BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2012 Update	:	**Docket No. M-00051865**

COMMENTS OF PECO ENERGY COMPANY ON THE PROPOSED UPDATE TO THE TECHNICAL REFERENCE MANUAL

Pursuant to the September 23, 2011 Tentative Order entered by the Pennsylvania Public Utility Commission (the "Commission") in the above-referenced docket, PECO Energy Company ("PECO") hereby submits comments on the Commission's proposed 2012 update to its Technical Reference Manual ("TRM").

I. INTRODUCTION

PECO appreciates the Commission's efforts to complete an updated TRM that will serve as a more effective tool for validating savings and providing support for Act 129 goals. PECO agrees that the Commission should continue to broaden the scope of the TRM to reflect new energy efficiency and conservation ("EE&C") measures being implemented by electric distribution companies ("EDCs"), as well as to clarify and streamline TRM protocols. PECO's general comments in response to the proposed TRM update and key issues identified in the Tentative Order are provided below. A summary of the proposed update and specific, section-by-section comments are attached to this document as Appendix A. Overall, the Company believes that great progress has been made through the TRM update process and looks forward to continued participation in the process.

II. GENERAL COMMENTS

A. Verified Gross Adjustments Should Be Adjusted When Actual Measure Installations Are Greater Or Less Than Stated In Incentive Applications

The TRM update acknowledges that, in many cases, the number of measures installed onsite differs from the number stated in the incentive application. *See* Proposed 2012 TRM Update, Section 1.11.4. The TRM update proposes that when the number of measures found onsite is less than what is stated on the application, the savings will be adjusted downward. *Id.* However, if the number of measures found onsite is greater than stated on the application, the savings will not be adjusted upward. *Id.*

In the context of projects with a high volume of measures (e.g., lighting projects), PECO believes that savings should be adjusted to reflect the actual, onsite measure count – whether that count is above or below the number on the incentive application. Allowing upward adjustments is appropriate because customers make installation decisions on a project basis, not fixture-by-fixture. Generally, a customer will consider overall project cost and total possible incentives when deciding whether to proceed with a project. If the incentives are sufficiently attractive, the project will be completed. Thus, even if a customer initially underestimates the number of measures required for the project, all measures ultimately installed are attributable to the EDC's EE&C plan incentives and should be counted when determining plan savings.

Finally, PECO agrees that measure numbers that are within 5% of the application number do not require savings adjustments. However, the Statewide Evaluator ("SWE") should have the discretion to make savings adjustments if it determines they are appropriate. For example, if all projects of a particular type were found to overstate measure counts by 4.9%, the SWE may determine that savings adjustments are warranted for that type of project.

B. The TRM Should Separately Address The Reporting Of Energy And Demand Savings For Act 129 Compliance Purposes

The TRM update contains a section addressing how transmission and distribution system losses should be accounted for when determining energy and demand savings for total resource cost calculations. *See* Proposed 2012 TRM Update, Section 1.13. Specifically, it provides that an electric line loss factor of 1.11 be applied to both energy and demand savings to gross them up from the customer meter level to system level. *Id.*

PECO believes that the TRM should separately address the reporting of energy and demand savings for Act 129 compliance purposes. In particular, Act 129 describes energy savings targets at the customer level but demand savings at the system level, so the TRM should provide for the reporting of energy savings at the customer meter level and demand savings at the system level (grossed up for line losses). In the compliance context, the electric line loss factor applied to demand savings should be specific to the reporting EDC, and not the statewide value of 1.11. The Company has discussed this position regarding Act 129 compliance reporting with the SWE and understands that the SWE supports this position and the placement of compliance reporting instructions in the TRM. PECO also understands that the SWE is currently developing separate guidance on the compliance reporting issue.

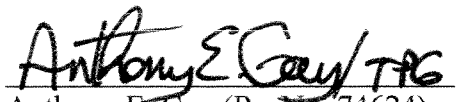
C. PECO Supports The Continued Use Of 3.0 Hours Of Use Per Day For CFLs

The TRM update proposes maintaining 3.0 as the stipulated value for CFL hours of use ("HOU"). PECO agrees with the Commission that 3.0 remains an appropriate value that is well supported by recent research from similar Northeast state markets. *See* Tentative Order, pp. 15-17. The SWE and Technical Working Group should continue to monitor and review HOU studies in relevant markets moving forward.

III. CONCLUSION

PECO appreciates the opportunity to comment on this important matter and believes that the Company's recommended revisions can improve the effectiveness of the Technical Reference Manual.

Respectfully Submitted,



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October 28, 2011

For PECO Energy Company

Appendix A to PECO Comments on the PA PUC 2012 TRM Annual Update Tentative Order and Associated PA Technical Reference Manual Dated June 2012

Submitted to the

Pennsylvania Public Utility Commission

Reference Docket Number: M-00051865

PECO Energy Company

October 28, 2011

Acknowledgements

These report comments were prepared by PECO, with input from Navigant Consulting, Inc. This report is a compilation of comments in response to the PA TRM Order Docket Number: M-00051865.

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General Comments to the Pennsylvania PUC June 2012 Technical Reference Manual

PECO would like to congratulate the Commission, BTUS staff, SWE team and the Technical Working Group (TWG) in the progress made thus far on the development of the Pennsylvania Statewide TRM. The TRM has grown from a list of only a relatively small handful of measures with many discrepancies in the 2009 TRM to a relatively comprehensive statewide TRM in 2012. Although PECO provides many comments below, a majority of these comments are minor refinement/correction of existing measure protocols with only a few more substantive comments. This is significant progress in a relatively short time frame. Application of the TRM has also become more clear leading to easier program implementation for most measures, which in turn leads to more cost effective savings. Similar to this year's comments below, we envision future updates as generally minor modifications to refine savings estimates based on improved knowledge of measure characteristics and Pennsylvania programs. The approval process for Interim TRM Measure Protocols also continues to be useful and important and we encourage its continued availability. We understand there are still some measures which may see major revisions in future program years as the Commission, SWE, EDCs and their evaluators gain more knowledge through evaluations which can better reflect actual measure savings. We continue to encourage this process and look forward to further participation.

Summary of 2012 TRM modifications to Section 2 Residential Measures

The 2012 TRM Order lists 10 new residential measures as included in the 2012 TRM. This was accomplished by adding 8 new protocols in the draft 2012 TRM (one protocol includes two of the listed measures), and adding one measure to an existing protocol ("Appliance Recycling and Replacement with non-ENERGY STAR Refrigerators" added to measure 2.22 Refrigerator / Freezer Recycling and Replacement). The draft 2012 TRM update also includes one additional new protocol not listed in the Order; "ENERGY STAR Office Equipment" is included in the 2012 TRM but was not mentioned in the Order. The complete list of new Residential measures as found during PECO's review is as follows:

2.22 Refrigerator / Freezer Recycling and Replacement (Existing protocol)
- New measure added for "Appliance Recycling and Replacement with non-ENERGY STAR Refrigerators"

2.31 ENERGY STAR Office Equipment
2.32 ENERGY STAR LEDs
2.33 Residential Occupancy Sensors
2.34 Holiday Lights
2.35 Low Income Lighting (FirstEnergy)
2.36 Water Heater Tank Wrap
2.37 Pool Pump Load Shifting
2.38 High Efficiency Two-Speed Pool Pump
2.39 Variable Speed Pool Pumps (with Load Shifting Option)

PECO's review identified the following Residential measures were removed from the 2012 TRM:

- Central A/C and ASHP (Proper Sizing) - from measure 2.1 Electric HVAC

- Central A/C and ASHP (Quality Installation) - from measure 2.1 Electric HVAC

In our estimation the following Residential measures received significant revisions between the 2011 TRM to the 2012 TRM. This does not necessarily correlate to significant savings changes, but the measures are included for a more complete understanding of the level of changes made in the 2012 TRM.

2.1 Electric HVAC
2.11 Programmable Thermostat (previously Programmable Setback Thermostat)
2.21 Ceiling / Attic and Wall Insulation
2.22 Refrigerator / Freezer Recycling and Replacement
2.24 Residential New Construction
2.25 ENERGY STAR Appliances
2.26 ENERGY STAR Lighting

Summary of 2012 TRM modifications to Section 3 Commercial Measures

The Order lists 17 new C&I measures included in the 2012 TRM. This was accomplished by adding 16 new protocols in the draft 2012 TRM, and adding one measure to an existing protocol ("Exterior Lighting for New Construction" added to measure 3.2 Lighting Equipment Improvements). PECO also identifies two additional new measure protocols included in the 2012 TRM which are not listed in the Order. "Geothermal Heat Pumps" and "ENERGY STAR Room Air Conditioner" are included in the 2012 TRM, but were not mentioned in the Order. The complete list of new Commercial measures is as follows:

3.2 Lighting Equipment Improvements (Existing protocol)
- New measure added for "Exterior Lighting for New Construction"

3.17 Strip Curtains for Walk-In Freezers and Coolers
3.18 Geothermal Heat Pumps
3.19 Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons
3.20 ENERGY STAR Electric Steam Cooker
3.21 Refrigeration – Night Covers for Display Cases
3.22 Office Equipment – Network Power Management Enabling
3.23 Refrigeration – Auto Closers
3.24 Refrigeration – Door Gaskets for Walk-in Coolers and Freezers
3.25 Refrigeration – Suction Pipes Insulation
3.26 Refrigeration – Evaporator Fan Controllers
3.27 ENERGY STAR Clothes Washer (Electric Water Heater, Electric Dryer)
3.28 Electric Resistance Water Heaters
3.29 Heat Pump Water Heaters
3.30 LED Channel Signage
3.31 Low Flow Pre-Rinse Sprayers
3.32 Small C/I HVAC Refrigerant Charge Correction
3.33 Refrigeration – Special Doors with Low or No Anti-Sweat Heat for Low Temp Case
3.34 ENERGY STAR Room Air Conditioner

PECO's review identified the following Commercial measures received significant revisions between the 2011 TRM to the 2012 TRM. Similar to the Residential measures, this does not necessarily correlate to

significant savings changes, but the measures are included for a more complete understanding of the level of changes made in the 2012 TRM.

3.2 Lighting Equipment
3.3 Premium Efficiency Motors
3.4 Variable Frequency Drive Improvements
3.6 HVAC Systems

Specific Comments to the Pennsylvania PUC June 2012 Technical Reference Manual

Section 2: Residential Measures

2.1 Electric HVAC

2.1.2 Definition of Terms; Table 2-1: Residential Electric HVAC - References

Comments:

- PECO recommends the stipulated $EFLH_{cool}$ and $EFLH_{heat}$ be further investigated by the TWG for reliability. PECO recommends this measure be specifically reviewed by the TWG for reasonableness of savings estimates, in particular the deemed EFLH. If savings are found to be unreliable, the TWG should develop an interim TRM protocol or TRM addendum which supersedes the 2012 default measure savings. Also see comments under measure 2.20 Fuel Switching: Electric Heat to Gas Heat.

2.3 Efficient Electric Water Heaters

Comments:

- The measure description should be corrected to reflect standard water heater efficiency is 0.904, not 0.9 as currently stated. Measure savings should also be updated to reflect this correction.
- The summary table should be updated to reflect corrected Unit Energy Savings and Unit Peak Demand Reductions as follows:

Energy Factor	Current Unit kWh	Proposed Unit kWh	Current Unit kW	Proposed Unit kW
0.93	133	119	0.0122	0.0109
0.94	175	157	0.0161	0.0144
0.95	217	199	0.0199	0.0183

-

2.3.3 Definition of Terms

Comments:

- EF_{base} in Table 2-2 should be updated to reflect the exact calculation of the federal standard, which is 0.904. This will make this input consistent with other hot water heating measures.

2.3.4 Deemed Savings

Comments:

- Table 2-3: Energy Savings and Demand Reductions should be adjusted as follows:

Energy Factor	Energy Savings (kWh)	Demand Reduction (kW)
0.95	~~217~~199	~~0.0199~~0.0183
0.94	~~175~~157	~~0.0161~~0.0144
0.93	~~133~~119	~~0.0122~~0.0109

2.6 Heat Pump Water Heaters

Comments:

- The measure description should be corrected to reflect standard water heater efficiency is 0.904, not 0.9 as currently stated. Measure savings should also be updated to reflect this correction.
- The summary table should be updated to reflect corrected Unit Energy Savings and Unit Peak Demand Reductions as follows:

Energy Factor	Current Unit kWh	Proposed Unit kWh	Current Unit kW	Proposed Unit kW
2.0	1,914	1896	0.175	0.174
2.3	2,202	2184	0.202	0.200

2.6.1 Eligibility

Comments:

- The first sentence should be corrected to read, "…with Energy Factors of 2.0 to ~~2/3~~2.3."

2.6.3 Definition of Terms

Comments:

- EF_{base} in Table 2-12 should be updated to reflect the exact calculation of the federal standard, which is 0.904. This will make this input consistent with other hot water heating measures.

2.6.5 Deemed Savings

Comments:

- Table 2-13: Energy Savings and Demand Reductions should be adjusted as follows:

Energy Factor	Energy Savings (kWh)	Demand Reduction (kW)
2.3	~~2202~~2184	~~0.202~~0.200
2.0	~~1914~~1896	~~0.175~~0.174

$$\Delta kWh = \frac{ISR \times N_{Persons} \times 365 \times \Delta T \times U_H \times U_E \times Gal \times \%FT \times (\%\ FR) \times (\%\ DD)}{Eff \times \frac{F_{FT}}{home}} \quad 2.11$$

Programmable Thermostat

2.11.2 Definition of Terms; Table 2-17: Residential Electric HVAC Calculation Assumptions

Comments:

- PECO recommends the stipulated $EFLH_{cool}$ and $EFLH_{heat}$ be further investigated by the TWG for reliability. PECO recommends this measure be specifically reviewed by the TWG for reasonableness of savings estimates, in particular the deemed EFLH. If savings are found to be unreliable, the TWG should develop an interim TRM protocol or TRM addendum which supersedes the 2012 default measure savings. Also see comments under measure 2.20 Fuel Switching: Electric Heat to Gas Heat.

2.12 Room AC (RAC) Retirement

2.12.1 Algorithms

Replacement and Recycling Comments:

- The proposed TRM uses a two-part calculation that bases the savings credit on existing unit characteristics during the period of Remaining Useful Life of the unit, and on the minimum Federal appliance standard EER for the period following the RUL. PECO agrees that this proposed approach is reasonable for such instances. As noted in the revised TRM, no EDCs are operating programs in this manner.

2.14 Solar Water Heaters

Comments:

- The measure description should be corrected to reflect standard water heater efficiency is 0.904, not 0.9 as currently stated. Measure savings should also be updated to reflect this correction.
- The summary table should be updated to reflect corrected Unit Energy Savings and Unit Peak Demand Reductions as follows:

Energy Factor	Current Unit kWh	Proposed Unit kWh	Current Unit kW	Proposed Unit kW

1.84	2,106	2,088	0.378	0.376

2.14.3 Definition of Terms

Comments:

- EF_{base} in Table 2-22 should be updated to reflect the exact calculation of the federal standard, which is 0.904. This will make this input consistent with other hot water heating measures.

2.14.4 Deemed Savings

Comments:

- Energy Savings and Demand Reductions should be adjusted as follows:
  $\Delta kWh = 2{,}088$ kWh
  $\Delta kW_{peak} = 0.376$ kW

2.17 Ductless Mini-Split Heat Pumps

2.17.3 Definition of Terms; Table 2-24: DHP – Values and References

Comments:

- PECO recommends the stipulated $EFLH_{cool}$ and $EFLH_{heat}$ be further investigated by the TWG for reliability. PECO recommends this measure be specifically reviewed by the TWG for reasonableness of savings estimates, in particular the deemed EFLH. If savings are found to be unreliable, the TWG should develop an interim TRM protocol or TRM addendum which supersedes the 2012 default measure savings. Also see comments under measure 2.20 Fuel Switching: Electric Heat to Gas Heat.

2.20 Fuel Switching: Electric Heat to Gas Heat

2.20.2 Definition of Terms; Table 2-32: Default values for algorithm terms, Fuel Switching, Electric Heat to Gas Heat

Comments:

- PECO recommends the stipulated $EFLH_{heat}$ be further investigated by the TWG for reliability. In particular $EFLH_{heat}$ appear to be very high for Pennsylvania. When using these values to determine measure savings, the savings appear to be significantly overstated causing PECO discomfort with the savings estimates. If the EFLHheat are in error for this measure, the error likely extends to all measures which use the $EFLH_{heat}$ defaults as well. This includes measure 2.1 Electric HVAC, 2.11 Programmable Thermostat, and 2.17 Ductless Mini-Split Heat pumps. Because these measures are calculating only a relatively small incremental electric savings there is less concern that the savings are significantly overstated, but it is possible that savings are unreliable and should be updated in future TRM updates.
  PECO recommends measure 2.20 be specifically reviewed by the TWG for reasonableness of savings estimates, in particular the deemed $EFLH_{heat}$ values. If savings are found to be unreliable,

the TWG should develop an interim TRM protocol or TRM addendum which supersedes the 2012 default measure savings.

2.25 ENERGYSTAR Appliances

Comments:

- In Table 2.41: Several refrigerators configurations are missing from the TRM including:
  - Bottom-mounted freezer with door ice
  - Refrigerator only – Single Door without ice
  - Refrigerator/Freezer – Single Door

  These configurations are not listed in the ES Calculator, however, the savings could be determined by taking an average savings for the available models listed in the ES Refrigerators Qualified Product List for these three configurations.

2.26 ENERGY STAR Lighting

2.26.1 Algorithms

Comments:

- PECO recommends that the form of the algorithms for kWh and kW savings be made consistent across all standard and specialty CFL measures. We recommend the algorithms for ES Torchieres, ES Indoor Fixtures, ES Outdoor Fixtures and Ceiling Fan with ES Light Fixture be modified to be consistent with the ES CFL Bulbs algorithms. All algorithms should use $Watts_{base}$ minus $Watts_{retrofit}$ to determine the actual measure savings. Default values for the $Watts_{base}$ and $Watts_{retrofit}$ can be provided which show how the savings were determined. This will allow the independent evaluators to determine if the measures reported match the deemed defaults. Currently the displaced watts (delta watts) for standard CFLs are expressed as a difference between a base wattage term and a CFL wattage term, while for specialty CFLs this difference is expressed as a single term in the algorithm.

2.26.2 Definition of Terms

Comments:

- PECO suggests that a source be added as a footnote for Table 2-43 titled: Baseline Wattage by Lumen Output of CFL.

2.29 Home Performance with ENERGY STAR

Comments:

- Since Home Performance with ENERGY STAR is an existing homes program, we recommend the following edit to footnote 87 (additions are shown in italics and underlined):

"[87] A new standard for BESTEST-*EX* *for existing homes* is currently being developed – *status is found at http://www.nrel.gov/buildings/bestest_ex.html*. The existing 1995 standard can be found at http://www.nrel.gov/docs/legosti/fy96/7332a.pdf."

2.32 ENERGY STAR LEDs

Comments:

- The last sentence of the opening paragraph should be removed. There were no earlier TRM protocols for ES LEDs, only interim TRM protocols.

2.32.1 General Service Lamps

Comments:

- Table 2-52 General Service Lamps should be corrected to match the similar Table 2-43 Baseline Wattage by Lumen Output of CFL. The EISA compliance year for 60 watt-equivalent lamps should be changed from 2013 to 2014 similar to Table 2-43. Per the standard 60W changes are effective 1/1/2014.

2.32.3 Definition of Terms

Comments:

- The current definition for CF is incorrect. Revise the definition for coincidence factor, and use it consistently throughout the document.
    - TRM currently shows: CF = Demand Coincidence Factor, percentage of load connected during peak hours
    - Consider revising to: CF = Coincidence Factor, defined as the fraction of the technology demand that is coincident with the utility peak
    - This was also one of PECO's comments on the 2011 TRM update

2.32.4 Measure Life

Comments:

- PECO recommends that reported measure life for reflector CFLs be changed from 13 to either 13.7 or 14. The footnote to the description of measure life notes that all LEDs that qualify for ENERGY STAR have a minimum lifetime of 15,000 hours and that at 3 hours of use per day this equates to 13.7 years.

2.34 Holiday Lights

2.34.1 Eligibility

Comments:

- The last sentence referring to requirements for applicants to receive incentives should be removed along with the following bullet points. This is a program design element, not a measure eligibility requirement and may vary by EDC.

2.34.2 Algorithms

Comments:

- PECO suggests that the reference to cost estimates in the Key Assumptions section be dropped, since there are no other algorithms or comments that refer to cost, and therefore cost estimates are unnecessary.
- PECO recommends that the definition of "# Strands" be modified to say "Number of strands of lights per package" rather than "Number of strands of lights" in order to clarify that a single package of LED holiday lights is the operative unit of the energy savings calculation.
- PECO suggests that the three Weight factor terms be dropped from the Definition of Terms, since these are not used in any algorithm.

2.37 Pool Pump Load Shifting

2.37.3 Definition of Terms

Comments:

- The default value for CF_{pre} is based on a peak period of 2 pm – 6 pm and is based on the coincident percentages for all southern California including desert and coastal areas. Using the peak period of noon to 8 pm, only the inland hourly coincidence percentages, and the approved non-weather dependent Pennsylvania Coincident Peak Demand calculator for all utilities results in an average CF_{pre} value of 0.235 using the same data source[1]. This is primarily due to the high very high coincidence factors in the desert areas in California during peak hours which artificially inflate the value as stated in the draft TRM.

EDC	Weighted Peak CF
Allegheny	0.214
Duquesne	0.224
Met-Ed	0.231
Penelec	0.258
Penn Power	0.253
PECO	0.239
PPL	0.229
Average	**0.235**

[1] Derived from Pool Pump and Demand Response Potential, DR 07.01 Report, SCE Design and Engineering, Table 16

2.38 High Efficiency Two-Speed Pool Pump

2.38.3 Definition of Terms

Comments:

- Baseline kWh are based on a 1.364 kW pump size. Base load should be changed to reflect this value or both should be rounded. Table 2-63 kW_{base} should also be updated to reflect this.
- The default value for CF in Table 2-63 is based on a peak period of 2 pm – 6 pm and is based on the coincident percentages for all southern California including desert and coastal areas. Using the peak period of noon to 8 pm, only the inland hourly coincidence percentages, and the approved non-weather dependent Pennsylvania Coincident Peak Demand calculator for all utilities results in an average CF_{pre} value of 0.235 using the same data source[2]. This is primarily due to the high very high coincidence factors in the desert areas in California during peak hours which artificially inflate the value as stated in the draft TRM.

EDC	Weighted Peak CF
Allegheny	0.214
Duquesne	0.224
Met-Ed	0.231
Penelec	0.258
Penn Power	0.253
PECO	0.239
PPL	0.229
Average	**0.235**

- Table 3-63: High Efficiency Pool and Motor – Two Speed Pump Calculations Assumptions should be updated as recommended below:

Component	Type	Value	Source
kWh_{Base}	Fixed	707 kWh	Unchanged
$kWh_{Two\ Speed}$	Fixed	177 kWh	Unchanged
kW_{Base}	Fixed	1.364 kW	1

[2] Derived from Pool Pump and Demand Response Potential, DR 07.01 Report, SCE Design and Engineering, Table 16

$kW_{Two\ Speed}$	Fixed	0.171 kW	Unchanged
$RHRS_{Base}$	Fixed	518	Unchanged
$RHRS_{Two\ Speed}$	Fixed	1,036	Unchanged
CF	*Fixed*	23.5%	2

Sources:

1. Integration of Demand Response Into Title 20 For Residential Pool Pumps, SCE Design & Engineering; Phase 1: Demand Response Potential DR 09.05.10 Report.
2. Derived from Pool Pump and Demand Response Potential, DR 07.01 Report, SCE Design and Engineering, Table 16.

- Table 2-64: Two-Speed Pool Pump Deemed Savings Values should be updated as recommended below:

Average Annual kWh Savings per Unit	Average Summer Coincident Peak kW Savings per unit
530 kWh	~~0.31~~0.28 kW

2.39 Variable Speed Pool Pumps (with Load Shifting Option)

2.38.3 Definition of Terms

Comments:

- The default value for CF_{pre} is based on a peak period of 2 pm – 6 pm and is based on the coincident percentages for all southern California including desert and coastal areas. Using the peak period of noon to 8 pm, only the inland hourly coincidence percentages, and the approved non-weather dependent Pennsylvania Coincident Peak Demand calculator for all utilities results in an average CF_{pre} value of 0.235 using the same data source[3]. This is primarily due to the high very high coincidence factors in the desert areas in California during peak hours which artificially inflate the value as stated in the draft TRM.

EDC	Weighted Peak CF
Allegheny	0.214
Duquesne	0.224

[3] Derived from Pool Pump and Demand Response Potential, DR 07.01 Report, SCE Design and Engineering, Table 16

Met-Ed	0.231
Penelec	0.258
Penn Power	0.253
PECO	0.239
PPL	0.229
Average	**0.235**

Section 3: Commercial and Industrial Measures

3.2 Lighting Equipment Improvements

3.2.6 Quantifying Annual Hours of Operation

Projects with connected load savings less than 20 kW

Comments:

- As currently written the TRM does not allow for using verified building HOU for building types which are specified in Table 3-4 during the evaluation, even if the hours in Table 3-4 vary significantly from the verified hours. We recommend adding language which allows verified HOU when those hours differ from the stipulated values by more than 10%. This at least allows the evaluation to make appropriate adjustments to the sampled projects which will in turn improves the overall reliability of program savings.

Projects with connected load savings of 20 kW or higher

Comments:

- While we agree with the changes to the metering requirements and determination of HOU, there is still a minor area of confusion. This section now requires metering for projects with connected load savings over 200 kW. It is not clear if this is required for claiming savings or only verifying savings. Add language to clarify the intent of this requirement. Also, how should this metering be done? Is it sufficient to meter one representative fixture in each usage area, or is a 90/20 sample required based on number of fixtures replaced, etc? Add language to clarify this requirement.
- PECO recommends the language of this section should be modified to clarify the EDCs' independent evaluator should use metering data provided by the EDC if the evaluator reviews the data and determines it to be reliable. This is intended to limit the burden placed on a customer if metering is required. Without this language it is conceivable that a customer will be required to accommodate metering from the EDC/implementer, the evaluator, and the SWE, even if they have already provided metering themselves. This would place an undue burden on the customer and would not significantly improve the reliability of savings estimates.
- Although the Commission explained the rationale for removing the requirement for a minimum number of usage groups, it is unclear why Table 3-2 Hours of Use for Usage Groups was removed in the 2012 TRM. While we agree with the removal of the minimum number of usage groups, there is still a requirement for EDCs to determine the appropriate usage groups and associated HOU for each group. The Commission, however, has now removed the stipulated hours for such usage groups and instead refers users to the whole building HOU listed in Table 3-4. We recommend keeping the previous table 3-2 for use when actual HOU for usage groups cannot be readily determined by the implementer or evaluator, but not require their use when more reliable values can be determined. Using whole building HOU as the default for usage groups does not seem appropriate.

3.2.7 Calculation Method Descriptions By Project Classification

New Construction and Building Additions

Comments:

- It is suggested that the specific ASHRAE table numbers (Table 9.5.1 & Table 9.6.1) be moved to foot notes so as to reduce the potential for confusion.
- For clarity we suggest revising the wording of the first paragraph of this section as follows:

  For new construction and building addition projects, savings are calculated using ASHRAE 90.1-2007 to determine the baseline demand (kW_{base}) and the new fixtures' rated wattages as the post-installation demand (kW_{ee}). Pursuant to ASHRAE 90.1-2007, the interior lighting baseline is calculated using either the Building Area Method[4] as shown in Table 3-1, *or the Space-by-Space Method[5] as shown in* Table 3-2. *For exterior lighting the baseline is calculated using the ASHRAE 90.1-2007 Baseline Exterior Lighting Power Densities Table[6] as shown in* Table 3-3. *The new fixture wattages are specified in the Lighting Audit and Design Tool shown in Appendix C.*

- For clarity we suggest revising the wording of the second paragraph of this section as follows:

  CF and IF values are the same as those shown in Table 3-4 and Table 3-5. HOU shall be determined in accordance with Section 3.2.6.

- For clarity we suggest revising the wording of the third paragraph of this section as follows:

  HOU and CF values for dusk-to-dawn lighting is the same as those shown in Table 3-4 *unless shorter hours are required by ASHRAE or the fixtures are demonstrated to operate longer hours (e.g. for signage or in parking garages).*

Prescriptive Lighting Improvements

Comments:

- The Commission stated in the Order in Section E.1.c Determination of Hours of Use and Coincidence Factor (page 24):

  "In addition, the Commission proposes that flexibility be introduced to calculate custom coincidence factors, if hours of operation are determined for a site, using the non-weather dependent coincident peak demand calculator, which calculates demand by weighting time bins according to when the top 100 hours are most likely to occur based on historical data. This is possible for lighting because the load shape in most cases corresponds to the hours of operation."

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[4] ASHRAE 90.1-2007, Table 9.5.1 - Building Area Method

[5] ASHRAE 90.1-2007, Table 9.6.1 - Space-by-Space Method

[6] ASHRAE 90.1-2007, Table 9.4.5 - Baseline Exterior Lighting Power Densities

This flexibility was not added to the language of the TRM. The second paragraph, second sentence directs users to refer to Tables 3-4 and 3-5 for other factors which includes CF. This seems to indicate that these factors must be used. Please add such language to the Prescriptive Lighting Improvements section to allow the flexibility the Commission intended in their comments.

- For clarity we suggest revising the wording of the second paragraph, third sentence as follows and moving it to Section 3.2.6 Quantifying Annual Hours of Operation:

  Note that if HOU is stated and verified by logging, the actual HOU from the resulting site specific lighting use profile should be applied.

- For clarity we suggest moving the second paragraph, last sentence to Section 3.2.6 Quantifying Annual Hours of Operation

Table 3-5: Interactive Factors and Other Lighting Variables

Comments:

- We agree with the temperature definitions for the different space types, however, the table is missing IF values for Freezer spaces from 0F to 32F. Please clarify.

Lighting Control Adjustments

Comments:

- For clarity we suggest revising the wording of the second paragraph, first sentence into 2 sentences as shown:

  If a lighting improvement consists solely of lighting controls, the lighting fixture baseline is defined by the existing fluorescent fixtures with the existing lamps and ballasts. If lighting fixtures are retrofit in conjunction with the controls upgrade, the new fluorescent fixtures, lamps and ballasts are reported using the Lighting Audit and Design Tool shown in Appendix C.

Table 3-10: LED Exit Signs

Comments:

- Cross reference for interactive factors (IF) should both direct reader to Table 3-5, not Table 3-6 as currently shown.

3.3 Premium Efficiency Motors

3.3.4 Evaluation Protocol

Comments:

- We recommend adding language that allows the evaluator to not use metering in the event that the motors in question are constant speed and hours can be easily verified through a building automation system schedule which clearly shows motor run time. For example, if the motors are clearly scheduled to run continuously from 7am to 6pm, Monday through Friday, 52 weeks per

year and are off all other hours, metering is not going to improve the reliability of savings estimates, but will add unnecessary cost.

3.4 Variable Frequency Drive (VFD) Improvements

Comments:

- Clarify the applicability of this measure is for either only commercial space types, or only for those space types listed in Table 3-14.

3.4.1 Algorithms

Comments:

- The energy savings factors and demand savings factors pulled from the Mid-Atlantic TRM, which references the UI and CL&P Program Saving Documentation for 2009 Program Year, are not used in the same algorithm here as they are in their original source. Confirm use of constants before applying to these algorithms.

3.4.3 Description of Calculation Method

Comments:

- Add the word "peak" to the ΔkW term for consistency with section 3.4.1. The sentence should read, "Relative to the algorithms in section (3.4.1), ΔkW_{peak} values will be calculated for each VFD improvement in any project (account number)."

3.5 Variable Frequency Drive (VFD) Improvement for Industrial Air Compressors

3.5.2 Algorithms

Comments:

- Many of PECO's comments on the 2011 Draft TRM were addressed in the Commission's response and final order for 2011. The following comment was not addressed and we believe is still appropriate. From the Comments on 2011 Draft TRM update:

  "Need to apply LF to calculate ΔkW and ΔkW_{peak}. Currently, the LF is only used to calculate kWh ($kWh = 0.129 \times HP \times LF/\eta_{motor} \times RHRS_{base}$). The LF has an impact on kW usage. The algorithm should be adjusted to read:

  $\Delta kW = 0.129 \times HP \times LF/\eta_{motor}$"

3.5.2 Definition of Terms

Comments:

- The coincidence factor is not directly used in the algorithms and therefore can be removed from the list of terms. Instead, the equation uses a fixed coincident peak kW/motor HP of 0.106.

Table 3-18: Variables for Industrial Air Compressor Calculation

Comments:

- The value field for load factor (LF) component currently states "Based on spot metering/nameplate." Recommend changing to be consistent with the definition of load factor to state "Based on spot metering/nameplate or default value (see Definition of Terms)."
- The following comment from the Comments on 2011 Draft TRM update still applies: "The document listed as the source for the two factors (0.129 and 0.106) used in the savings algorithms is a manufacturer's document. The validity of the two factors should be verified and compared to other available sources (e.g., DOE's Compressed Air Challenge and AirMaster)."

3.6 HVAC Systems

3.6.2 Definition of Terms

Comments:

- The definition of "$BtuH_{cool}$" should be modified to say: "Rated cooling capacity of the energy efficient unit in Btu/hour." Currently, the term is in the definition, which could be confusing.
- The definition of "$BtuH_{heat}$" should be modified to say: "Rated cooling capacity of the energy efficient unit in Btu/hour." Currently, the term is in the definition, which could be confusing.

Table 3-21: HVAC Baseline Efficiencies

Comments:

- Match the section names in this table to the titles in the algorithms (e.g., central AC, air-cooled DX, split systems, packaged terminal AC, air source and packaged terminal heat pump).

Table 3-22: Cooling and Heating EFLH for Pennsylvania Cities and Table 3-23

Comments:

- Both tables should refer to the Appendix F: Zip Code Mapping with a footnote. The footnote should state: "A zip code mapping table is located in Appendix F. This table should be used to identify the reference Pennsylvania City for all zip codes in Pennsylvania."

3.7 Electric Chillers

Comments:

- A sentence in the second introduction paragraph could be added for clarification: "Single VFD chillers in a plant with other chillers serving the same loop must follow a site specific custom protocol." (Note: comment from the Comments on 2011 Draft TRM update)

Table 3-25: Chiller Cooling EFLH by Location

Comments:

- Table should refer to the Appendix F: Zip Code Mapping with a footnote. The footnote should state:

  "A zip code mapping table is located in Appendix F. This table should be used to identify the reference Pennsylvania City for all zip codes in Pennsylvania."

3.8 Anti-Sweat Heater Controls

Comments:

- For clarity we suggest revising the wording of the single paragraph introducing this section as follows:

  Anti-sweat heater (ASH) controls measure either the humidity or due point in the store outside of reach-in, glass door refrigerated cases and turn off anti-sweat heaters during periods of low humidity. Without controls, anti-sweat heaters run continuously whether they are necessary or not. ASH controls can also cycle the heating strips to save energy, even during periods of high humidity. The ASH control is applicable to glass doors with heaters, and the savings given below are based on adding controls to doors with uncontrolled heaters.

  Savings are realized from the reduction in energy used by not having the heaters running at all times. In addition, secondary savings result from reduced cooling load on the refrigeration unit when the heaters are off. The savings calculated from the algorithms below is on a per door basis for two temperatures: Refrigerator/Coolers and Freezers. A default value to be used when the case service temperature is unknown is also calculated. Furthermore, impacts are calculated for both a per-door and a per-linear-feet of case unit basis, because both are used for Pennsylvania energy efficiency programs.

Table 3-26 - Anti-Sweat Heater Controls – Values and References

Comments:

- The third item down in the Component column should be "DoorFt" instead of "Unit" so as to maintain consistency with the variable name used in algorithms.

3.10 High-Efficiency Evaporator Fan Motors for Reach-In Refrigerated Cases

Table 3-33 - Variables for High-Efficiency Evaporator Fan Motor

Comments:

- Three of the four sources for this table seem to have been deleted or moved.

Implementation of the following two points depends on the contents of the missing "source 2."

- The compressor COP degrade factor cited as 0.98 does not mesh with the adjustment factor of 0.80 suggested by source 1 under Table 3-33.

  - Given the tendency for refrigeration components to degrade over time (i.e. damaged fins, ice build-up, refrigerant leaks, etc.), a COP degradation factor of 0.8 seems reasonable.
  - Making this addition will increase savings, but necessitate an update to default savings provided in tables 3-35 through 3-38.
- If this change of DG is incorporated in to this TRM, then the paragraph just before the section 3.10 algorithms should include a sentence to the effect of:

  "The system efficiency degradation factor (DG) is used to convert the rated COP of the compressor to that of the refrigeration system as a whole."

3.11 High-Efficiency Evaporator Fan Motors for Walk-in Refrigerated Cases

Comments:

- See comments related to the COP degradation factor of 0.8 as noted in the previous section (3.10)

3.13 Smart Strip Plug Outlets

Comments:

- We recommend this measure be investigated further to establish if savings are being accurately stated. The measure assumes a coincidence factor of 0.5 to estimate peak demand savings, however, most office equipment will be operating during the peak coincident hours and hence peak demand savings may differ from the estimated values. The key assumptions should be investigated further.

3.16 Wall and Ceiling Insulation

3.16.1 - Eligibility

Comments:

- For clarity we suggest revising the wording of this section as follows:

  This measure applies to non-residential buildings heated and/or cooled using electricity. Upon project completion, existing construction buildings are required to meet or exceed the code requirement. New construction buildings receive credit only for insulation levels that exceed the minimum code requirement. Eligibility may vary by PA EDC; savings from chiller-cooled buildings are not included.

3.17 Strip Curtains for Walk-In Freezers and Coolers

3.17.2 Algorithms

Comments:

- In the sentence just before the equation for ΔkWh, "find more accurate assumptions" should be edited to "provide more reliable site specific inputs"

3.18 Geothermal Heat Pumps

3.18.2 Algorithms

Comments:

- For consistency with other measures, consider removing the summation (Σ) in the equations.

Table 3-62: Geothermal Heat Pump– Values and References

Comments:

- The term "$CAPY_{cool}$," which is included in the values field for "$BtuH_{heat}$" is not defined in the Definition of Terms or the values and references table.
- The references to Table 3-20 and Table 3-21 should be changed to reference Table 3-65.
- The source for the component "η_{eepump}" should be changed from "See Table 2" to read "See Table 3-64."

Table 3-63: Federal Minimum Efficiency Requirements for Motors and Table 3-64: Ground Loop Pump Efficiency

Comments:

- Sources should be added to Table 3-63 and Table 3-64.

3.19 Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons

3.19.3 Definition of Terms

Comments:

- Add "CF" to the definition of terms with the definition used for other measures: "Demand Coincidence Factor (See Section 1.4)"

Table 3-66: DHP – Values and References

Comments:

- Spell out the acronyms used in Table 3-66: DHP – Values and References for clarity.

Table 3-67: Cooling EFLH for Pennsylvania Cities and Table 3-68: Heating EFLH for Pennsylvania Cities

Comments:

- Both tables should refer to the Appendix F: Zip Code Mapping with a footnote. The footnote should state:

  "A zip code mapping table is located in Appendix F. This table should be used to identify the reference Pennsylvania City for all zip codes in Pennsylvania."

3.21 Refrigeration – Night Covers for Display Cases

Comments:

- We recommend the variable currently listed as "H" be relabeled "HOU" to be more descriptive and prevent possible confusion with case height.

3.22 Office Equipment – Network Power Management Enabling

Comments:

- Edit table title by adding the measure name "Network Power Controls," such that the full title becomes: "Table 3-73: Network Power Controls, Per Unit Summary Table"

3.23 Refrigeration – Auto Closers

Comments:

- Auto closers also apply to reach-in units. An expansion of applicability in to next year's TRM should be considered.

3.23.2 *Algorithms*

Comments:

- Currently written as "Cooling Degree Days (CDDs).." Remove extra punctuation.

3.24 Refrigeration – Door Gaskets for Walk-in Coolers and Freezers

Comments:

- Refrigerated door gaskets also apply to reach-in units. An expansion of applicability in to next year's TRM should be considered.
- For clarity we suggest revising the wording of the first paragraph of this section this section as follows:

> *The following protocol is for the measurement of energy and demand savings applicable to commercial refrigeration and the replacement of worn-out gaskets with new better-fitting gaskets. Applicable gaskets include those located on the doors of walk-in coolers and freezers.*
>
> *Tight fitting gaskets inhibit infiltration of warm, moist air into the cold refrigerated space, thereby reducing the cooling load. Aside from the direct reduction in cooling load, the associated decrease in moisture entering a refrigerated space also helps prevent frost on the cooling coils. Frost build-up adversely impacts the coil's heat transfer effectiveness, reduces air passage (lowering heat transfer efficiency), and increases energy use during the defrost cycle. Therefore, replacing defective door gaskets reduces compressor run time and improves the overall effectiveness of heat removal from a refrigerated cabinet.*

3.25 Refrigeration – Suction Pipes Insulation

3.25.2 Algorithms

Comments:

- Consider removing the following text in the first paragraph. It applies to a different source than the savings data in Table 3-82 and does not seem relevant to the savings data because the data is split by coolers (low-temperature) and freezers (medium-temperature).
  "According to a survey carried out in the study, approximately 70% of refrigerated cases in audited grocery stores are medium temperature cases and 30% are low-temperature cases. As a result, the energy savings shown in this report are the weighted average energy savings (70% medium-temperature, 30% low-temperature)."

Table 3-82: Insulate Bare Refrigeration Suction Pipes Savings per Linear Foot

Comments:

- Consider changing the "Coolers" heading to "Medium-Temperature" and the "Freezers" heading to "Low-Temperature" to be more general to lines going to all refrigerated equipment including walk-in boxes and cases. The measure does not seem to be available for only coolers and freezers.
- Table should refer to the Appendix F: Zip Code Mapping with a footnote. The footnote should state:
  "A zip code mapping table is located in Appendix F. This table should be used to identify the reference Pennsylvania City for all zip codes in Pennsylvania."

3.26 Refrigeration – Evaporator Fan Controllers

Comments:

- A majority of this section appears to be pulled from the Massachusetts Technical Reference Manual, October 2010. Cite the Massachusetts Technical Reference Manual in the beginning of the section.
- It is important to note that different evaporator fan controller system operate differently. Some add a smaller fan to cycle the air while the evaporator fans are off, some add a variable frequency drive to the fan motor, while others will cycle the fans on and off to maintain air circulation. The equations specified in this section are for fans that are turned off and/or cycled. A sentence should be added to the introduction to explain the applicability of these equations.
- The following statement in the first paragraph should be deleted or modified as it does not reflect the actual control for evaporator fans for these equations. The fans do turn off completely, but can cycle to maintain de-stratification of air.
  "The controller reduces air flow rather than turning fans off completely when the compressor is not operating because minimum airflow is required to provide defrosting and prevent the air in the cooler from stratifying into layers of higher and lower temperature."

3.26.1 Eligibility

Comments:

- In the second sentence, replace the instance of the word "cooler" with "freezer." Low-temperature walk-in boxes are generally referred to as freezers in the industry. In addition, the possibility of controlling evaporator fans in low-temperature freezers is likely dependent on the controller manufacturer.

3.26.3 Definition of Terms

Comments:

- Add "(See Table 3-83 for power factor)" to the definition of "kW_{Fan}."
- Add "(See Table 3-83 for power factor)" to the definition of "kW_{CP}."

Table 3-83: Evaporator Fan Controller Calculations Assumptions

Comments:

- Source # 1 should be split into two sources at "Select Energy (2004)." Therefore, the sources should read as follows:
  1. Conservative value based on 15 years of NRM field observations and experience.
  2. Select Energy (2004). *Analysis of Cooler Control Energy Conservation Measures.* Prepared for NSTAR.
  3. Estimated average refrigeration efficiency for small business customers, Massachusetts Technical Reference Manual.
  4. This value is an estimate by NRM based on hundreds of downloads of hours of use data from the electronic controller.

3.27 ENERGY STAR Clothes Washer (Electric Water Heater, Electric Dryer)

3.27.2 Eligibility

Comments:

- We recommend expanding the measure eligibility to include clothes washers with gas as a fuel source. While it is correct that electric savings for measures with water heated using a gas fuel source are lower than that heated by electricity, this is not an adequate reason for precluding the measure. The residential protocol for clothes washers allows savings to be claimed for gas fuel sources and the commercial protocol should as well. It should be up to the EDCs whether or not to include the measure as part of their overall portfolio.

3.27.2 Algorithms

Comments:

- The paragraph starting with "Figure 3-1 shows the utilization factor for each hour of a sample week in July." Should be modified to be consistent with the stipulated values listed elsewhere in the measure. The second sentence of this paragraph should be modified to read:

  "…. (which have higher utilization rates – ~~1144~~950 loads/year compared to 392)…"

3.28 Electric Resistance Water Heaters

3.28.1 Eligibility

Comments:

- The measure description should be corrected to reflect standard water heater efficiency is 0.904, not 0.9 as currently stated. Measure savings should also be updated to reflect this correction.

3.28.2 Algorithms

Comments:

- The algorithm should be adjusted to match that of all other water heater measures in the TRM:

$$kWh = \frac{\left\{\left(\frac{1}{EF_{Base}} - \frac{1}{EF_{Proposed}}\right) \times \left(HW \times 365 \times 8.3\frac{lb}{gal} \times (T_{hot} - T_{cold})\right)\right\}}{3413\frac{Btu}{kWh}}$$

Where:
HW = annual load in gallons/year

- The use of kBtu loads from DEER in the current algorithm results in incorrect units of kWh*°F. DEER gas use data should be converted to average annual gallons of use using the following algorithm:

$$Gallons = \frac{Load \times EF \times 1000\frac{Btu}{kBtu}}{(T_{hot} - T_{cold}) \times 8.3\frac{lb}{gal}} \times \frac{Typical\ SF}{1000\ SF}$$

- Navigant used DEER baseline end-use loads and the baseline gas EF of 0.54 to convert the following loads to gallons. We used a cold water temperature of 67°F. This was estimated based on the average water main temperatures of 73 California cities.[7]

Building Type	Typical SF	Average Baseline Energy Use, kBtu[8]	Average Annual Use, Gallons
Small Office	10,000	2214	27,173
Small Retail	7,000	1451	12,469
Motel	30,000	2963	109,114

[7] US DOE Building America Program. *Building America Analysis Spreadsheet.* This database contains water main temperatures for cities across the nation.
http://www1.eere.energy.gov/buildings/building_america/analysis_spreadsheets.html

[8] *DEER Database.* http://www.deeresources.com/deer0911planning/downloads/DEER2008-CommercialResultsReview-NonUpdatedMeasures.exe

3.28.3 Definition of Terms

Comments:

- EF_{base} in Table 3-87 should be updated to reflect the exact calculation of the federal standard, which is 0.904. This will make this input consistent with other hot water heating measures.
- The "Load" parameter should be replaced with annual gallons of use.
- These revisions are highlighted in the table below.

Component	Type	Values	Source
EF_{base}, Energy Factor of baseline water heater	*Fixed*	*0.904*	*Used exact value instead of rounding*
$EF_{proposed}$, Energy Factor of proposed efficient water heater	Variable	≥0.93	Unchanged
Load, Annual Gallons	*Fixed*	*Varies*	*DEER Database*[9]
T_{hot}, Temperature of hot water	Fixed	120 °F	Unchanged
T_{cold}, Temperature of cold water supply	Fixed	55°F	Unchanged
EnergyToDemandFactor	Fixed	0.0001916	Unchanged

Note: Italics indicates changed values.

3.28.4 Deemed Savings

Comments:

- We recommend making the following changes to Table 3-88: Energy Savings and Demand Reductions based on the corrections noted above:

[9] Also used California water temperature information and standard conversion factors from US DOE Building America Program. *Building America Analysis Spreadsheet*. This database contains water main temperatures for cities across the nation.
http://www1.eere.energy.gov/buildings/building_america/analysis_spreadsheets.html

Building Type	EF	Current Annual Load, kBTU	Proposed Annual Load, Gallons	Current Energy Savings (kWh)	Proposed Energy Savings (kWh)	Current Demand Reduction (kW)	Proposed Demand Reduction (kW)
Motel	0.95	55,999	109,114	960	927	0.18	0.18
Small Office	0.95	13,946	27,173	239	231	0.05	0.04
Small Retail	0.95	7,314	12,469	125	106	0.02	0.02

3.29 Heat Pump Water Heaters

3.29.1 Eligibility

Comments:

- The measure description should be corrected to reflect standard water heater efficiency is 0.904, not 0.9 as currently stated. Measure savings should also be updated to reflect this correction.

3.29.2 Algorithms

Comments:

- The algorithm should be adjusted to match that of all other water heater measures in the TRM:

$$\Delta kWh = ((EF_{Base})^{-1} - (EF_{Proposed} \times F_{Derate})^{-1}) \times HW \times 365 \times 8.3 \times (T_{hot} - T_{cold}) \times 3413^{-1}$$

$$(kWh = \frac{\left\{\left(\frac{1}{EF_{Base}} - \frac{1}{EF_{Proposed} \times F_{Adjust}}\right) \times \left(HW \times 8.3\frac{lb}{gal} \times \left(T_{hot} - T_{cold}\right)\right)\right\}}{3413\frac{Btu}{kWh}}$$

Where:
HW = annual load in gallons/year

- The use of kBtu loads from DEER in the current algorithm results in incorrect units of kWh*°F. DEER gas use data should be converted to average annual gallons of use using the following algorithm:

$$HW = Gallons = \frac{Load \times EF \times 1000\frac{Btu}{kBtu}}{(T_{hot} - T_{cold}) \times 8.3\frac{lb}{gal}} \times \frac{Typical\ SF}{1000\ SF}$$

- Navigant used DEER baseline end-use loads and the baseline gas EF of 0.54 to convert the following loads to gallons. We used a cold water temperature of 67°F. This was estimated based on the average water main temperatures of 73 California cities.[10]

Building Type	Typical SF	Average Baseline Energy Use, kBtu[11]	Average Annual Use, Gallons
Small Office	10,000	2214	27,173
Small Retail	7,000	1451	12,469
Motel	30,000	2963	109,114

3.29.3 Definition of Terms

Comments:

- EF_{base} in Table 3-91 should be updated to reflect the exact calculation of the federal standard, which is 0.904. This will make this input consistent with other hot water heating measures.
- The "Load" parameter should be replaced with annual gallons of use.
- These revisions are highlighted in the table below.

[10] US DOE Building America Program. *Building America Analysis Spreadsheet*. This database contains water main temperatures for cities across the nation. http://www1.eere.energy.gov/buildings/building_america/analysis_spreadsheets.html

[11] *DEER Database*. http://www.deeresources.com/deer0911planning/downloads/DEER2008-CommercialResultsReview-NonUpdatedMeasures.exe

Component	Type	Values	Source
EF_{base}, Energy Factor of baseline water heater	*Fixed*	*0.904*	*Used exact value instead of rounding*
$EF_{proposed}$, Energy Factor of proposed efficient water heater	Variable	Nameplate	Unchanged
HW~~Load~~, Annual Gallons	*Fixed*	*Varies*	*DEER Database*[12]
T_{hot}, Temperature of hot water	Fixed	120 °F	Unchanged
T_{cold}, Temperature of cold water supply	Fixed	55°F	Unchanged
EnergyToDemandFactor	Fixed	0.0001916	Unchanged
F_{Adjust}, COP Adjustment factor	Fixed	0.80 if outdoor 1.09 if indoor 1.30 if in kitchen	Unchanged
ResistiveDiscountFactor	Fixed	0.90	Unchanged

Note: Italics indicates changed values.

3.29.4 Deemed Savings

Comments:

- Table 3-92 should be updated to reflect the recommended changes to described above.

3.30 LED Channel Signage

3.30.2 Algorithms

Comments:

- The current algorithms only provide savings per letter, not savings per sign. The algorithms should be modified to either use sign length as follows:

[12] Also used California water temperature information and standard conversion factors from US DOE Building America Program. *Building America Analysis Spreadsheet*. This database contains water main temperatures for cities across the nation. Data from 21 Pennsylvania cities were averaged, resulting in a yearly average cold water temperature of 57°F.
http://www1.eere.energy.gov/buildings/building_america/analysis_spreadsheets.html

kWbase = kW_N/ft X L

kWee = kW_{LED}/ft X L

Where L is already defined as Length of the sign in feet in section 3.30.3 Definition of Terms

Or to use number of letters as follows:

kWbase = kW_N/ft X Q X N

kWee = kW_{LED}/ft X Q X N

Where N is defined as the number of letters in the sign

Table 3-93: LED Channel Signage Calculation Assumptions

Comments:

- Due to the significant difference in savings between channel signs greater than 2 ft tall and those 2 ft or less, we recommend separating savings between these two categories rather than having one default. Depending on the distribution of signs being retrofit, the savings could be significantly different than the default values would allow.

3.31 Low Flow Pre-Rinse Sprayers

Comments:

- Unit Savings should be revised per the measure corrections identified below.

3.31.1 Algorithms

Comments:

- This measure should be made consistent with other water heater related measures. The water heater is where the savings are actually achieved by reducing the load. The algorithms should use Energy Factor (EF), not Efficiency labeled as Eff. The algorithms should be modified to be consistent with all other water heater related measures as follows:

$$\Delta kWh = ((F_B \times U_B) - (F_P \times U_P)) \times 365 \times 8.33 \times (T_{hot} - T_{cold}) / (EF \times 3413\ Btu/kWh)$$

Where

T_{hot} = temperature of water coming from the spray nozzle = T_{HNG} or T_{HG}

T_{HNG} = 107F

T_{HG} = 97.6F

T_{cold} = incoming water temperature = 55F

F_B = Baseline flow rate of sprayer in GPM for either grocery or non-grocery applications

F_P = Post measure flow rate of sprayer in GPM for either grocery or non-grocery applications

U_B = Baseline water usage duration of sprayer in minutes/day for either grocery or non-grocery applications

U_P = Post measure water usage duration of sprayer in minutes/day for either grocery or non-grocery applications

EF = Energy Factor of existing water heater system

3.31.2 Definition of Terms

Comments:

- This section is not clear that the cold water temperature is meant to be incoming water temperature and that the hot water temperature is meant to be the temperature of water coming from the spray nozzle. The definitions should be modified to reflect these intended meanings. These values should have been 55°F for T_c and 107°F and 97.6°F for non-grocery and grocery applications, respectively.
- EF should reflect the exact calculation of the federal standard, which is 0.904. This will make this input consistent with other hot water heating measures. We recommend adjusting the base standard water heater efficiency to 0.904.
- These recommendations are summarized in the table below.

Description	Type	Value	Source
F_{BNG}	Fixed	2.25 gpm	Unchanged
F_{PNG}	Fixed	1.12 gpm	Unchanged
U_{BNG}	Fixed	32.4 min/day	Unchanged
U_{PNG}	Fixed	43.8 min/day	Unchanged
F_{BG}	Fixed	2.15 gpm	Unchanged
F_{PG}	Fixed	1.12 gpm	Unchanged
U_{BG}	Fixed	4.8 min/day	Unchanged
U_{PG}	Fixed	6 min/day	Unchanged
T_{MNG}	*Fixed*	*107F*	*Correction*
T_{CNG}	*Fixed*	*55F*	*Building America Analysis Spreadsheet*[13]
T_{MG}	*Fixed*	*97.6F*	*Correction*

[13] US DOE Building America Program. *Building America Analysis Spreadsheet*. This database contains water main temperatures for cities across the nation. http://www1.eere.energy.gov/buildings/building_america/analysis_spreadsheets.html

Tc	*Fixed*	*55F*	*Correction*
~~Cn~~	~~Fixed~~	~~8.33~~	~~Conversion~~
~~Cs~~	~~Fixed~~	~~1/3413~~	~~Conversion~~
Eff	*Fixed*	*0.904*	*Correction*
EnergyToDemandFactor	Fixed	0.000193885*	Unchanged

Note: Italics indicates changed values.

*see note below for EnergyToDemandFactor comments

- It is unclear whether or not the EnergyToDemandFactor was updated for commercial applications from the residential measures. If it was not updated, it should be corrected to match the 0.00009172 as listed in the residential sections, or 0.0001916 as listed in measure 3.28. If it was updated, measures 3.27, 3.28, 3.29, and 3.31 should all be reviewed for internal consistency with one another unless there is specific data which shows one or another should differ.

3.32 Small C/I HVAC Refrigerant Charge Correction

3.32.2 Algorithms

Comments:

- Change "CAP_C" to "$CAPY_C$" to be consistent with the definition of terms for the ΔkWh equation and the ΔkW_{peak} equation for cooling savings.
- Change "CAP_H" to "$CAPY_H$" to be consistent with the definition of terms for the ΔkWh equation for additional heating savings for heat pumps.

3.32.3 Definition of Terms

Comments:

- For the definition of "$CAPY_C$" add "for cooling" so the definition reads: "Unit Capacity, in Btu/h for cooling."
- Change "CAPY" (the second term) to "$CAPY_H$" and change the definition to read: "Unit Capacity, in Btu/h for heating."
- Change the term "$EFLH_{HM}$" to "$EFLH_{MH}$" to be consistent with the term in the algorithm.

Table 3-95: Refrigerant Charge Correction Calculations Assumptions

Comments:

- Change all instances of "$EFLH_{HM}$" to "$EFLH_{MH}$" to be consistent with the term in the algorithm.
- For the "$EFLH_{MH}$" value the text does not match the source. The text states: "Take $EFLH_{MH}$ as 80% of the listed $EFLH_H$ in Table 3-22 and 3-23. However, the source states: "Assumes 70% of heating is done by compressor, 30% by fan and supplemental resistive heat."

Table 3-96: Refrigerant charge correction COP degradation factor (RCF) for various relative charge adjustments for both TXV metered and non-TXV units

Comments:

- Add a source to the table.

Appendix F: Zip Code Mapping

Comments:

- Addition of a column showing the associated ASHRAE climate zone with each zip code would be helpful in the future.