3.0 Perform Corrective Measures as Needed

3.1 Clean Condenser – required
3.2 Clean Evaporator – required
3.3 Clean Blower – required
3.4 Verify clean filter: change or clean as needed – required
3.5 Verify Airflow within range (+/- 15% of 400 cfm/ton) – required
3.6 Check refrigerant charge; adjust to Manufacturer's Spec's as needed

4.0 Test Out: The Test Out (TO) procedure requires measurements that are used to determine the performance characteristics of the cooling system after all corrective measures have been implemented.

4.1 Air Flow - Use same method as Test In
4.2 Air Flow Power Consumption
  a. For ECMs, make sure it is operating in full cooling mode during the entire tune-up.
  b. Measure and record the blower voltage and current.
4.3 Measure and record Supply and Return Air Conditions:
  a. Return Air Dry Bulb Temperature [°F]
  b. Return Air Wet Bulb Temperature [°F]
  c. Supply Air Dry Bulb Temperature [°F]
  d. Supply Air Wet Bulb Temperature [°F]
4.4 Condenser and Compressor Measurements
  a. Compressor Volts
  b. Compressor Current
  c. Ambient Air Dry Bulb Temperature
  d. Ambient Air Wet Bulb Temperature
4.5 Information from Refrigerant Analyzer:
  a. Suction Pressure [PSI]
  b. Discharge Pressure [PSI]
  c. Evaporator Temperature [°F]
  d. Condenser Temperature [°F]
  e. Vapor Line Temperature (VLT) [°F]
  f. Liquid Line Temperature (LLT) [°F]
  g. Superheat [°F]
  h. Subcooling [°F]
4.6 Review System Performance

5.0 Generate invoice: A customer signed invoice is required for participation in the program. The following information must be shown on the invoice:

5.1 Customer Address
5.2 Contractor Name and Address
5.3 Project Number Listed on the DCVF
5.4 Corrective Measures Performed
5.5 Charge for Services Performed
5.6 Rebate Amount Applied to Charges

APPENDIX F. COUNTIES BY WEATHER ZONE ASSIGNMENT

County Name	Zone	County Name	Zone	County Name	Zone	County Name	Zone
Anderson	2	Brown	2	Cooke	2	Falls	2
Andrews	2	Burleson	3	Coryell	2	Fannin	2
Angelina	2	Burnet	2	Cottle	1	Fayette	3
Aransas	4	Caldwell	3	Crane	2	Fisher	2
Archer	2	Calhoun	4	Crockett	2	Floyd	1
Armstrong	1	Callahan	2	Crosby	1	Foard	1
Atascosa	3	Cameron	4	Culberson*	2 & 5	Fort Bend	3
Austin	3	Camp	2	Dallam	1	Franklin	2
Bailey	1	Carson	1	Dallas	2	Freestone	2
Bandera	2	Cass	2	Dawson	2	Frio	3
Bastrop	3	Castro	1	De Witt	3	Gaines	1
Baylor	2	Chambers	3	Deaf Smith	1	Galveston	3
Bee	3	Cherokee	2	Delta	2	Garza	1
Bell	2	Childress	1	Denton	2	Gillespie	2
Bexar	3	Clay	2	Dickens	1	Glasscock	2
Blanco	2	Cochran	1	Dimmit	3	Goliad	3
Borden	2	Coke	2	Donley	1	Gonzales	3
Bosque	2	Coleman	2	Duval	4	Gray	1
Bowie	2	Collin	2	Eastland	2	Grayson	2
Brazoria	3	Collingsworth	1	Ector	2	Gregg	2
Brazos	3	Colorado	3	Edwards	2	Grimes	3
Brewster	2	Comal	3	El Paso	5	Guadalupe	3
Briscoe	1	Comanche	2	Ellis	2	Hale	1
Brooks	4	Concho	2	Erath	2	Hall	1

* Up to the town of Van Horn is in EPE's territory

County Name	Zone	County Name	Zone	County Name	Zone	County Name	Zone
Hamilton	2	Jasper	2	Leon	2	Montague	2
Hansford	1	Jeff Davis	2	Liberty	3	Montgomery	3
Hardeman	1	Jefferson	3	Limestone	2	Moore	1
Hardin	3	Jim Hogg	4	Lipscomb	1	Morris	2
Harris	3	Jim Wells	4	Live Oak	3	Motley	1
Harrison	2	Johnson	2	Llano	2	Nacogdoches	2
Hartley	1	Jones	2	Loving	2	Navarro	2
Haskell	2	Karnes	3	Lubbock	1	Newton	2
Hays	2	Kaufman	2	Lynn	1	Nolan	2
Hemphill	1	Kendall	2	Madison	3	Nueces	4
Henderson	2	Kenedy	4	Marion	2	Ochiltree	1
Hidalgo	4	Kent	1	Martin	2	Oldham	1
Hill	2	Kerr	2	Mason	2	Orange	3
Hockley	1	Kimble	2	Matagorda	3	Palo Pinto	2
Hood	2	King	1	Maverick	3	Panola	2
Hopkins	2	Kinney	3	Mcculloch	2	Parker	2
Houston	2	Kleberg	4	Mclennan	2	Parmer	1
Howard	2	Knox	1	Mcmullen	3	Pecos	2
Hudspeth	5	La Salle	3	Medina	3	Polk	3
Hunt	2	Lamar	2	Menard	2	Potter	1
Hutchinson	1	Lamb	1	Midland	2	Presidio	2
Irion	2	Lampasas	2	Milam	3	Rains	2
Jack	2	Lavaca	3	Mills	2	Randall	1
Jackson	3	Lee	3	Mitchell	2	Reagan	2

County Name	Zone	County Name	Zone	County Name	Zone	County Name	Zone
Real	2	Shackelford	2	Titus	2	Wharton	3
Red River	2	Shelby	2	Tom Green	2	Wheeler	1
Reeves	2	Sherman	1	Travis	2	Wichita	2
Refugio	4	Smith	2	Trinity	3	Wilbarger	1
Roberts	1	Somervell	2	Tyler	3	Willacy	4
Robertson	2	Starr	4	Upshur	2	Williamson	2
Rockwall	2	Stephens	2	Upton	2	Wilson	3
Runnels	2	Sterling	2	Uvalde	3	Winkler	2
Rusk	2	Stonewall	1	Val Verde	3	Wise	2
Sabine	2	Sutton	2	Van Zandt	2	Wood	2
San Augustine	2	Swisher	1	Victoria	3	Yoakum	1
San Jacinto	3	Tarrant	2	Walker	3	Young	2
San Patricio	4	Taylor	2	Waller	3	Zapata	4
San Saba	2	Terrell	2	Ward	2	Zavala	3
Schleicher	2	Terry	1	Washington	3		
Scurry	2	Throckmorton	2	Webb	4		

Public Utility Commission of Texas

Texas Technical Reference Manual

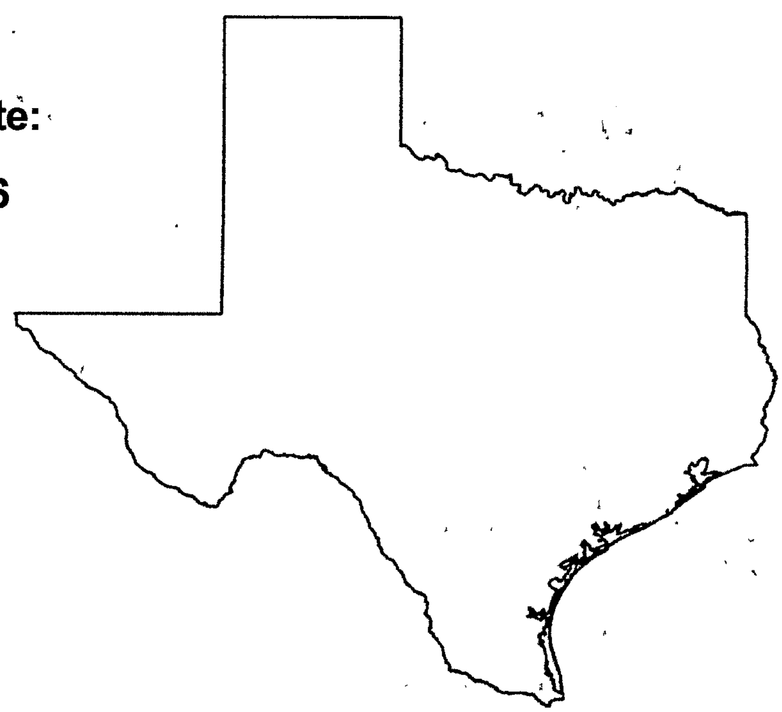
Version 4.0

Volume 5: Implementation Guidance

Program Year (PY) 2017

Last Revision Date:

November 1, 2016



Public Utility Commission of Texas

Texas Technical Reference Manual

Version 4.0

Volume 5: Implementation Guidance

Program Year (PY) 2017

Last Revision Date:

November 1, 2016

Table of Contents

List of Figures

List of Tables

Acknowledgements

The Technical Reference Manual is maintained by the Public Utility Commission of Texas' independent Evaluation, Monitoring and Verification (EM&V) team members—Tetra Tech, The Cadmus Group, Itron, and Johnson Consulting Group.

This version of the Texas Technical Reference Manual was primarily developed from program documentation and measure savings calculators used by the Texas Electric Utilities and their Energy Efficiency Services Providers (EESPs) to support their energy efficiency efforts, and original source material from petitions filed with the Public Utility Commission of Texas by the utilities, their consultants and EESPs such as Frontier Associates (TXu 1-904-705), ICF, CLEAResult and Nexant. Portions of the Technical Reference Manual are copyrighted 2001-2016 by the Electric Utility Marketing Managers of Texas (EUMMOT), while other portions are copyrighted 2001-2016 by Frontier Associates. Certain technical content and updates were added by the EM&V team to provide further explanation and direction as well as consistent structure and level of information.

TRM Technical Support

Technical support and questions can be emailed to the EM&V team's project manager (lark.lee@tetratech.com) and PUCT staff (katie.rich@puct.texas.gov).

1. INTRODUCTION

This volume of the TRM contains EM&V team recommendations regarding program implementation that may affect claimed savings. The EM&V contractor drafts guidance memos for the electric utilities' energy efficiency programs in order to provide clear direction on calculating or claiming savings. Guidance memos are consistent with the Energy Efficiency Rule 16 TAC 25.181 and the TRM, but address areas where additional direction is needed for consistency and transparency across utilities' claimed savings from the programs. This volume compiles the various guidance memos produced during the course of the EM&V effort.

Implementation guidance contained in this volume is summarized by sector below:

<u>Residential</u>

- HVAC Early Replacement

<u>Commercial</u>

- Lighting Calculator Building Type
- Non-qualifying LEDs
- Project Documentation
- Incentives and Claimed Savings

<u>Cross-Sector</u>

- Load Management Programs
- Behavioral Programs
- Multi-family Savings
- Upstream Lighting Savings

2. RESIDENTIAL

2.1 HVAC EARLY RETIREMENT

The Texas Technical Reference Manual (TRM) 3.0 for program year 2016 (PY2016) included the expansion of HVAC and appliance early replacement savings from low-income customers to all residential customers, as requested by Frontier Associates on behalf of the electric utilities marketing managers of Texas (EUMMOT). The EM&V team then provided additional guidance to assist the electric utilities in effectively incorporating early replacement of HVAC equipment and appliances into residential programs. The responsible implementation of the expansion puts in place criteria to prevent high rates of misattribution or mischaracterization of projects as early replacements.

2.1.1 Background

Historically, residential HVAC and appliance early replacement savings have been claimed in Texas only by participants who qualify for low-income programs that are recipients of federal funding. Participants in other programs may still claim savings for these projects, but at a lower rate associated with "replacement on burnout" of the old unit. Lower-income customers may lack the resources to replace old or poorly-functioning units, leading to long periods of installation for inefficient units until natural burnout necessitates immediate replacement. These homes are therefore where early retirement projects can achieve the highest savings over the longest period of time. In TRM v3.0, Frontier Associates proposed adopting a methodology consistent with that used by commercial measures,[1] and allowing non-low-income qualifying customers to claim early replacement savings. As no petition has yet been filed and approved by the Commission for residential measures outlining procedures for claiming early retirement savings, programs conducted under standard offer templates—residential standard offer programs (RSOPs) and hard-to-reach standard offer programs (HTR SOPs)—have not been permitted to claim the additional savings associated with this project type.

2.1.2 Rationale for Early Replacement

Replacement of functioning or repairable appliances and HVAC equipment before the end of their useful lifetime presents an opportunity for additional energy savings beyond a standard replacement of the existing unit at the end of its lifetime. "Early replacement" or "Early retirement" projects target homeowners who would otherwise have operated and maintained older, less efficient equipment for a number of years without the program intervention. By encouraging these customers to replace their equipment ahead of schedule, utility programs remove high-consumption units that fall below the baseline and install high-performance units in their place. Moreover, an early retirement strategy can allow Energy Efficiency Service Providers (EESPs) to reach customers before emergency replacement, which provides customers with additional time to review efficient options.

2.1.3 Early Retirement in Other Jurisdictions

Some TRMs developed for other jurisdictions, including those in Ohio, Illinois, Pennsylvania, provide for early retirement savings. At the same time, evaluation research in other jurisdictions has also found that

[1] See TRM v2.0 Volume 3, Appendix D for detailed savings weighting procedure. The methodology used to calculate remaining useful life (RUL) was introduced in PUCT Docket No. 40083, Appendix A.

early retirement projects can be difficult to implement cost-effectively and can result in misapplication by contractors or participants.

Without appropriate program safeguards, customers may claim early retirement incentives/savings for replace-on-burnout projects.

2.1.4 Customer Identification and Eligibility for Savings

With the expansion of eligibility for early retirement savings comes an increased risk that early retirement customers will not be properly identified and differentiated from replace-on-burnout customers. Among the lower-income population, it is assumed that lower levels of disposable income do not permit replacement of an installed unit before failure in the absence of program incentives. Extending early retirement savings to all customer types, the increase in savings—and, by extension, incentive payments—may encourage early retirement savings to be claimed when a project would be more properly characterized as a replacement-on-burnout. It is therefore incumbent upon the utility to facilitate accurate savings claims by setting up appropriate procedural guidelines and requiring provision of sufficient evidence.

2.1.5 EM&V Team Recommendations for Effective Early Replacement

In order to ensure that early replacement savings are being awarded in an accurate way, the EM&V team recommends a two-fold approach:

1. **Provide a framework for proper identification of early replacement projects.** High initial costs of new equipment and a lack of urgency to upgrade an old unit may deter residential customers from undertaking an early replacement project, in contrast with a replace-on-burnout scenario. These barriers to participation necessitate a utility-directed approach to encourage early retirement projects where such savings are applicable. In their annual Energy Efficiency Plan and Reports (EEPRs), utilities wishing to claim early retirement savings for RSOP participants should present an outline detailing procedures to properly identify early retirement projects. This plan should also describe verification efforts to ensure that savings are being properly claimed. The EM&V team suggests incorporating the following elements into utility plans to facilitate the identification process:
    - **Incentive structure.** In residential markets, customers may be deterred from undertaking early retirement projects due to the immediate and large capital outlay. Utilities should therefore describe how customers will be encouraged to replace functioning equipment, e.g., through a tiered incentive structure.[2]
    - **EESP training.** Implementers should consider holding training sessions to educate energy efficiency service providers (EESPs) on procedural guidelines for proper differentiation of early retirement customers versus replace-on-burnout.
    - **EESP professionalism.** Utilities should develop a network of EESPs that have long-established and trustworthy relationships with implementers.

[2] "Two key program drivers are used to motivate homeowners to realize the advantages of immediate action: a tiered incentive structure; and developing well-trained contractors to provide homeowners with the necessary information to make a potentially large financial decision." Cofer, S., and Livingston, J. *A Tale of Two Programs: An Analysis of Residential Early Retirement HVAC Programs.* 2010 Proceedings of the ACEEE Summer Study of Energy Efficiency in Buildings. Washington, D.C.: American Council for an Energy-Efficient Economy, 2010.

- **Documentation and verification activities.** Procedural steps should be added to verify and document early retirement projects, including QA/QC visits by the implementer for a percentage of installed measures and through customer survey questionnaires that document the condition of the replaced unit and motivation behind the measure installation.

2. **Specifications for tracking data to verify eligibility of early replacement projects.** For any program in which a utility seeks to claim early retirement savings, stringent and verifiable eligibility criteria and corresponding data tracking requirements should be outlined in the plan portion of the appropriate Energy Efficiency Plan and Report (EEPR). In TRM 3.0, proposed tracking variables have been noted as "recommended" in the respective *Program Tracking Data & Evaluation Requirements* sections for applicable measures. These inputs are indicated as recommended for early retirement projects only. In Table 2-1, the EM&V team presents potential requirements at the measure level that seek to prevent misapplication of early retirement savings. These requirements are to ensure that savings are properly claimed given the age and functionality of existing unit. The recommended additional data tracking requirements will also support application of the appropriate baseline for savings calculations.

Table 2-1: EM&V Team Recommended Eligibility and Data Tracking Requirements for Early Retirement Savings

Measure Name	Recommended Eligibility Requirements	Recommended Additional Data Tracking Requirements
Central Air Conditioners, Central Heat Pumps and Room Air Conditioners	• Existing unit must be fully operable • For RSOP customers: the age of the existing unit may not exceed the 75th percentile of measure lifetimes for this measure type • Customers must provide survey responses to document the condition of the replaced unit and their motivation for measure replacement[3] • Sizing of new unit must be less than or equal to that of the existing unit	• Photograph of existing unit nameplate • Photograph of temperature gauged by thermostat/thermometer before and after operating the unit to demonstrate functionality of the existing unit. • Manufacturer, serial number, and model number of existing unit • Age of existing unit • Customer responses to survey questionnaire
ENERGY STAR® Refrigerators	• Existing unit must be fully operable • For RSOP customers: the age of the existing unit may not exceed the 75th percentile of measure lifetimes for this measure type • Customers must provide survey responses to document the condition of the replaced unit and their motivation for measure replacement • Refrigerator: internal temperature less than 40°F must be attainable[4] • Freezer: internal temperature of 0°F must be attainable[5]	• Manufacturer, serial number, and model number of existing unit • Age of existing unit • Internal temperatures in refrigerator and, if present, freezer • Customer responses to survey questionnaire

---

[3] This approach is employed by EmPOWER Maryland for commercial and industrial customers undertaking early retirement projects. The questionnaire is described in: Northeast Energy Efficiency Partnerships. *Early Replacement Measures Scoping Study: Phase I Research Report*. Prepared by Evergreen Economics. August 2014. (18)

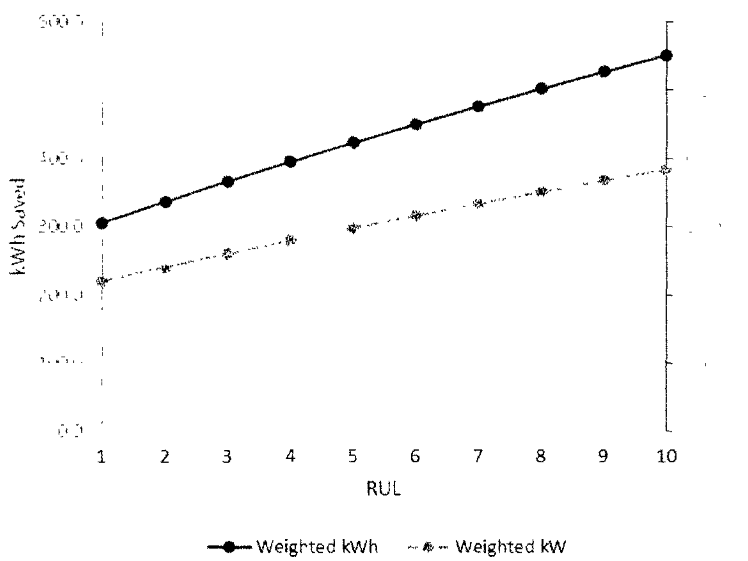
[4] U.S. Food and Drug Administration. *Are you Storing Food Safely?* Accessed November 2014. http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm093704.htm.

[5] Ibid.

2.1.6 Savings Calculations: Remaining Useful Lifetime

In addition to allowing all customer classes to claim savings for early retirement projects, Frontier Associates has proposed an alternative methodology, currently in use for commercial measures, for calculating the remaining useful lifetime (RUL) of previously installed units. The RUL indicates the number of years that the existing unit would be expected to remain installed and operable, and is used to derive the weighted first-year energy savings values that may be claimed for early retirement measures. Higher RULs lead to higher savings, as in the absence of the program, the inefficient unit in place would be expected to continue operating for a longer period of time before being replaced with a market-baseline unit (see Figure 2-1).

Figure 2-1: Example of Sensitivity of Claimed Savings to RUL[6]



The EM&V team recommends that Frontier's proposed methodology be employed, although with a reasonable estimated lifetime cap in place for the existing unit. The team proposes that the sum of the unit age and the RUL be capped at the 75th percentile of equipment age on retirement, as determined using the DOE survival curves. Where the age of the unit exceeds the 75th percentile of lifetimes, replace-on-burnout savings should be awarded.

[6] This analysis assumes a piece of equipment with an 11-year expected useful lifetime (EUL), a 5% weighted average cost of capital, and the 2% escalation rate stipulated by the PUCT Substantive Rule §25.181. Assumptions with respect to existing, baseline, and installed energy and demand savings are based on approximate values for a room air conditioner.

3. COMMERCIAL

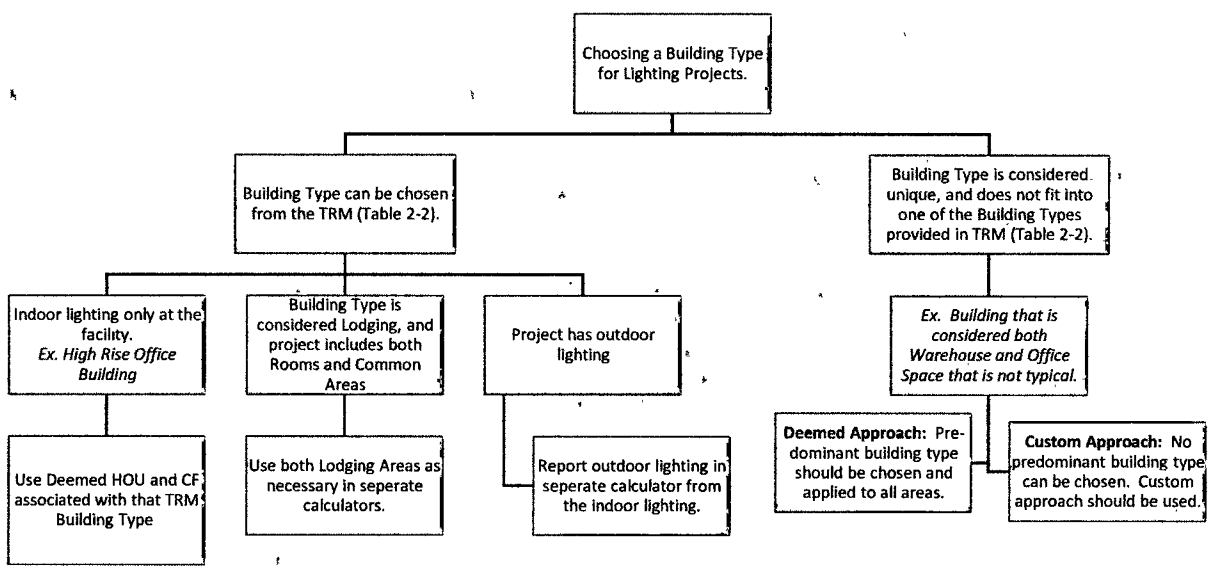
3.1 LIGHTING CALCULATOR BUILDING TYPE

This section provides additional guidance on Recommendation #1b in the 2013 Statewide Annual Portfolio Evaluation Report[7].

The TRM provides deemed lighting hours of use (HOU) and peak summer coincidence factors (CF) for utilities to use in calculating savings associated with lighting, broken down by building type. These values are provided in Table 2-2 of the TRM. For the majority of the building types listed in this table, the HOU and CFs were created based on weighted averages of lighting usage across all activity areas of the building[8]. Therefore, the deemed HOU and CFs are representative of an entire building type, across all activity areas that are in a 'typical' building for this type.

The following flow chart, Figure 3-1, has been provided to assist the utilities in understanding how they can utilize the deemed methods for calculating lighting savings based on HOU and CF provided in the TRM. Additionally, it provides guidance on how to treat lodging facilities and outdoor lighting projects as well as unique building types.

Figure 3-1: Building Type Decision Making



Lodging Sites: Lodging facilities (Hotel/Motel/Dormitories) have been identified in the TRM by *Common* and *Rooms*, both with different HOU and CF. As two different values have been provided for these areas, it is acceptable for the utilities to use either or both of these Building Types for a single project.

[7] Annual Statewide Portfolio Report for Program Year 2013 – Volume I. Prepared for the Public Utility Commission of Texas. October 6th, 2014.

[8] More information on how these values were created can be found in PUCT Docket #39146.

3. COMMERCIAL

Outdoor Lighting Projects that involve outdoor lighting should be claimed in a separate calculator. The exception to this is walkway lighting that is similar to building operation. In this application, the utilities should use the primary building type as their HOU and CFs have been rolled up into the overall building type calculations. *Ex. Walkway lighting between two buildings that operates during business hours.*

In situations where multiple TRM building types seem plausible, or a predominant TRM building type is unclear, the utilities have two choices:

Deemed Approach: The deemed approach is a simplified method where the utilities should choose a TRM building type based on the "best fit" for the facility. The utilities will use their best judgment in making this decision and provide sufficient, defensible documentation for their decision-making process.

Custom Approach: In more unique situations where the deemed building types in the TRM may not be representative of the project's facility type, or where the facility may represent multiple TRM building types without a clear predominant building type (or the use of a predominant building type may be too conservative in the estimate of savings), the utilities should consider these projects "custom". The deemed methods are only applicable to specific scenarios and cannot be developed for all unique situations. The utility should provide sufficient, defensible documentation for their HOU and CF values used in their savings calculations that can be reviewed by the EM&V team.

3.2 NON-QUALIFYING LEDS

This section provides guidance on assessing and calculating nonresidential lighting project savings that include non-qualifying LEDs. The information should help utilities respond to Recommendation #1a from the program year (PY) 2013 Statewide EM&V Portfolio Report:

> **Recommendation #1a: LED lighting qualification requirements.** The EM&V team found that several LED lighting fixtures and lamps were not meeting the qualification requirements specified in the TRM. The new LED fixtures and lamps installed as part of the commercial energy efficiency programs should meet the certification requirement and confirm the eligibility of the LED fixtures and lamps. The qualification requirements are in keeping with national industry practice that protect customers from inferior products and help ensure the energy savings.
>
> **1a Action Plan:** Utilities will require certification for all LEDs with a certification category with the Design Light Consortium (DLC) or ENERGY STAR as specified in the TRM. If a LED has been submitted for certification but has not yet been processed, the utility will check that it is being processed and also request forms LM79 and LM80 to review that the LED meets the required efficiency standards. In cases where a certification category does not address a certain LED usage (i.e., outdoor signage), the utility will inform the EM&V team and discuss a M&V plan and supporting savings information for these LED applications.

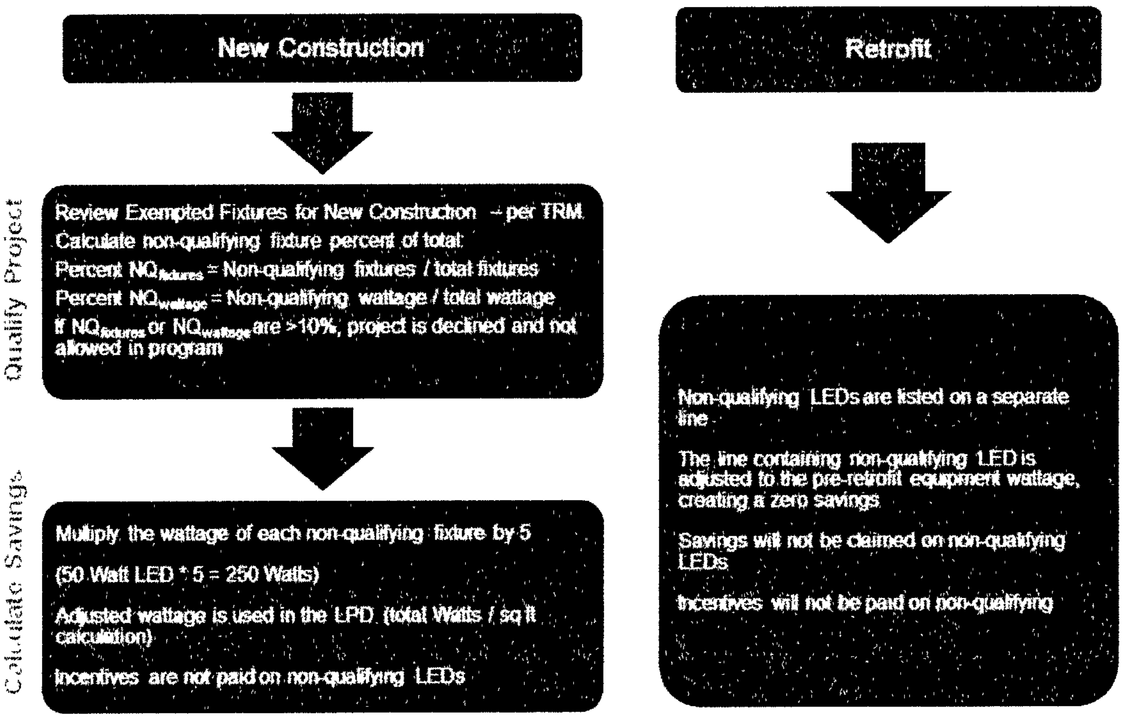
3.2.1 Background

The Texas Technical Reference Manual (TRM) includes the following requirement for LEDs: "LED lamps and fixtures need to be certified by *Design Lights Consortium* (DLC) or *ENERGY STAR®*" (TRM Volume 3, Section 2.1.1). This requirement is to ensure the quality of the products and resulting savings incentivized through the utility programs.

Oncor Electric Delivery (Oncor) reported to the EM&V team that even though they promote qualified LEDs, they are still receiving projects that have some percent of non-qualifying LEDs. As part of the PY2014 evaluation, Oncor asked the EM&V team for guidance on how to calculate savings for these projects. The EM&V team advised isolating the non-qualifying LEDs when possible including the square footage for new construction projects. The EM&V team also recommended establishing a percent cut-off of non-qualifying LEDs for program participation and not counting savings from non-qualifying LEDs or rebating them. Additional methodologies were discussed for when project conditions do not provide for isolation of the square footage. Since the original discussion, Oncor has been observing the number of projects with some non-qualifying LEDs increase and reports it is difficult to isolate square footage of non-qualifying LEDs in practice. Furthermore, this issue has greatly increased the utility review and approval time of lighting projects. Oncor proposed a streamlined methodology, which the EM&V team reviewed and finds reasonable. This savings process is provided below for all utilities to utilize when projects meet such criteria.

3.3 SAVINGS PROCESS

Figure 3-2 summarizes the recommended protocol for lighting system projects with non-qualifying LEDs when square footage cannot be isolated. Additional explanation and criteria for use follows.



Source: Oncor

Figure 3-2: Non-Qualifying LED Process for Lighting Projects

3.3.1 Step 1: Qualify New Construction Projects

Calculate two non-qualifying LED project percentages:

Based as a percentage of quantity (Percent $NQ_{fixtures}$ = quantity of non-qualifying fixtures / quantity of total fixtures)

If $NQ_{fixtures}$ >10 percent, project is declined and not allowed in program.

Based as a percentage of demand (Percent $NQ_{wattage}$ = wattage of non-qualifying fixtures / wattage of total fixtures)

If $NQ_{wattage}$ >10 percent, project is declined and not allowed in program.

If $NQ_{fixtures}$ and $NQ_{wattage}$ <10 percent, project is approved and continue to step 2 or step 3 as applicable to project type.

The EM&V team finds the 10 percent cut off for project approval reasonable and is consistent with lighting project limits for non-operating fixtures.

3.3.2 Step 2: New Construction Projects Only

Non-qualifying fixtures that pass Step 1, would follow all instructions for excluded fixtures, as provided in the TRM, Volume 3, Section 2.1.1.

List all non-qualifying LEDs in the tool, but exclude from the lighting power density calculation.

List non-qualifying LEDs on separate lines (e.g. separate on lighting inventory worksheet of deemed savings tool). Non-qualifying fixtures are identified by a unique fixture code.

Adjust non-qualifying LED wattage so their demand energy reduction is not included as part of the lighting power density (LPD) code limit requirements. To do so, multiply the rated fixture wattage times five. The adjusted wattage is included as part of the overall LPD calculation, and will increase the calculated watts per square foot of the project.

The EM&V team finds the five times factor conservative, however in line with a typical baseline condition and equivalent and ensures the non-qualifying LED demand is not included with the LPD code allowance requirements.

3.3.3 Step 3: Retrofit Projects

List non-qualifying LEDs on separate lines (e.g. separate on lighting inventory worksheet of deemed savings tool.)

Include a unique identifier/marker for the non-qualifying LED within the fixture code and description (e.g. inputs within the standard wattage table worksheet of the deemed savings tool.)

Adjust non-qualifying LED wattage so their demand and energy savings are not included as part of the project savings. Demand and energy savings for non-qualifying LEDs shall result in zero project savings.

Adjust non-qualifying LED quantities so they are not included as part of the project incentive. Incentives shall not be paid on non-qualifying LEDs.

Provide clear visibility for all changes within the savings calculation (e.g. deemed savings tool), including changes to all input assumptions and calculation methodologies to implement the above procedure.

All other savings procedures and requirements as specified within the TRM for lighting measures apply to all fixtures of a lighting project.

The EM&V team finds this procedure as an acceptable and systematic method to approve and document lighting projects with a small portion of non-qualified LEDs. As more LEDs earn DLC and ENERGY STAR® approval, the procedure may also allow for easier integration into project savings by the programs and the evaluation if such conditions take place within the same program year.

3.3.4 Conclusion

The savings approach in this memo will facilitate utilities responding to PY2013 Recommendation #1a in PY2015 in keeping with § 25.181 (q) (9) while recognizing the market and administrative challenges of projects with non-qualifying LEDs.

3.4 PROJECT DOCUMENTATION

This section summarizes the progress and current status of the EM&V team's assessment of the utilities' efforts to meet and conform to project documentation standards and provides additional guidance for areas still in need of improvement as part of the PY2015 EM&V.

3.4.1 Background

For all energy efficiency programs, critical inputs and methodologies needed to replicate claimed savings calculations are captured in a combination of the TRM, program manuals, program tracking data systems, and individual project documentation. Project-level documentation is critical to the transparency of claimed savings as well as facilitates efficient third-party EM&V at the project, program, and portfolio levels. This memo specifically addresses the individual project documentation needs. Individual project documentation includes all relevant site specific detail (i.e., audit reports, worksheets, program applications, invoices, project overview/description, photos, installation reports, etc.)

Documentation guidance was originally provided in PY2012 with additional status and recommendations in PY2013 as part of the evaluation activities and utility action plan discussions. The sufficiency of program documentation has improved from PY2012 to PY2014 across almost all utilities and programs as noted in the PY2014 Statewide Portfolio Report. However, for some utilities, there is still a need to increase the sufficiency of program documentation for the Commercial Standard Offer Programs (CSOP).

Next we provide further detail on documentation best practices currently incorporated into many of the Texas programs (based on information gathered during PY2014 evaluation activities) and recommendations for improvement. The objective is to support the utilities in achieving industry-standard degrees of documentation rigor, clarity, and efficacy necessary to clearly organize and manage such information to yield transparency and facilitate efficient and effective oversight.

3.4.2 Additional Documentation Guidance

The reader is referred to PY2012 and PY2013 Annual Statewide Portfolio Reports for prior program documentation guidance. In this section, we provide additional guidance geared specifically to help improve CSOP program documentation scores, though the guidance may also be used to support the continued improvement of program documentation for other programs.

Recommendation 1: Clearly organize project files

Organized project files are critical for many reasons including:

- Clear and transparent reporting of documentation used to support claimed savings
- Ease of identification of related program project files that may not have made the data transfer
- Backup support for information within tracking data systems
- Support the use of custom parameters
- Support deviation or enhancement of methodologies in order to gain greater accuracy

3. COMMERCIAL

An important part of organized project folders, files and documents are clear naming conventions. This assists in keeping files organized and improves consistency in document placement and ease in locating critical documents to support the EM&V efforts. Below are some examples of the difficulty the EM&V team has had with project level folders/files received:

- The project folders often contained inconsistencies with regard to file/document names, locations and contents. Files with similar names often contained disparate information while seemingly identical files contained dissimilar information.
- The project folders included multiple copies of project documents. Locating the final documents used to support the reported savings proved difficult for many projects. For example, when numerous photos are provided, locating those that support the key savings assumptions is difficult. Distinguishing between pre versus post equipment photos was also at times difficult.
- Project folders contained documents labeled as Verification Reports when they were still actually M&V plans with no verification data completed. Such plans provided the methodology to verify project savings estimates, yet do not document that they were ever completed.

The project file organization example below provides a list of potential project sub folders and documents that would be ideal to collect whether a pre- and/or post-inspection is completed. Many documents listed are key elements necessary to support custom project assumptions and review.

Project File Organization Example:

	Retrofit and New Construction
Pre Project*	• Pre-project calculator • Plans (e.g. drawings, fixture list) • Pre-project/inspection photos • Pre-project audit reports • Project descriptions, sponsor agreements, etc.
Post Project	• Post- project/inspection calculator • Post-inspection field notes • Post-project/inspection photos • As-built plans • Installation reports
Supporting Documents	• Calculators - old and archived • Spreadsheets or other backup (especially those to support custom calculations) • Specifications, cut sheets, certifications • Check requests to utility • Partner letters or savings summaries • Material purchase orders/invoices • Email communication • M&V plan – for custom key input assumptions (e.g. operating hours) or custom savings methodologies
Final Documents**	• Final calculator • Final M&V plan – for custom projects • Final verification documents – for custom projects • Final project notes

* New construction projects may not necessarily include these documents.
** These documents also support EM&V on-site minimum requirements for data collection needs.

Recommendation #2: Use photo verifications to support key measure assumptions.

When onsite field work is completed, whether by trade allies, implementation staff or utility staff, photos can assist in documenting and supporting key measure attributes and assumptions. Most programs include some form of photo documentation to support projects. Some programs in Texas even utilize tablets in the field whereby project site and equipment photos are taken by trade allies and automatically uploaded to tracking systems and project folders. Guidance for how photos can assist in supporting documentation of projects are more fully described in the table below for some of the most common commercial project types, lighting and HVAC based projects.

Photo Verification Applications and Examples:

	Lighting Projects*	**HVAC Projects**
Pre Project	• Existing lighting system types (e.g. lamp, ballast, fixture) • Existing lighting equipment quantities • Existing control type • Existing lighting equipment operability/ inoperability • Building type • Air conditioning type	• Existing HVAC equipment types and sizes • Existing HVAC equipment quantities • Existing HVAC equipment operability/ inoperability (e.g. set point, load display shots) • Building type
Post Project	• New lighting system types (e.g. lamp, ballast, fixture) • New lighting equipment quantities • New control type • New control schedule automation (e.g. building/lighting automation system screen shots) • New lighting equipment operability • Building type • Air conditioning type	• New HVAC equipment types and sizes • New HVAC equipment quantities • New HVAC equipment operability (e.g. set point, load display shots) • Building type

* Note that for large lighting projects, some of these project parameters may not be possible to be captured for all lighting quantities. In these cases, alternative project documentation types may be preferred.

Recommendation #3: Include clear descriptors of measure type as well as QA/QC inspections in tracking system.

Different projects (e.g. retrofit versus new construction projects, inspected versus not inspected sites) have different documentation needs. Capturing participant descriptors can aid evaluation efforts immensely, keep cost burdens low, and facilitate transparency.

Many commercial programs continue to track and describe measure-level savings at the measure-category level (or savings calculator level) instead of the measure-specific level. For example, the tracking system will document the savings associated with a lighting project as captured within a lighting calculator (i.e. Lighting Equipment Survey Form ver 9.02), but the calculator itself includes many different lighting fixture types, effective useful lives and related savings. Tracking project data at the measure-specific level (e.g. Integrated-ballast LED Lamps, Linear Fluorescent, Lighting Controls) rather than the measure-category level will improve the level of transparency in the data as the types of measures and individual savings being claimed can then be readily assessed. This structure also supports ease for calculating cost-effectiveness.

As another example, new construction projects may not have pre-inspection forms or field notes whereas retrofit projects may have many types of pre-project documentation (e.g. pre-project calculator, pre-project plans, pre-inspection photos). Providing information regarding "greenfield" or complete demolition and rebuild projects as a differentiator from retrofits and small remodels up front is a valuable population segmenting descriptor. When descriptors like these are used in tracking systems they become a valuable screening tool and can inform evaluators not to request certain documentation (that may not exist), which can misdirect time and resources. It also allows better budgeting and allocation of resources, improving overall efficacy. Another example are those sites or program participants that have received internal QA/QC, versus those that did not. Some programs have modified their tracking systems to begin logging this data and/or providing a list as part of the EM&V data collection process which notifies the EM&V team that a site will not have particular project level documentation because it was not site inspected, or site verified, etc.

Recommendation #4: Complete M&V plans and reports are needed for custom projects.

The industry standard for M&V plans and reports is based on the guidelines of Efficiency Valuation Organizations (EVO) International Performance Measurement and Verification Protocol (IPMVP). IPMVP Volume I EVO 10000-1:2012 is the current version available, which includes clear recommendations for meeting the minimum information requirements for complying with IPMVP protocols including those specific to M&V Plan Contents summarized in Chapter 5 and M&V Reporting summarized in Chapter 6.

Utilities and their implementation contractors are encouraged to engage and collaborate with the EM&V team, to discuss issues and options, obstacles and possible solutions for M&V plans as new technologies or offerings become part of the Texas portfolios.

3.5 INCENTIVES AND CLAIMED SAVINGS

This section provides guidance on claiming savings where a financial incentive does not cover all of the project savings from the implementation of energy efficiency measures[9]. These recommendations are to begin in PY2016.

3.5.1 Background

To meet various program objectives, it is common practice for utilities to set a ceiling or cap for the financial incentive any one energy efficiency service provider (EESP) or project can receive. These 'individual incentive caps' are set as an overall percent of total incentive budget or as a dollar amount. The established caps vary by utility and are noted in their program manuals.

This is a different situation from a 'set incentive'. During the application phase, utilities calculate a project incentive based on pre-installation estimated savings, the incentive funds are reserved at this time. There may be some variation in the initial savings estimates that were agreed upon in setting the incentive and the actual post-installation savings once the project is completed. This is due to changes in efficiency levels, quantities or equipment type that take place from the project planning phase to the project implementation phase.

3.5.2 Considerations

In the case of incentive caps, the EM&V team has some concern regarding claiming all of the savings in projects where an incentive cap is reached. Since all of the project savings are not being incentivized at the project planning phase, claiming all of the project savings may result in increased free-ridership. A free-rider is, "a program participant who would have implemented the program measure or practice in the absence of the program." (16 TAC § 25.181 (c) (24))[10].

In the case of set incentives, the EM&V team has some concern that spillover could be claimed incorrectly during post-project inspections. Spillover is, "reductions in energy consumption and/or demand caused by the presence of an energy efficiency program, beyond the program-related gross savings of the participants and without financial or technical assistance from the program." ((16 TAC § 25.181 (c) (53)). Spillover is a component of net savings and claimed savings are based on gross savings. Therefore, spillover should not be included in claimed savings if found on-site during post-project inspections.

---

[9] This guidance does not apply to behavioral, code or other market transformation programs where the primary program strategy is technical assistance and/or education that results in behavioral or operational changes for energy and demand savings.

[10] In addition to the incentive caps or set incentives at the individual EESP or customer-level, utilities may also set caps on incentives a customer can receive at the measure level. For example, a utility may cap lighting incentives at 50% of the total project incentive. The EM&V team does not have the same concerns regarding free-ridership for measure-level caps and the recommendations in this memo do not apply to these situations.

3.5.3 Recommendations

Individual incentive caps. If utilities are planning to claim savings beyond those incentivized for an individual EESP or project, they are requested to inform the EM&V team and supply project documentation for the specific project. The EM&V team may conduct additional research to determine the influence of the program on the total project savings. The EM&V team's recommendation should be used to adjust the utilities' claimed savings for the project(s).

Set incentives. The EM&V team recommends utilities educate internal staff, implementation contractors and EESPs on spillover to help ensure it is not included in claimed savings if found during post-project inspections. However, documenting spillover may be beneficial when net-to-gross ratios are updated.

4. CROSS SECTOR

4.1 LOAD MANAGEMENT PROGRAMS

This memo summarizes guidance from the EM&V team on two load management issues raised by one or more of the utilities during PY2014-PY2015 EM&V. These are 1) rounding of demand impacts and 2) meter issues.

4.1.1 Rounding

In the course of the EM&V contractor's effort of evaluating commercial load management programs, the EM&V contractor has found some differences in rounding in the commercial load management programs' demand impacts. These rounding differences are minor and are not a concern in the accuracy of the reporting of impacts. However, in response to a request for guidance to address rounding consistently, the EM&V team recommends utilities round commercial load management impacts consistently with how incentives are awarded, which is at the customer-level.

4.1.2 Meter Issues

Utilities are responsible for calling a test event each program year for the load management programs. The test event has several purposes, including assuring the proper functioning of program meters. Utilities are responsible for maintaining working program meters.

Commercial load management programs. Without complete interval meter data to calculate the baseline and event impacts, savings may not be claimed. However, if a customer has alternate interval meter data available, this can be used in lieu of program meter data to calculate claimed savings. Using customer meters for the load management program savings requires that the data meet interval metering requirements presented in the version of the Texas Technical Reference Manual for the program year. In general, it is recommended that customer owned interval meters should only be used in the event that utility interval meters fail. Data from each should not be combined for claiming savings for a specific event and must be able to cover both the event day data and baseline data.

The EM&V team requests utilities notify them in these circumstances. All calculations and data stemming from the use of customer meters should be provided as part of the EM&V data request similarly to when program meter data is used. If requested by the utility, the EM&V team is available to review the use of customer meter data in advance of a program claiming savings from customer meters.

Residential load management programs. If there are random, non-systematic errors in smart meter data for less than one percent of total participants, the average savings from a similar group of participants (i.e., single-family, multi-family) may be used for claimed savings if: (1) the control event technology and intervention are the same, and (2) the control event intervention can be confirmed based on standard program practices for event confirmation.

The EM&V team requests utilities notify them in these circumstances to discuss the approach for determining and applying average savings for those customers with incomplete meter data.

4.2 BEHAVIORAL PROGRAMS

This section provides additional guidance on claiming savings for behavioral programs.

4.2.1 Background

Behavioral programs are newly allowed energy efficiency programs in Texas as specified in the Energy Efficiency Rule (16 TC 25.181-(c)(12). Guidance for Behavioral Programs' M&V protocols was first integrated into Texas Technical Reference Manual (TRM) 3.1: Volume 4.

4.2.2 Considerations and Recommendations

Consideration #1: Sufficient post-program data to estimate savings

The annual reporting of program savings poses a challenge to accurately estimating impacts from behavioral programs in Texas as 12 months pre- and post-data are needed to account for seasonal variations. Having 12-months of data is the recognized industry-standard practice as specified in the Department of Energy's Uniform Methods Project (UMP):

"these [behavioral] programs may influence weather-sensitive energy uses, such as space heating or cooling, so collecting less than 1 year of data to reflect every season may yield incomplete results[11]."

Recommendation#1: Behavioral Programs should award incentives and claim savings for 40% of projected savings in the first program year and award the remaining incentives and claim savings the next program year once 12 months of post-program data is available to complete the M&V.

In Texas, a precedence has been established for awarding incentives and claiming savings for custom commercial programs where the required M&V to calculate savings spans program years. In these cases, 40% of the incentives are awarded and savings claimed the first program year based on initial estimated savings. Then in the subsequent program year when M&V is completed, the remaining 60% or 'true-up' of estimated savings is paid and incentives are awarded. The EM&V team asserts that a similar process should be used to estimate behavioral program savings.

[11] The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 17: Residential Behavior Protocol, page 20. While a specific nonresidential behavior protocol is not included in the UMP, this chapter recognizes the same approach is applicable to nonresidential programs though there has been less research and implementation of these programs.

Consideration #2: Measure life

The TRM 3.1 Behavioral Program M&V Protocol states that measure life/lifetime savings are not applicable to behavioral programs (p. 2-40) as only annual savings are to be claimed.

Recommendation #2: Utilities should only claim annual savings for behavioral programs until M&V demonstrates measure persistence

The persistence of behavioral savings after the intervention (e.g., program outreach) has ended is still widely debated in the industry and it is recognized that additional research is needed on the persistence of behavioral savings[12]. While there has been some, though still limited, research for home energy reports for residential programs, there is very little research on savings persistence for nonresidential behavioral programs.

[12] The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 17: Residential Behavior Protocol, page 14.

4.3 MULTI-FAMILY

This section provides guidance on which sector to claim savings for multi-family customers.

During the course of the evaluation effort, there were a couple of situations where utilities requested guidance on where savings from multi-family projects should be claimed. To facilitate savings being claimed consistently at the sector-level for multi-family projects across utilities, the EM&V team provides this guidance memo based on discussion with the utilities and the PUCT Staff as well as practices in other states.

The general guidance is that if a multi-family customer is master-metered, they are a commercial account and savings should be claimed for the commercial sector. If a multi-family customer is individually-metered, savings should be claimed for the residential sector. From discussions with Texas utilities, this is their standard practice and is also the standard practice in others states based on the EM&V team's experience.

4.3.1 Considerations

Below we summarize two specific situations that were discussed in the course of the EM&V with specific utilities that have additional complexities.

Major renovation from multi-metered to individually-metered complex. A multi-family customer was completing major renovations of their facility including moving from master-metered to individually-metered units. In this situation, the savings should be claimed at the residential sector since benefits will accrue to residential customers and the participants are those individual ESIIDS (or other unique identifier).

Natural gas space and water heating. One utility program encourages multi-family natural gas space and water heating through the installation of a central boiler system as opposed to individual electric space and water heating. In these cases, the boiler is a commercial account and the measure is a commercial application. However, savings should be claimed at the residential sector as the benefits accrue to the residential customer and the participants should be the individual electric account ESIIDS (or other unique identifier).

The EM&V team further recommends in these situations; program costs are reported at the same sector as the benefits.

4.4 UPSTREAM LIGHTING

This memo provides guidance on calculating and allocating savings at the sector-level for upstream lighting programs. While these programs primarily target residential customers, a small percent of incentivized bulbs are purchased and used by commercial customers. The recommendations below are to be utilized for upstream lighting programs' claimed savings starting with PY2017.

4.4.1 Overview

An increased number of utilities are offering or planning to offer upstream lighting programs in Texas. It is important that savings are calculated and reported consistently across utilities and in agreement with industry standard practice and the Energy Efficiency Rule 16 TAC § 25.181. The industry refers to the installation of residentially-targeted program light bulbs in commercial applications as "cross-sector sales." Industry standard practice is to allocate an informed percent of upstream program bulbs to the commercial sector to account for cross-sector sales.

The EM&V project manager reviewed twelve upstream lighting evaluation reports or Technical Reference Manuals (TRMs), each of which touched on the topic of cross-sector sales. A summary of research reviewed is at the end of this memo. Overall, the percent of commercial sales attributed to upstream lighting programs ranged from three percent to just under thirteen percent.

4.4.2 Recommendations

Claimed savings by sector. The EM&V team recommends five percent of upstream lighting program benefits and costs be allocated to commercial customers with the remaining 95 percent allocated to residential customers. The recommended cross-sector sales values may be updated in the future as additional industry or Texas-specific research becomes available. While recognizing that the cross-sector sales research reviewed does not specifically address size of customers or rate class, anecdotal evidence is that small commercial customers are most likely to purchase bulbs in retail settings. Small Commercial customers in Texas are typically defined as those with peak demands <=100kW.

Deemed Savings. The utilities' commercial lighting savings calculators include qualified LEDs. Utilities should use the 'office' building type for lighting for the five percent of savings allocated to the commercial sector. The 'office' building type is found in TRM 3.1 Volume 3, Table 2-3, Operating Hours and Coincidence Factors by Building Type.

4.4.3 Research Summary

The table below summarizes the evaluation reports and TRMs reviewed to inform the recommendations for the Texas upstream lighting programs.

4. CROSS SECTOR

Table 4-1: Upstream Lighting Cross-Sector Sales Summaries: Evaluations and TRMs

Utility and/or State	Program	Summary	Publish Date
Arkansas TRM	Retail sales programs implemented by Arkansas utilities	Based on a review of 23 programs across 10 states, the TRM designates that 6.7% of installed lamps are allocated to the commercial program. Commercial savings are calculated based on weighted building types participating in program year.	2015
California PUC	California IOUs upstream lighting programs	Two on-site surveys, CA Lighting and Appliance Saturation Survey, and Commercial Market Share Tracking Commercial Study, were used to develop estimates of the percent of retail sales installed in residential versus non-residential settings. Non-residential bulbs were estimated at 7% of retail sales.	2014
ComEd Illinois	Residential ENERGY STAR® Lighting	Store intercept surveys determined a cross-sector sales value of 3.0%	2014
Consumers Energy Michigan	ENERGY STAR® Residential Lighting Program	Residential phone surveys determined a cross-sector sales percent of 4.7%	2013
Duquesne, Pennsylvania	Efficient Products	Primary research determined a 12.6% value.	2016
Illinois TRM	IOU upstream lighting programs	Documents the default split to be used for Upstream Lighting (96% Res/4% Non-res) under both the residential and commercial ENERGY STAR® lighting	2015
Massachusetts Program Administrators	Residential Lighting	Meta-study of 23 evaluation studies found percent of bulbs going to commercial customers ranged from 0% to 19%. Based on the meta-study, 7 percent of bulbs sales are to be attributed to commercial customers.	2015
Maryland EmPOWER Programs	Residential Lighting and Appliance	In-store intercept surveys were used to estimate percent of commercial retail sales at 5.2%	2012
MidAmerican Energy, Iowa	Upstream lighting program	Research showed 90% of upstream bulbs go to residential customers with the remaining percent going to commercial (3%), Agriculture (4%) and multi-family (3%).	2015
Pennsylvania TRM	ENERGY STAR® lighting	Utilities are instructed to conduct research on the split between residential and non-residential installations. The research should be to determine the percentage of bulbs sold and installed in various types of non-residential applications. Utilities are instructed to use the CF and hours of use by business type for commercial applications.	2016
WI Focus on Energy	Residential Lighting and Appliance	Store intercept study estimated 7.1% of program discounted bulbs were installed in commercial facilities.	2014
Xcel Energy, Colorado	Upstream Lighting	Surveys with Xcel customers and benchmarking of other studies showed non-residential customers range from 3 to 9 percent of upstream bulb sales. Xcel's evaluator recommended a value of 5%.	2015