for ΔkWh cool calculations and using HSPF, instead of COP, for ΔkWh heat calculations.[[270]](#footnote-270) PECO also recommends that the Commission review the Load Factor value of 25%. PECO asserts that most TRMs do not differentiate mini-splits from other packaged and split systems. While it is reasonable to expect mini-splits to have less EFLH than a ducted system, PECO believes that reducing by ¾ is excessive. PECO notes that it is likely that the original intent was a load factor equal to 75% rather than 25%.[[271]](#footnote-271)

**b. Disposition**

The Commission accepts PECO’s proposal to revise the Ductless Mini Split Heat Pumps protocol such that SEER is used for ΔkWh cool calculations instead of EER and HSPF is used for ΔkWh heat calculations instead of COP. In doing so, the protocol will be consistent with the treatment of other HVAC protocols in the TRM. The Commission supports PECO’s suggestion to review the Load Factor value of 25%. The Commission agrees with PECO that other TRMs do not differentiate mini-splits from other packaged and split systems and therefore do not account for load factor. Other TRMs, however, include ductless mini-split heat pumps only for the residential sector and not for the C&I sector. The Commission believes that this topic requires further review to determine how to revise the assumptions to accurately represent savings. Therefore, the Commission recommends that this topic be referred to and considered by the PEG and that recommendations be provided for future TRM updates.

**10. ENERGY STAR Clothes Washer**

The ENERGY STAR Clothes Washer measure was not discussed in the Tentative Order, however, comments related to this measure are addressed below. This protocol discusses the calculation methodology and the assumptions regarding baseline equipment, efficient equipment, and usage patterns used to estimate annual energy savings expected from the replacement of a standard clothes washer with an ENERGY STAR clothes washer.

**a. Comments**

PECO recommends that the new Federal standards for commercial clothes washers be incorporated into the 2013 TRM. PECO states that, on January 8, 2013, the Federal standards for commercial clothes washers will change as shown in the table below.[[272]](#footnote-272)

|  |  |  |
| --- | --- | --- |
| **Class** | **MEF (cubic feet/kWh)** | **WF (gal/cubic feet)** |
| Top-Loading | 1.60 | 8.5 |
| Front-Loading | 2.00 | 5.5 |

PECO also states that, as of February 1, 2013, commercial clothes washers must meet a Modified Energy Factor (MEF) of 2.2 and a Water Consumption Factor (WF) of 4.5 to be ENERGY STAR-qualified. In addition, PECO asserts that, in 2013, all ENERGY STAR-qualified commercial clothes washers are likely to be front-loading units because there are no top-loading commercial clothes washers that have been certified by DOE as meeting the 2013 standards. PECO also recommends changing the algorithm for the commercial clothes washers protocol to that used for residential clothes washers. PECO recommends using separate average capacities for the baseline and higher efficiency units because higher efficiency clothes washers tend to have larger capacities.[[273]](#footnote-273) Next, PECO recommends that the number of cycles be increased from 950 to 1,241 for multifamily applications based on the most recent analysis supporting energy conservation standards for commercial clothes washers, which DOE published in December 2009.[[274]](#footnote-274) Finally, PECO recommends using the DOE estimated average lifetime of 11.3 years.[[275]](#footnote-275)

**b. Disposition**

The Commission carefully reviewed the comments provided by PECO and made changes to address those comments where a simple resolution was possible. The following changes were accepted:

* Changing the value for number of loads per year in Table 3-84[[276]](#footnote-276) from 950 to 1,241 for multifamily and 2,190 for Laundromat.[[277]](#footnote-277)
* Changing the measure life from 10 years to 7.1 years for Laundromat and 11.3 years for multifamily[[278]](#footnote-278) in Section 3.27.5.[[279]](#footnote-279)

The Commission also agrees with PECO’s suggestion to incorporate the new federal standards and ENERGY STAR requirements for commercial clothes washers. PECO was correct to note that the new federal standards will go into effect on January 8, 2013, with the ENERGY STAR requirements will go into effect on February 1, 2013. The Commission, however, rejects PECO’s recommendation to change the algorithm for the commercial clothes washers’ protocol to that used for residential clothes washers. The Commission believes that there are some significant differences between commercial and residential protocols, such as the flexibility to vary fuel mixes, volumes of baseline and efficient clothes washers, and the need to obtain a Commercial Buildings Energy Consumption Survey (CBECS) applicable to C&I sector. For these reasons, the Commission believes that it is not appropriate to report deemed savings for the C&I clothes washer protocol using algorithms and assumptions from the residential protocol. The Commission believes, however, that the C&I clothes washer protocol should be modified to reflect the standards and latest available information. Therefore, the Commission has revised the protocol using the calculation methodology, the assumptions regarding baseline equipment and efficient equipment, and usage patterns from the U.S. Department of Energy’s Life-Cycle Cost and Payback Period tool[[280]](#footnote-280) to estimate annual energy savings. Deemed savings shall be reported for top-loading and front-loading washing machines for different combinations of water heater and dryer types in laundry rooms of multifamily complexes and commercial Laundromats.

The Commission supports PECO’s recommendation to use separate average capacities for the baseline and higher efficiency units because higher efficiency clothes washers tend to have larger capacities. The Commission believes, however, that there is not sufficient information available from secondary sources to determine reasonable average capacities for baseline and efficient clothes washers that will result in accurate savings. Therefore, the Commission uses the same capacity for baseline and efficient clothes washers to calculate deemed savings, consistent with the methodology employed by DOE. In addition, the Commission will add a user-input data field for baseline and efficient clothes washer capacities, thereby allowing the EDCs to calculate savings in cases where the capacities are different. The Commission also directs the PEG to continue conducting research and provide recommendations, as new data becomes available regarding the C&I clothes washer protocol during future TRM updates.

**11. Electric Resistance Water Heaters**

The Electric Resistance Water Heaters measure was not discussed in the Tentative Order, however, related comments are addressed below. This protocol documents the energy savings attributed to efficient electric resistance water heaters.

**a. Comments**

PECO states that there appears to be an error in the algorithms and savings estimates for this measure. PECO notes that it is not possible to replicate the deemed savings values listed in Table 3-88 using the algorithms and default assumptions in the protocol.[[281]](#footnote-281) PECO again recommends changing the cold water temperature to 57F[[282]](#footnote-282) from 55F and revising savings estimates for all water heating related measures in the TRM.[[283]](#footnote-283)

**b. Disposition**

PECO was correct to note that there is an error in the algorithms for the Electric Resistance Water Heaters measure in Section 3.28[[284]](#footnote-284) in the 2013 Tentative TRM. The Commission accepts PECO’s suggestion to revise the algorithms to accurately represent savings. The Commission also noticed that there was a similar error in the algorithms for Heat Pump Water Heaters protocol in Section 3.29.[[285]](#footnote-285) The Commission clarifies that the deemed savings values in Table 3-88 and Table 3-92 are accurate. The Commission has updated the algorithms for both measures.

The Commission rejects PECO’s request to change the cold water temperature to 57° F[[286]](#footnote-286) from 55° F and to revise savings estimates for all water heating related measures in the TRM. The Commission believes that a good approximation of annual average water main temperature is the average annual ambient air temperature estimated at 55° F. In addition, the Commission notes that PECO’s recommendation is only based on Philadelphia, whereas we believe it is important to consider other cities in other EDC service territories to determine PA-specific average water temperature.

**12. Small C/I HVAC Refrigerant Charge Correction**

 The Small C/I HVAC Refrigerant Charge Correction measure was not discussed in the Tentative Order, however, comments related to this protocol are addressed below. This protocol describes the assumptions and algorithms used to quantify energy savings for refrigerant charging on packaged AC units and heat pumps operating in small commercial applications.

**a. Comments**

PECO recommends using SEER and HSPF for energy calculations under 65,000 Btu/hr and EER and COP for large systems for the Small C&I Refrigerant Charge Correction.[[287]](#footnote-287)

**b. Disposition**

The Commission accepts PECO’s proposal to revise the measure such that SEER and HSPF are used for energy calculations for systems under 65,000 Btu/hr and EER and COP are used for large systems. In addition, we note that there is no source indicated for the efficiency ratings in Table 3-95[[288]](#footnote-288) of the 2013 TRM for EER and HSPF and have been updated them to reflect the correct values listed in Table 3-20.[[289]](#footnote-289) This change will make this measure protocol consistent with the other HVAC protocols in the TRM.

## D. Application of the TRM

 The application of the TRM was not discussed within the Tentative Order, however, related comments are addressed here.

**1. Comments**

 The EAP states that the Commission’s current process for updating and maintaining the TRM is out of sync with the EE&C Plan filing schedule, is financially and administratively burdensome and subjects the EDCs, stakeholders and Commission Staff to costly plan revisions and uncertainty.[[290]](#footnote-290) Duquesne agrees with the comments filed by the EAP.[[291]](#footnote-291) Additionally, the EAP states that the values within the 2013 Tentative TRM differ from those used as assumptions in the SWE’s Electric Energy Efficiency Potential for Pennsylvania Final Report.[[292]](#footnote-292) As such, the EAP questions the fairness of applying a different standard of assumptions to the Phase II EE&C Plans than were used as the basis for the consumption reduction goals approved by the Commission.[[293]](#footnote-293) The EAP and PPL aver that TRM updates should focus on the inclusion of new measures, changes in codes and statutes or corrections in charts and algorithms rather than on revisiting assumptions or parsing studies to determine a new deemed savings value for the existing measures used in approved EE&C Plans.[[294]](#footnote-294) Lastly, the EAP strongly recommends that the Commission continue to update the TRM annually but modify the effective date of the changes to coincide with the beginning of the next phase of EE&C Plans.[[295]](#footnote-295)

FirstEnergy provides similar comments, stating that some of the changes proposed will make certain savings levels relied upon in the Market Potential Study obsolete, leaving the Phase II targets obsolete, as well. FirstEnergy states that it is unclear whether the achievable potentials from the Market Potential Study would still be achievable. FirstEnergy avers that it is unclear whether the 25% increase in acquisition costs within the Market Potential Study will adequately compensate for issues related to the reduction of savings resulting from this TRM update. Lastly, FirstEnergy believes that changes to the TRM that occur during Phase II will undermine the ability of the EE&C Plans to achieve the reduction targets defined by the Commission.[[296]](#footnote-296) FirstEnergy requests that, with each TRM update, the SWE include a quantitative estimate of the impact of each change on achievable goals and acquisition costs. This will inform the Commission and the EDCs of the impact of the proposed changes on already-existing EE&C Plans.[[297]](#footnote-297)

PPL maintains the legal arguments presented[[298]](#footnote-298) relative to the Commission’s use of the TRM to modify PPL’s EE&C Plan and the potential adverse effect that the TRM process could have on an EDC’s compliance with Act 129.[[299]](#footnote-299) PECO requests that the 2013 TRM serve as the TRM for the entirety of Phase II. PECO believes that additional updates during Phase II would be unlikely to significantly improve the TRM, but would impact EDC savings forecasts and potentially EDC compliance with consumption reduction goals.[[300]](#footnote-300)

**2. Disposition**

 Through the entirety of Phase I, 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.”[[301]](#footnote-301) 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.[[302]](#footnote-302)

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.

In the Phase II Implementation Order, the Commission maintained the same position regarding TRM updates during the Phase II timeframe. Specifically, 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.[[303]](#footnote-303)

The Commission maintains this position in this proceeding. While the EAP, FirstEnergy, PECO and PPL all provided comments on this issue, those comments focus on how the update affects their ability to attain their consumption reduction goal. The Commission is confident that the 25% increase in acquisition costs that the SWE included in its Market Potential Study will aid in accounting for the changes included within this and future updates to the TRM. We have confidence in the SWE’s methodology and expertise in this matter and, as such, disagree with the EAP and the EDCs regarding the EDCs’ possible inability to meet the consumption reduction targets, as outline in the Phase II Implementation Order.

# 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 PEG and 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 2013 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, 2013.

 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 a notice of this Order and 2013 version of the Technical Reference Manual with the Legislative Reference Bureau for publication in the *Pennsylvania Bulletin*.

 4. That this Order and the 2013 Technical Reference Manual update, as well its appendices by published on the Commission’s website.



**BY THE COMMISSION**

Rosemary Chiavetta

Secretary

(SEAL)

ORDER ADOPTED: December 20, 2012

ORDER ENTERED: December 20, 2012

1. *See* 73 P.S. §§ 1648.1-1648.8 and 66 Pa. C.S. § 2814. [↑](#footnote-ref-1)
2. Order entered on October 3, 2005, at Docket No. M-00051865 (October 3, 2005 Order). [↑](#footnote-ref-2)
3. As of August 11, 2011, the Bureau of CEEP was eliminated and its functions and staff transferred to the newly created Bureau of Technical Utility Services. *See Implementation of Act 129 of 2008; Organization of Bureaus and Offices*, Final Procedural Order, entered August 11, 2011, at Docket No. M-2008-2071852, at page 4. [↑](#footnote-ref-3)
4. *See* October 3, 2005 Order at page 13. [↑](#footnote-ref-4)
5. *See Energy Efficiency and Conservation Program* Implementation Order at Docket No. M-2008-2069887, (Phase I Implementation Order), at page 13, entered January 16, 2009. [↑](#footnote-ref-5)
6. *Id*. [↑](#footnote-ref-6)
7. *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)
8. *Id*. at pages 17 and 18. [↑](#footnote-ref-8)
9. *See Energy Efficiency and Conservation Program* Implementation Order, at Docket No. M-2012-2289411, (*Phase II Implementation Order*), entered August 3, 2012, at page 71. [↑](#footnote-ref-9)
10. *Id*. at page 75. [↑](#footnote-ref-10)
11. The PEG is chaired by Commission Staff 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)
12. The TWG is chaired by Commission Staff 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)
13. The Commission held a TWG meeting on August 7, 2012, 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)
14. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual Update*, Tentative Order at Docket No. M‑00051865, entered February 2, 2010. [↑](#footnote-ref-14)
15. *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. [↑](#footnote-ref-15)
16. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual Update*, Tentative Order at Docket No. M‑00051865, entered November 24, 2010. [↑](#footnote-ref-16)
17. *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, (2011 TRM), entered February 28, 2011. [↑](#footnote-ref-17)
18. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2012 Update*, Tentative Order at Docket No. M‑00051865, entered September 23, 2011. [↑](#footnote-ref-18)
19. *See 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. [↑](#footnote-ref-19)
20. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2013 Update*, Tentative Order, entered on September 13, 2013, at Docket No. M-2012-2313373 (Tentative Order). [↑](#footnote-ref-20)
21. <http://www.pabulletin.com/secure/data/vol42/42-39/index.html> [↑](#footnote-ref-21)
22. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2013 Update*, Secretarial Letter at Docket No. M-2012-2313373, served November 9, 2012. [↑](#footnote-ref-22)
23. NHT/PHFA Comments at 2. [↑](#footnote-ref-23)
24. FirstEnergy Reply Comments at 3. [↑](#footnote-ref-24)
25. *See* Section 1.17, page 10, of the 2013 TRM. [↑](#footnote-ref-25)
26. *See* Section 3.24, page 288, of the 2013 TRM. [↑](#footnote-ref-26)
27. *See* Section 1.16, page 9, of the 2013 TRM. [↑](#footnote-ref-27)
28. KEEA Comments at 2. [↑](#footnote-ref-28)
29. FirstEnergy Reply Comments at 2; PECO Reply Comments at 4. [↑](#footnote-ref-29)
30. *Ex ante* savings are also known as “claimed savings” and result directly from completed program-related actions taken by participants. *Ex post* savings are also known as “verified savings” and are based on an independent assessment of the reliability of the *ex-ante* savings. [↑](#footnote-ref-30)
31. CLEAResult Comments at 3. [↑](#footnote-ref-31)
32. CLEAResult Comments at 4. [↑](#footnote-ref-32)
33. KEEA Comments at 9. [↑](#footnote-ref-33)
34. *See* Appendix A, page 335, of the 2013 TRM. [↑](#footnote-ref-34)
35. PPL Comments at 22. [↑](#footnote-ref-35)
36. PPL Comments at 23. [↑](#footnote-ref-36)
37. *See* Section 2.30, page 128, of the 2013 TRM. [↑](#footnote-ref-37)
38. *See 2012 Total Resource Cost (TRC) Test*, Final Order, (2013 TRC Test Order) at Docket No. M-2012-2300653, entered August 30, 2012, at pages 15 and 16. [↑](#footnote-ref-38)
39. *See* Appendix B, page 339, of the 2013 TRM. [↑](#footnote-ref-39)
40. PPL Comments at 23. [↑](#footnote-ref-40)
41. *See* Section 2.1.1, pages 15 and 16, Table 2-1, of the 2012 TRM. [↑](#footnote-ref-41)
42. *See* Section 2.1, page 15, Table 2-1, of the 2012 TRM. [↑](#footnote-ref-42)
43. *See* Section 2.5, page 27, Table 2-6, of the 2012 TRM. [↑](#footnote-ref-43)
44. *See* Section 2.11, page 48, Table 2-17, of the 2012 TRM. [↑](#footnote-ref-44)
45. *See* Section 2.17, page 69, Table 2-24, of the 2012 TRM. [↑](#footnote-ref-45)
46. *See* Section 2.20, page 84, Table 2-32, of the 2012 TRM. [↑](#footnote-ref-46)
47. *See* Section 2.21, page 89, Table 2-34, of the 2012 TRM. [↑](#footnote-ref-47)
48. KEEA Comments at 3. [↑](#footnote-ref-48)
49. FirstEnergy Reply Comments at 4. [↑](#footnote-ref-49)
50. PECO Reply Comments Appendix A at 1. [↑](#footnote-ref-50)
51. PECO Comments Appendix A at 1. [↑](#footnote-ref-51)
52. *See* Section 2.1.1, page 12, of the 2011 TRM. [↑](#footnote-ref-52)
53. PPL Comments at 3 and 4. [↑](#footnote-ref-53)
54. KEEA Comments at 2. [↑](#footnote-ref-54)
55. ACCA, “Verifying ACCA Manual S Procedures,” <http://www.acca.org/Files/?id=67>. [↑](#footnote-ref-55)
56. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2012 Update*, Order at Docket No. M‑00051865, entered December 16, 2011, at page 41. [↑](#footnote-ref-56)
57. KEEA Comments at 2. [↑](#footnote-ref-57)
58. KEEA Comments at 2 and 3. [↑](#footnote-ref-58)
59. New Jersey Board of Public Utilities, *New Jersey Clean Energy Program Protocols to Measure Resource Savings*, July 2011. [↑](#footnote-ref-59)
60. Northeast Energy Efficiency Partnerships, Inc., “Benefits of HVAC Contractor

Training,” (February 2006): Appendix C Benefits of HVAC Contractor Training: Field

Research Results 03-STAC-01. Page 18. [↑](#footnote-ref-60)
61. KEEA Comments at 3. [↑](#footnote-ref-61)
62. KEEA Comments at 4. [↑](#footnote-ref-62)
63. *See* 42 U.S.C.A. § 6295(i) (West Supp. 2011) and 10 C.F.R. § 430.32(x) (2011). [↑](#footnote-ref-63)
64. *See* Section 2.26, pages 106-109, of the 2012 TRM. [↑](#footnote-ref-64)
65. *See* pages 21-29 of the 2011 Mid-Atlantic TRM. [↑](#footnote-ref-65)
66. *See* Section 2.6, page 36, Table 2-14, of the 2012 TRM. [↑](#footnote-ref-66)
67. *See* Section 2.35, page 136, Table 2-58, of the 2012 TRM. [↑](#footnote-ref-67)
68. PECO Comments Appendix at 10. [↑](#footnote-ref-68)
69. U.S. EPA, *Next Generation Lighting Programs: Opportunities to Advance Efficient Lighting for a Cleaner
Environment*, October 2011. Available at <http://www.energystar.gov/ia/partners/manuf_res/downloads/lighting/EPA_Report_on_NGL_Programs_for_508.pdf> [↑](#footnote-ref-69)
70. PECO Comments Appendix at 10. [↑](#footnote-ref-70)
71. *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, entered December 16, 2011, at page 45. (2012 TRM Final Order) [↑](#footnote-ref-71)
72. FirstEnergy Comments at 5. [↑](#footnote-ref-72)
73. PECO Comments Appendix at 9. [↑](#footnote-ref-73)
74. PECO Comments Appendix at 9 and 10. [↑](#footnote-ref-74)
75. *See* Section 2.25, pages 100-105, of the 2012 TRM. [↑](#footnote-ref-75)
76. *See* Table 2-48, page 110, of the 2013 Tentative TRM. [↑](#footnote-ref-76)
77. PECO Comments Appendix at 5. [↑](#footnote-ref-77)
78. PECO Comments Appendix at 7. [↑](#footnote-ref-78)
79. PECO Comments Appendix at 8. [↑](#footnote-ref-79)
80. PECO Comments Appendix at 8. [↑](#footnote-ref-80)
81. *See* Table 2-59, page 123, of the 2013 Tentative TRM. [↑](#footnote-ref-81)
82. PECO Comments Appendix at 8. [↑](#footnote-ref-82)
83. PECO Comments Appendix at 8. [↑](#footnote-ref-83)
84. *See* Section 2.25, pages 102-104, Table 2-40 and Table 2-41, of the 2012 TRM. [↑](#footnote-ref-84)
85. *See* Table 2-45, page 108, of the 2013 Tentative TRM. [↑](#footnote-ref-85)
86. *See* Table 2-47, page 109, of the 2013 Tentative TRM. [↑](#footnote-ref-86)
87. *See* Table 2-50, page 115, of the 2013 Tentative TRM. [↑](#footnote-ref-87)
88. PECO Comments Appendix at 5 and 6. [↑](#footnote-ref-88)
89. PECO Comments Appendix at 6. [↑](#footnote-ref-89)
90. PECO Comments Appendix at 6 and 7. [↑](#footnote-ref-90)
91. PECO Comments Appendix at 7. [↑](#footnote-ref-91)
92. PECO Comments Appendix at 9. [↑](#footnote-ref-92)
93. *See* Table 2-65, page 127, of the 2013 Tentative TRM. [↑](#footnote-ref-93)
94. *See* Table 2-67, page 127, of the 2013 Tentative TRM. [↑](#footnote-ref-94)
95. PECO Comments Appendix at 9. [↑](#footnote-ref-95)
96. U.S. Department of Energy. 10 CFR Parts 429 and 430. *Energy Conservation Program: Energy Conservation Standards for Residential Clothes Washers*. Direct Final Rule. [↑](#footnote-ref-96)
97. Federal Standards: U.S. Department of Energy. *Federal Register*. 164th ed. Vol. 76, August 24, 2011. [↑](#footnote-ref-97)
98. *Id*. [↑](#footnote-ref-98)
99. ENERGY STAR standards: *ENERGY STAR Program Requirements Product Specification for Room Air Conditioners, Eligibility Criteria Version 3.0*. June 22, 2012. [↑](#footnote-ref-99)
100. *See* Section 2.26, page 114, of the 2013 Tentative TRM. [↑](#footnote-ref-100)
101. *See* Section 2.27, page 119, of the 2013 Tentative TRM. [↑](#footnote-ref-101)
102. *See* Section 2.28, page 122, of the 2013 Tentative TRM. [↑](#footnote-ref-102)
103. *See* Section 2.29, page 124, of the 2013 Tentative TRM. [↑](#footnote-ref-103)
104. PECO Comments Appendix at 7 and 8. [↑](#footnote-ref-104)
105. The CA 2004-05 and 2006-08 regression models can be found within their respective evaluation reports at [www.calmac.org](http://www.calmac.org). [↑](#footnote-ref-105)
106. See 2012 TRM Final Order at page 48. [↑](#footnote-ref-106)
107. *See*, U.S. Department of Energy, draft Uniform Methods Project protocol titled “Refrigerator Recycling Evaluation Protocol”, prepared by Doug Bruchs of the Cadmus Group, July 2012,

<http://ump.pnnl.gov/showthread.php/4902-Refrigerator-Recycling-Evaluation-Protocol>. (US DOE Uniform Methods Project). *See also*, 2009-2010 Pacific Power/Rocky Mountain Power Impact Evaluations - PacifiCorp has impact evaluations for CA, ID, UT, WA, and WY that contain an earlier version of the multi-state Appliance Recycling Program regression models for both refrigerators and freezers. Commission staff and the SWE reviewed the report for the State of Washington, but all states include the same models and are publicly available online.

<http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/WA_2011_SYLR_Final_Report.pdf>. *See also*, 2010 Ontario Power Authority Impact Evaluation - This evaluation report contains a regression equation for annual consumption for refrigerators only.

<http://www.powerauthority.on.ca/sites/default/files/new_files/2010/2010%20Residential%20Great%20Refrigerator%20Roundup%20Program%20Evaluation.pdf>. See page 10 for the regression equation. *See also*, Cadmus Memo - August 20, 2012 Technical Memo from the Cadmus Group to the Michigan Evaluation Working Group on the topic of Appliance Recycling Measure Savings Study. This memo summarizes research on the energy savings of recycled refrigerators and freezers conducted by The Cadmus Group, Inc. and Opinion Dynamics (together known as the evaluation team) on behalf Consumers Energy (Consumers) and DTE Energy (DTE). This memo provides an overview of the research conducted and Cadmus’ recommendations for deemed per-unit energy and demand savings values for affected measures in the Michigan Energy Measures Database (MEMD). [↑](#footnote-ref-107)
108. Rounding differences have been accounted for by providing deemed savings values rounded to the nearest kWh. [↑](#footnote-ref-108)
109. The average annual unit energy consumption of participating refrigerators is 967 kWh based on the PY3 data. [↑](#footnote-ref-109)
110. The average refrigerator was plugged in 96.9% of the year based on PY3 data. [↑](#footnote-ref-110)
111. See U.S. DOE Uniform Methods Project. [↑](#footnote-ref-111)
112. Average values used for each independent variable in the regression equation are based upon the entire fleet of refrigerators for all Pennsylvania EDCs removed during Act 129 PY3. [↑](#footnote-ref-112)
113. Rounding differences have been accounted for by providing deemed savings values rounded to the nearest kWh. [↑](#footnote-ref-113)
114. *See* Cadmus Memo - August 20, 2012 Technical Memo from the Cadmus Group to the Michigan Evaluation Working Group on the topic of Appliance Recycling Measure Savings Study. This memo summarizes research on the energy savings of recycled refrigerators and freezers conducted by The Cadmus Group, Inc. and Opinion Dynamics (together known as the evaluation team) on behalf Consumers Energy (Consumers) and DTE Energy (DTE). This memo provides an overview of the research conducted and Cadmus’ recommendations for deemed per-unit energy and demand savings values for affected measures in the Michigan Energy Measures Database (MEMD) (Cadmus Memo). *See also*, 2009-2010 Pacific Power/Rocky Mountain Power Impact Evaluations - PacifiCorp has impact evaluations for CA, ID, UT, WA, and WY that contain an earlier version of the multi-state Appliance Recycling Program regression models for both refrigerators and freezers. Commission staff and the SWE reviewed the report for the State of Washington, but all states include the same models and are publicly available online

<http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/WA_2011_SYLR_Final_Report.pdf>. *See also*, 2010 Ontario Power Authority Impact Evaluation - This evaluation report contains a regression equation for annual consumption for refrigerators only (the freezer sample was too small).

<http://www.powerauthority.on.ca/sites/default/files/new_files/2010/2010%20Residential%20Great%20Refrigerator%20Roundup%20Program%20Evaluation.pdf>. See page 10 for the regression equation. [↑](#footnote-ref-114)
115. The average freezer was plugged in 98.5% fo the year based on PY3 data. [↑](#footnote-ref-115)
116. See Cadmus Memo. [↑](#footnote-ref-116)
117. Average values used for each independent variable in the regression equation are based upon the entire fleet of refrigerators for all Pennsylvania EDCs removed during Act 129 PY3. [↑](#footnote-ref-117)
118. PPL Comments at 5-6. [↑](#footnote-ref-118)
119. PPL Comments at 6. [↑](#footnote-ref-119)
120. PPL Comments at 8. [↑](#footnote-ref-120)
121. PECO Comments Appendix at 3. [↑](#footnote-ref-121)
122. KEEA Comments at 8. [↑](#footnote-ref-122)
123. The 2012 Residential Baseline Study can be found on the Commission’s website at <http://www.puc.state.pa.us/filing_resources/issues_laws_regulations/act_129_information.aspx>. [↑](#footnote-ref-123)
124. *See 2012 Residential Baseline Study*, Section 4.7.1 – Refrigerators/Freezers. [↑](#footnote-ref-124)
125. *See Responsible Appliance Disposal Program – 2011 Annual Report*, U.S. Environmental Protection Agency, Docket No. EPA-430-K-12-003, September 2012. This report can be found at - <http://www.epa.gov/rad/downloads/RAD_2011_Annual_Report.pdf>. [↑](#footnote-ref-125)
126. *See Phase II Implementation Order* at 82. [↑](#footnote-ref-126)
127. Energy Conservation Program for Consumer Products: Test Procedure for Water Heaters”, Federal Register / Vol. 63, No. 90, at page 25996. [↑](#footnote-ref-127)
128. *Id.* at pages 26005 and 26006. [↑](#footnote-ref-128)
129. U.S. DOE EERE Water Heaters Technical Support Document from January 17, 2001, Final Rule, Chapter 9: Life-Cycle Cost Analysis, at pages 9-14. [↑](#footnote-ref-129)
130. *Baseline Results and Methodology of the Consumer Sub-Group Analysis for Residential Water Heater Efficiency Standards*, Submitted to U.S. DOE, October 1998. [↑](#footnote-ref-130)
131. Thomas, M. et al. “A New Study of Hot Water Use in Canada” Natural Resources Canada. Presented at ASHRAE Winter Meeting, Las Vegas, NV (2011). [↑](#footnote-ref-131)
132. *See* Section 2.3, page 22, Table 2-2, of the 2012 TRM. [↑](#footnote-ref-132)
133. *See* Section 2.6, page 32, Table 2-12, of the 2012 TRM. [↑](#footnote-ref-133)
134. *See* Section 2.14, page 58, Table 2-22, of the 2012 TRM. [↑](#footnote-ref-134)
135. *See* Section 2.15, page 62, of the 2012 TRM. [↑](#footnote-ref-135)
136. *See* Section 2.18, page 74, Table 2-26, of the 2012 TRM. [↑](#footnote-ref-136)
137. *See* Section 2.19, page 78, Table 2-29, of the 2012 TRM. [↑](#footnote-ref-137)
138. PECO Comments Appendix A at 1. [↑](#footnote-ref-138)
139. PECO Comments Appendix A at 1. [↑](#footnote-ref-139)
140. *See* Section 7.4.4, page 412, of the 2012 Illinois TRM. [↑](#footnote-ref-140)
141. *Id*., page 413. [↑](#footnote-ref-141)
142. *See* Section 2.9, page 42, Table 2-16, of the 2012 TRM. [↑](#footnote-ref-142)
143. *See* Section 7.4.4, page 414, of the 2012 Illinois TRM. [↑](#footnote-ref-143)
144. *Id.*, page 414. [↑](#footnote-ref-144)
145. PECO Comments Appendix A at 2. [↑](#footnote-ref-145)
146. *See* Section 2.24, page 95, of the 2012 TRM. [↑](#footnote-ref-146)
147. *Id*. [↑](#footnote-ref-147)
148. *Id.* [↑](#footnote-ref-148)
149. KEEA Comments at 9 and 10. [↑](#footnote-ref-149)
150. PECO Comments Appendix A at 3-5. [↑](#footnote-ref-150)
151. KEEA Comments at 4. [↑](#footnote-ref-151)
152. PECO Reply Comments Appendix A at 1. [↑](#footnote-ref-152)
153. *See* Table 2-6, page 28, of the 2013 Tentative TRM. [↑](#footnote-ref-153)
154. PECO Comments Appendix A at 2. [↑](#footnote-ref-154)
155. *See* Section 2.6, page 31, of the 2013 Tentative TRM. [↑](#footnote-ref-155)
156. KEEA Comments at 4-5. [↑](#footnote-ref-156)
157. PECO Reply Comments Appendix A at 1. [↑](#footnote-ref-157)
158. KEEA Comments at 5. [↑](#footnote-ref-158)
159. *See* Section 2.9, page 41, of the Draft 2013 TRM. [↑](#footnote-ref-159)
160. PECO Comments Appendix A at 2. [↑](#footnote-ref-160)
161. KEEA Comments at 5. [↑](#footnote-ref-161)
162. As used by PECO. This type of program offers incentives to manufacturers to reduce the incremental cost of an efficient measure. PECO Reply Comments Appendix A at 1 and 2. [↑](#footnote-ref-162)
163. PECO Reply Comments Appendix A at 1 and 2. [↑](#footnote-ref-163)
164. KEEA Comments at 5. [↑](#footnote-ref-164)
165. KEEA Comments at 5 and 6. [↑](#footnote-ref-165)
166. PECO Reply Comments at 2. [↑](#footnote-ref-166)
167. PECO Comments Appendix A at 2. [↑](#footnote-ref-167)
168. *See Electricity Savings Opportunities for Home Electronics and Other Plug-In Devices in Minnesota Homes*. Prepared by Energy Center of Wisconsin. ECW Report Number 257-1. May 2010. [↑](#footnote-ref-168)
169. KEEA Comments at 6. [↑](#footnote-ref-169)
170. KEEA Comments at 6. [↑](#footnote-ref-170)
171. PECO Reply Comments at 2. [↑](#footnote-ref-171)
172. PECO Comments Appendix A at 3. [↑](#footnote-ref-172)
173. PECO Comments Appendix A at 3. [↑](#footnote-ref-173)
174. KEEA Comments at 5 and 6. [↑](#footnote-ref-174)
175. PECO Reply Comments Appendix A at 2. [↑](#footnote-ref-175)
176. KEEA Comments at 7. [↑](#footnote-ref-176)
177. PECO Reply Comments Appendix A at 2. [↑](#footnote-ref-177)
178. KEEA Comments at 7. [↑](#footnote-ref-178)
179. NHT/PHFA Comments at 2. [↑](#footnote-ref-179)
180. FirstEnergy Reply Comments at 3. [↑](#footnote-ref-180)
181. KEEA Comments at 8. [↑](#footnote-ref-181)
182. *Id*. [↑](#footnote-ref-182)
183. PECO Reply Comments Appendix A at 2. [↑](#footnote-ref-183)
184. KEEA Comments at 8. [↑](#footnote-ref-184)
185. PECO Reply Comments Appendix A at 2. [↑](#footnote-ref-185)
186. KEEA Comments at 8. [↑](#footnote-ref-186)
187. PECO Reply Comments Appendix A at 2. [↑](#footnote-ref-187)
188. *Id*. [↑](#footnote-ref-188)
189. KEEA Comments at 8. [↑](#footnote-ref-189)
190. PPL Comments at 22. [↑](#footnote-ref-190)
191. PECO Comments Appendix at 10. [↑](#footnote-ref-191)
192. *Id*. [↑](#footnote-ref-192)
193. *Id*. [↑](#footnote-ref-193)
194. PECO Comments Appendix at 10 and 11. [↑](#footnote-ref-194)
195. PECO Comments Appendix at 1. [↑](#footnote-ref-195)
196. PECO Comments Appendix at 2. [↑](#footnote-ref-196)
197. *Id*. [↑](#footnote-ref-197)
198. PECO Comments Appendix at 11. [↑](#footnote-ref-198)
199. PPL Comments at 22. [↑](#footnote-ref-199)
200. *See* Section 3.2.7, pages 159-160, of the 2012 TRM. [↑](#footnote-ref-200)
201. Small Commercial Contract Group Direct Impact Evaluation Report prepared by Itron for the California Public Utilities Commission Energy Division, February 9, 2010. [↑](#footnote-ref-201)
202. Database for Energy Efficiency Resources (2008 version) - <http://www.deerresources.com/> . [↑](#footnote-ref-202)
203. The Database for Energy Efficiency Resources (DEER) 2011– <http://www.deerresources.com/>. [↑](#footnote-ref-203)
204. PECO Comments at 11. [↑](#footnote-ref-204)
205. PPL Comments at 9-13. [↑](#footnote-ref-205)
206. *Id*. [↑](#footnote-ref-206)
207. *Id.* [↑](#footnote-ref-207)
208. FirstEnergy Reply Comments at 4 and PPL Comments at 10. [↑](#footnote-ref-208)
209. *See* Section 3.2.7, pages 159-160, of the 2012 TRM. [↑](#footnote-ref-209)
210. Small Commercial Contract Group Direct Impact Evaluation Report prepared by Itron for the California Public Utilities Commission Energy Division, February 9, 2010. [↑](#footnote-ref-210)
211. PPL Comments at 13 and 14. [↑](#footnote-ref-211)
212. FirstEnergy Reply Comments at 4. [↑](#footnote-ref-212)
213. *See* Section 3.2.7, page 163, of the 2012 TRM. [↑](#footnote-ref-213)
214. *See* <http://efficiency.lbl.gov/drupal.files/ees/Lighting%20Controls%20in%20Commercial%20Buildings_LBNL-5095-E.pdf>. [↑](#footnote-ref-214)
215. *See* Section 3.2.2, page 151, of the 2012 TRM. [↑](#footnote-ref-215)
216. PECO Comments at 11 and PPL Comments at 15. [↑](#footnote-ref-216)
217. PPL Comments at 15 and 16. [↑](#footnote-ref-217)
218. *See* 2012 TRM Final Order at page 49. [↑](#footnote-ref-218)
219. *See* 42 U.S.C.A. § 6295(g)(8) (West Supp. 2011). [↑](#footnote-ref-219)
220. PPL Comments at 16-18. [↑](#footnote-ref-220)
221. *Id*. [↑](#footnote-ref-221)
222. *See* Section 3.4, page 176, of the 2012 TRM. [↑](#footnote-ref-222)
223. UI and CL&P Program Savings Documentation for 2009 Program Year, United Illuminating Company, September 2008 (2009 Connecticut TRM). [↑](#footnote-ref-223)
224. *See* Section 3.2, pages 172 and 173, of the 2012 TRM. [↑](#footnote-ref-224)
225. PPL Comments at 18. [↑](#footnote-ref-225)
226. *Id*. [↑](#footnote-ref-226)
227. *See* Section 3.3, pages 197 of the 2013 Tentative TRM. [↑](#footnote-ref-227)
228. *See* Section 3.22, page 258, of the 2012 TRM. [↑](#footnote-ref-228)
229. <http://www.nwcouncil.org/energy/rtf/measures/measure.asp?id=95&decisionid=117> [↑](#footnote-ref-229)
230. PECO Comments at 12. [↑](#footnote-ref-230)
231. *Id*. [↑](#footnote-ref-231)
232. *See* Section 3.22, page 284, of the 2013 Tentative TRM. [↑](#footnote-ref-232)
233. PPL Comments at 18 and 19. [↑](#footnote-ref-233)
234. Regional Technical Forum (RTF) as part of the Northwest Power & Conservation Council, Deemed Measures List. Network Computer Power Management, v3.0. [↑](#footnote-ref-234)
235. Network PC Power Management Presentation, Regional Technical Forum, May 4, 2010. [↑](#footnote-ref-235)
236. *See* Section 3.30, page 285, of the 2012 TRM. [↑](#footnote-ref-236)
237. An SVG factor represents the percentage of time that lights are off due to lighting controls relative to the baseline controls system (typically manual switch). [↑](#footnote-ref-237)
238. *See* Section 3.30, page 287, of the 2012 TRM. [↑](#footnote-ref-238)
239. PECO Comments at 14. [↑](#footnote-ref-239)
240. PPL Comments at 19. [↑](#footnote-ref-240)
241. *See* Section 3.30, page 312, of the 2013 Tentative TRM. [↑](#footnote-ref-241)
242. *See* Sections 3.26, page 268, of the 2012 TRM. [↑](#footnote-ref-242)
243. *See* Sections 3.33, page 299, of the 2012 TRM. [↑](#footnote-ref-243)
244. PECO Comments at 12 and 13. [↑](#footnote-ref-244)
245. PPL Comments at 20. [↑](#footnote-ref-245)
246. 2012 Program Year Rhode Island Technical Reference Manual for Estimating Savings from Energy Efficiency Measures. [↑](#footnote-ref-246)
247. Impact and Process Evaluation Final Report for California Urban Water Conservation Council 2004-5 Pre-Rinse Spray Valve Installation Program (Phase 2), SBW Consulting, 2007, Table 3-4, p. 23. [↑](#footnote-ref-247)
248. *Id.* [↑](#footnote-ref-248)
249. *See* Sections 3.31, page 291, of the 2012 TRM. [↑](#footnote-ref-249)
250. EPAct 2005 sets the maximum flow rate for pre-rinse spray valves at 1.6 GPM at 60 pounds per square inch of water pressure when tested in accordance with ASTM F2324-03. This performance standard went into effect January 1, 2006. [↑](#footnote-ref-250)
251. Food Service Technology Center, 12949 Alcosta Blvd., Suite 101, San Ramon, CA 94583. Web address: http://www.fishnick.com/equipment/sprayvalves/, Accessed September 21, 2012. Sprayer by T&S Brass Model JetSpray B-0108 was rated at 1.48 GPM, and tested at 1.51 GPM. [↑](#footnote-ref-251)
252. Global Industrial. Web address: <http://www.globalindustrial.com/g/plumbing/faucets/food-service-faucets/TS-Brass-Pre-Rinse-Hose-Reels>. Listings for 27 models from multiple manufacturers. Highest ratings were 1.42 GPM. Two models by Zurn listed on the summary table at 1.6 GPM were found to be rated at 1.24 GPM upon checking. Accessed September 21, 2012. [↑](#footnote-ref-252)
253. PECO Comments at 14 and 15. [↑](#footnote-ref-253)
254. Federal Energy Management Program (FEMP). Cleanability performance of 26 seconds per plate or less based on ASTM F2324-03: Standard Test Method for Pre-Rinse Spray Valves. Web address: <http://www1.eere.energy.gov/femp/technologies/eep_low-flow_valves.html> Accessed September 21, 2012. [↑](#footnote-ref-254)
255. PECO Comments at 14 and 15. [↑](#footnote-ref-255)
256. CLEAResult Comments at 3. [↑](#footnote-ref-256)
257. Ibid [↑](#footnote-ref-257)
258. See Section 6.2.11, page 109, of the 2012 Illinois TRM [↑](#footnote-ref-258)
259. *See* Sections 3.31, page 318, of the 2013 Tentative TRM. [↑](#footnote-ref-259)
260. *See* Sections 3.26, page 267, of the 2012 TRM. [↑](#footnote-ref-260)
261. PECO Comments at 12 and 13. [↑](#footnote-ref-261)
262. *Id*. [↑](#footnote-ref-262)
263. *Id*. [↑](#footnote-ref-263)
264. PPL Comments at 20. [↑](#footnote-ref-264)
265. *See* Sections 3.26, page 295, of the 2013 Tentative TRM. [↑](#footnote-ref-265)
266. 2011 Program year Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures, October 2010. [↑](#footnote-ref-266)
267. *See* Sections 3.2.5, page 176, of the 2013 Tentative TRM. [↑](#footnote-ref-267)
268. FirstEnergy Comments at 5 and Reply Comments at 5. [↑](#footnote-ref-268)
269. PPL Comments at 21. [↑](#footnote-ref-269)
270. PECO Comments at 11 and 12. [↑](#footnote-ref-270)
271. *Id*. [↑](#footnote-ref-271)
272. PECO Comments at 13. [↑](#footnote-ref-272)
273. *Id.* [↑](#footnote-ref-273)
274. *Id.* [↑](#footnote-ref-274)
275. *Id.* [↑](#footnote-ref-275)
276. *See* Sections 3.27, page 298, of the 2013 Tentative TRM. [↑](#footnote-ref-276)
277. *See* <http://www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers.html>. *See also*, [DOE Technical Support Document, 2009](http://www1.eere.energy.gov/buildings/appliance_standards/residential/clwash_0900_r.html). [↑](#footnote-ref-277)
278. *See* [DOE Technical Support Document, 2009](http://www1.eere.energy.gov/buildings/appliance_standards/residential/clwash_0900_r.html). [↑](#footnote-ref-278)
279. *See* Sections 3.27, page 299, of the 2013 Tentative TRM. [↑](#footnote-ref-279)
280. <http://www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers_snopr_spreadsheets.html>. [↑](#footnote-ref-280)
281. PECO Comments at 14. [↑](#footnote-ref-281)
282. U.S. Department of Energy. Building America Benchmark Program Database. 2010. [↑](#footnote-ref-282)
283. PECO Comments at 14. [↑](#footnote-ref-283)
284. *See* Sections 3.28, page 300, of the 2013 Tentative TRM. [↑](#footnote-ref-284)
285. *See* Sections 3.29, page 305, of the 2013 Tentative TRM. [↑](#footnote-ref-285)
286. U.S. Department of Energy. *Building America Benchmark Program Database.* 2010. [↑](#footnote-ref-286)
287. PECO Comments at 15. [↑](#footnote-ref-287)
288. *See* Sections 3.32, page 322, of the 2013 Tentative TRM. [↑](#footnote-ref-288)
289. *See* Sections 3.6, page 208, of the 2013 Tentative TRM. [↑](#footnote-ref-289)
290. EAP Comments at 2. [↑](#footnote-ref-290)
291. Duquesne Comments at 1. [↑](#footnote-ref-291)
292. *See Electric Energy Efficiency Potential for Pennsylvania Final Report*, prepared by GDS Associates, Inc. and Nexant, Inc., submitted to the Pennsylvania Public Utility Commission on May 10, 2012 (Market Potential Study). [↑](#footnote-ref-292)
293. EAP Comments at 3. [↑](#footnote-ref-293)
294. EAP Comments at 4 and PPL Comments at 1 and 2. [↑](#footnote-ref-294)
295. EAP Comments at 5. [↑](#footnote-ref-295)
296. FirstEnergy Comments at 2 and 3 and Reply Comments at 2 and 3. [↑](#footnote-ref-296)
297. FirstEnergy Comments at 4 and Reply Comments at 4. [↑](#footnote-ref-297)
298. *See, e.g.,* *Petition of PPL Electric Utilities Corporation for Approval of its Energy Efficiency and Conservation Plan* (Order entered October 26, 2009), Docket No. M-2009-2093216; *Petition of PPL Electric Utilities Corporation for Approval of its Energy Efficiency and Conservation Plan* (Order Entered February 17, 2010), Docket No. M-2009-2093216; *Petition of PPL Electric Utilities Corporation for Approval of its Energy Efficiency and Conservation Plan* (Order Entered May 6, 2011), Docket No. M-2009-2093216. [↑](#footnote-ref-298)
299. Specifically, PPL incorporates the legal arguments contained in the “Comments of PPL Electric Utilities Corporation” filed on December 27, 2010 at Docket No. M-00051865, pp. 29-46 (as applicable), and its Petition for Review of the Order approving the 2011 TRM. [↑](#footnote-ref-299)
300. PECO Comments at 1; PECO Reply Comments at 1. [↑](#footnote-ref-300)
301. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2011 Update*, Order at Docket No. M-00051865, entered on February 28, 2011 at 49. *See also, Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2012 Update*, Order at Docket No. M-00051865, entered on December 16, 2011 at 72. [↑](#footnote-ref-301)
302. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2011 Update*, Order at Docket No. M-00051865, entered on February 28, 2011 at 49 and 50. *See also, Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2012 Update*, Order at Docket No. M-00051865, entered on December 16, 2011 at 72. [↑](#footnote-ref-302)
303. *See Phase II Implementation Order* at page 75. [↑](#footnote-ref-303)