# Public Utility Commission of Texas

**Texas Technical Reference Manual**

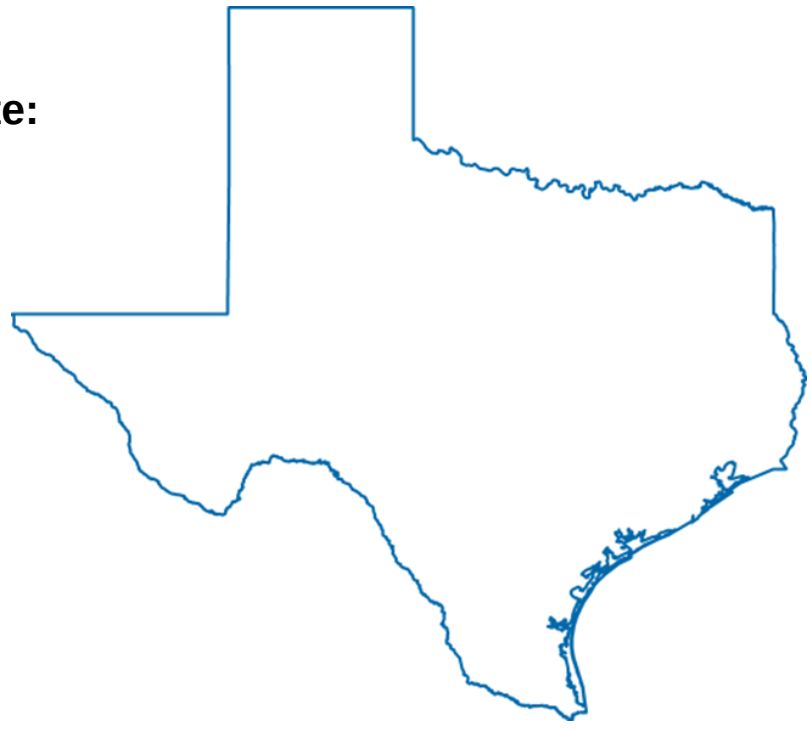
**Version 5.0**

**Volume 5: Implementation Guidance**

**Program Year (PY) 2018**

**Last Revision Date:**

**October 2017**



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## 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:

Residential

- HVAC Early Retirement

Commercial

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

Cross-Sector

- 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 retirement 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 retirement 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 retirement.

### 2.1.1 Background

Historically, residential HVAC and appliance early retirement 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 "replace-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 retirement 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 Retirement

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 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.

[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.

### 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 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 replace-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 Retirement

In order to ensure that early retirement 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 retirement 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 retirement 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.
- **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 retirement 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.

[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.

**Table 2-1: EM&V Recommended Eligibility and Data Tracking Requirements for ER Savings**

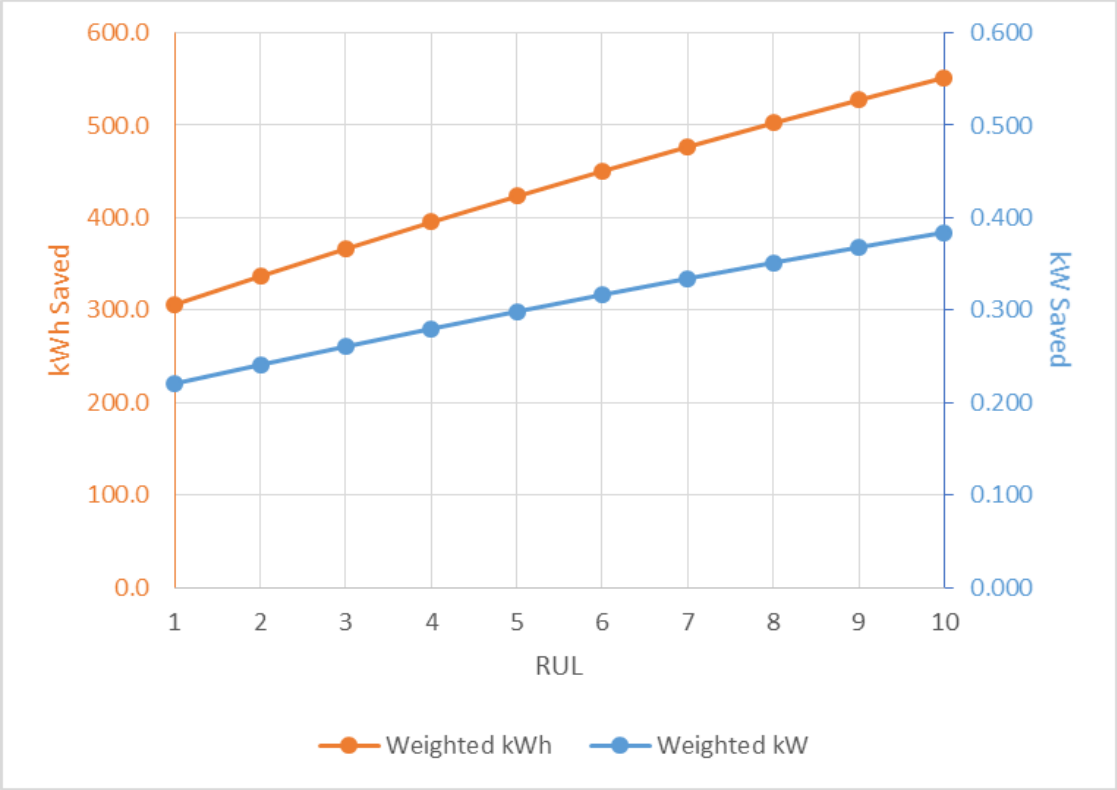
| Measure Name | Recommended Eligibility Requirements | Recommended Additional Data Tracking Requirements |
|---|---|---|
| Central Air Conditioners, Central Heat Pumps and Room Air Conditioners | • Existing unit must be fully operable<br>• For RSOP customers: the age of the existing unit may not exceed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

### 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).

[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.

**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 75$^{th}$ percentile of equipment age on retirement, as determined using the DOE survival curves. Where the age of the unit exceeds the 75$^{th}$ 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

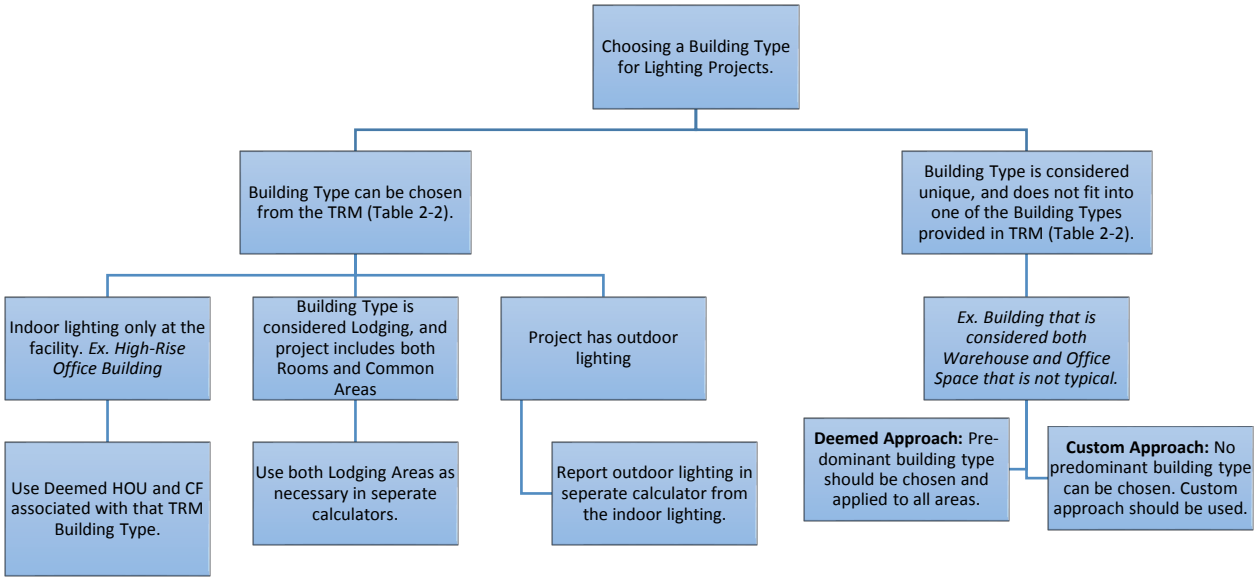
## 3.1 LIGHTING CALCULATOR BUILDING TYPE

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.

**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

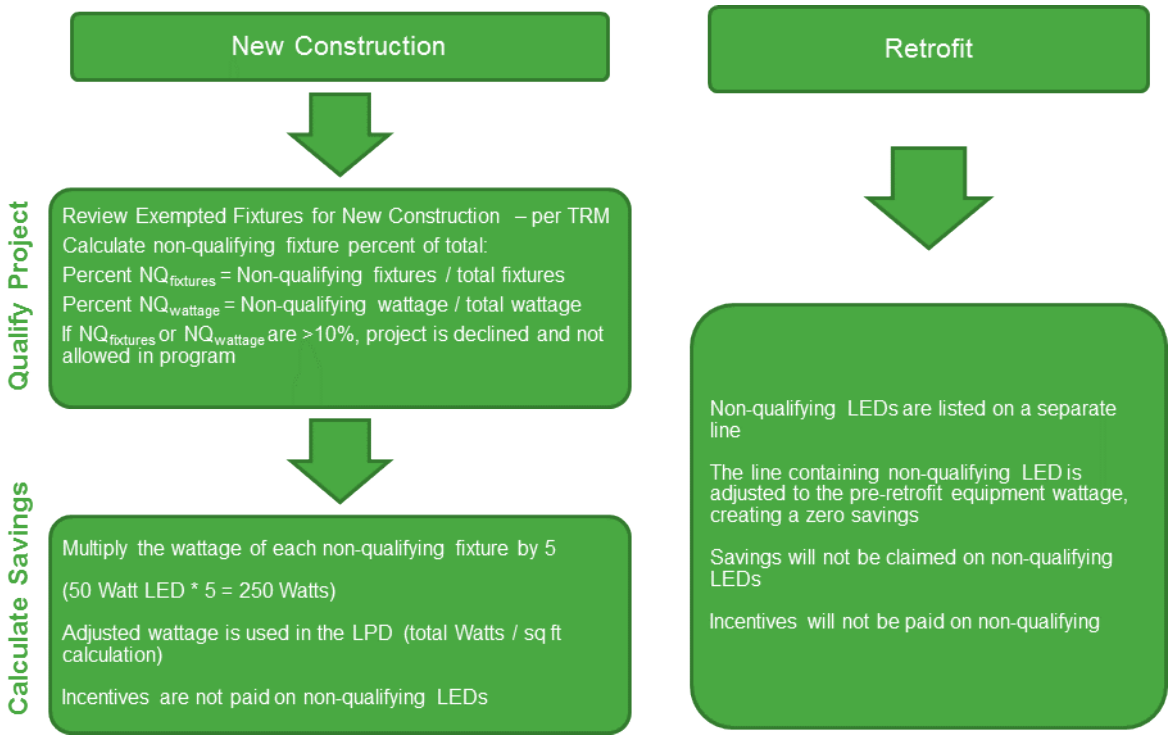
The Texas Technical Reference Manual (TRM) includes the following requirement for LEDs: "LED lamps and fixtures need to be certified by *Design Lights Consortium* (DLC) or *ENERGY STAR®*" (TRM Volume 3, Section 2.1.1). This requirement is to ensure the quality of the products and resulting savings incentivized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

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




Source: Oncor

### 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

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:

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

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

This section summarizes key findings and recommendations from the program year (PY) 2016 evaluation of air-conditioning and heat pump tune-ups to provide additional guidance on calculating savings through a M&V approach. The guidance provided was also incorporated into the PY2016 Statewide Portfolio Report.

### 4.3.1 Introduction

The PY2014 Statewide Portfolio Report detailed findings and recommendations from a census review of CoolSaver air conditioning tune-ups in Section 4.5. One of the key recommendations was that calibration of the model used to develop the stipulated efficiency losses[13] should be completed annually with the M&V data collected in the prior program year. In addition, as part of the PY2014 EM&V, the EM&V team worked with the implementation contractor to develop a M&V protocol for tune-ups to include in the PY2016 TRM version 3.1 Volume 4:M&V Protocols. As part of the PY2016 EM&V efforts, a census review of CoolSaver air conditioning tune-ups was again conducted to assess implementation of the PY2014 recommendations as well as any needed updates to the TRM M&V Protocol for this measure.

### 4.3.2 Measure Overview

In PY2016, over 13,000 tune-up measures were provided to residential and commercial customers through four Texas utilities across seven different program offerings (Table 4-2).

**Table 4-2. PY2016 Tune-Up Summary by Utility and Program**

| Utility | Market Transformation Program | Energy Savings | | Tune-Up Count |
|---|---|---|---|---|
| | | Reported kW | Reported kWh | |
| AEP TCC | CoolSaver[14] | 2,460 | 6,538,402 | 3,791 |
| CenterPoint | Retail Electric Provider[15] | 5,054 | 12,319,136 | 8,716 |
| El Paso Electric | Large Commercial Solutions | 1 | 832 | 1 |
| | Residential Solutions | 7 | 11,974 | 12 |
| | SCORE | 3 | 3,518 | 4 |
| | Small Commercial Solutions | 14 | 24,169 | 27 |
| Entergy | Commercial Solutions | 726 | 2,020,706 | 544 |
| **Total** | | **8,264** | **20,918,737** | **13,095** |

[13] Efficiency loss is the ratio of the air conditioners measured efficiency before and after a tune-up.
[14] AEP TCC's CoolSaver reported kW, reported kWh, and tune-up counts do not include 53 HVAC replacement measures reported in PY2016 as part of the program.
[15] CenterPoint's Retail Electric Provider reported kW, reported kWh, and tune-up counts do not include 103 lighting measures reported in PY2016 as part of the program.

### 4.3.3 Reported Tune-Up Savings Methodology

According to the 2016 CoolSaver Option A M&V Plan methodology, a combined state average of Texas and New Mexico efficiency losses from PY2011 through PY2015 were used to estimate the tune-up savings for PY2016 which are presented in Table 4-3 below by two different tune-up types: those where the refrigerant charge was adjusted and those where they were not. Air conditioners are designed to operate best with a predetermined charge of refrigerant gas as specified by the manufacturer. They rely on the correct charge, or amount of refrigerant gas in their systems, to work correctly. Refrigerant charging refers to the replenishment of these gases when system repairs or leaks have caused depleted levels. Refrigerant may need to be removed from a system that has been over charged as well.

**Table 4-3. Stipulated Tune-up Efficiency Losses (PY2011-PY2015 averages)**

| Refrigerant Charge Adjusted | Efficiency Loss |
|---|---|
| No | 0.149 |
| Yes | 0.110 |

Approximately 10 percent of tune-ups are anticipated by the CoolSaver program to receive M&V in a given year for use in the annual efficiency loss updates. Table 4-4 shows the total tune-ups and M&V quantities by utility that were completed in PY2016. Three of the four utilities were slightly lower than 10 percent while the one utility that conducted 100 percent M&V on their tune-up projects brings the statewide total percentage close to 10 percent.

**Table 4-4. PY2016 M&V Summary by Utility**

| Utility | Tune-Up Count | M&V Count | M&V Percent |
|---|---|---|---|
| AEP TCC | 3,791 | 332 | 8.8% |
| CenterPoint | 8,716 | 838 | 9.6% |
| El Paso Electric | 44 | 44 | 100% |
| Entergy | 544 | 48 | 8.8% |
| **Total** | **13,095** | **1,262** | **9.6%** |

### 4.3.4 Evaluated Savings

First, we discuss the PY2016 evaluation approach followed by results and key findings and recommendations.

### 4.3.5 Evaluation Approach

As a first step, the EM&V team conducted a complete tracking system review for all four utilities that reported tune-ups in 2016. This was then followed by an in-depth review of the M&V sample collected in the field by the programs and an analysis of the current program year's efficiency losses. After reporting initial findings, an error in the tracking data was identified and updated tracking system databases were provided by the implementation contractor for three utilities for re-analysis. Finally, the EM&V team requested the full tune-up M&V dataset from

2011 through 2015 to analyze the efficiency losses, which are the key savings assumption for this measure.

As part of the EM&V team's analysis, a comprehensive review of the full M&V sample from 2011 through 2016 was completed. The tracking datasets from 2011 through 2016 were combined into a single dataset for analysis. The combined M&V dataset included 12,010 individual tune-up measures collected by the programs over the last six years. Each tune-up measure was tested to assure data validity before analysis of the efficiency loss values. The test included the following two procedures.

1. First, projects were checked for acceptable energy efficiency ratios (EER). The $EER_{pre}$ and $EER_{post}$ values were validated as appropriate when they were greater than 0 for both values. Six tune-ups were found invalid per the EER check and were excluded from further analysis.
2. Next, the validity of the refrigerant charge adjustment was checked for appropriateness. There was no single database field available for the status of the Refrigerant Charge Adjustment (RCA), so the EM&V team analyzed multiple fields that reflected the RCA which included the Condition and PercentChange fields for refrigeration circuits 1 and 2 for all projects. Where conflicting data was present, such as a Condition of "Add" with a PercentChange of "0", the data was excluded from the analysis. This review resulted in the exclusion of 85 tune-ups.

A total of 11,919 tune-up measures passed both data checks and were considered valid. Next, the dataset was separated for tune-ups with an RCA and without an RCA. This resulted in identifying 4,934 tune-ups without an RCA and 6,985 tune-ups with an RCA.

Both datasets were reviewed for outliers. Outliers can occur for various reasons, but one of the most common reasons is due to a unit that is not tested at full-load conditions in either the pre or post tune-up case. The outlier review was accomplished by calculating and comparing the pre and post tune-up compressor powers, using the data fields for CompressorVolts and CompressorCurrent. Since all testing is supposed to occur at or near full-load conditions, a difference in the compressor power between pre and post tune-up measurements indicates one of the two measurements may not have been conducted at full load conditions. The differences between the compressor power values were then divided by the nominal tonnage of the units to normalize the differences by capacity. Finally, the statistical ranges of the resulting values were analyzed and any value that was more than 3 standard deviations from the mean was excluded from the efficiency loss calculations. A total of 220 tune-ups were identified as outliers from the compressor power test and excluded from the analysis.

### 4.3.6 Evaluated Results

The tracking system reviews of the PY2016 M&V measures found adherence to the 2016 CoolSaver Option A M&V Plan protocols for tune-up measures. However, during the tracking data reviews, the EM&V team also found that the PY2016 efficiency loss values for the Residential sector deviated substantially from the PY2011-PY2015 averages and from the PY2015 efficiency losses, which are described in more detail next. In addition, the EM&V team found that the current CoolSaver Option A M&V Plan does not address the difference between residential and commercial tune-ups. The EM&V team believes this was due to CoolSaver being primarily all residential tune-ups historically, but there is now strong uptake of the measure

across both residential and commercial customers and therefore an update for the two different sectors is needed.

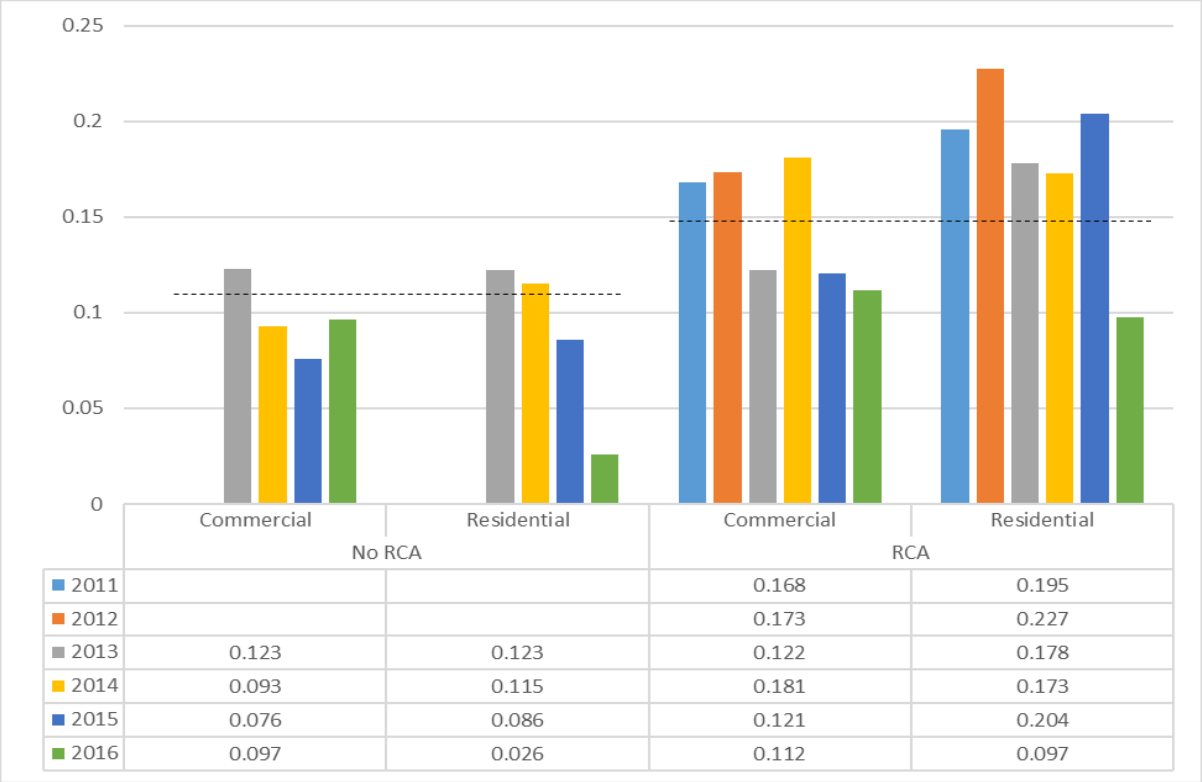
The number of M&V tune-ups validated by year is presented in Table 4-5. The exclusion rate for projects was lower from 2014-2016 (1.3-2.1 percent) compared to 2011-2013 (2.5-4.9 percent). The lower exclusion rate likely reflects the accuracy of the software testing suites, such as iManifold, that have increased in use among trade allies and provides for more accurate data collection.

**Table 4-5. M&V Tune-Ups Validated by Year**

| Year | M&V Tune-Ups | Passed Data Checks | Passed Compressor Power Test | Total Tune-Ups Excluded | Exclusion Rate |
|---|---|---|---|---|---|
| 2011 | 1,163 | 1,143 | 1,106 | 57 | 4.9% |
| 2012 | 638 | 629 | 607 | 31 | 4.9% |
| 2013 | 6,063 | 6,010 | 5,910 | 153 | 2.5% |
| 2014 | 2,065 | 2,064 | 2,029 | 36 | 1.7% |
| 2015 | 819 | 819 | 802 | 17 | 2.1% |
| 2016 | 1,262 | 1,254 | 1,245 | 17 | 1.3% |
| **Total** | **12,010** | **11,919** | **11,699** | **311** | **2.6%** |

The 11,699 Texas tune-ups that passed the data checks were then analyzed by year, by sector (i.e., residential, commercial), and RCA status. Figure 4-1 shows the resulting efficiency losses by year as compared with the efficiency losses from PY2011-PY2015 (black dashed line). The PY2016 Residential efficiency losses (with and without RCAs) were found much lower than values for any previous year. In addition, all four categories for PY2016 were below the PY2011-PY2015 values.

**Figure 4-1. Texas Average Efficiency Losses by Sector and Year**




| | No RCA | | RCA | |
|---|---|---|---|---|
| 2011 | | | 0.168 | 0.195 |
| 2012 | | | 0.173 | 0.227 |
| 2013 | 0.123 | 0.123 | 0.122 | 0.178 |
| 2014 | 0.093 | 0.115 | 0.181 | 0.173 |
| 2015 | 0.076 | 0.086 | 0.121 | 0.204 |
| 2016 | 0.097 | 0.026 | 0.112 | 0.097 |

## 4.3.7 Key Findings

Key findings and applicable recommendations are presented below based on the information gathered in reviews across multiple utilities as well as discussions with the implementation contractor.

***Key Finding #1a: The efficiency losses Determined from M&V measurements appear to be reducing over time.***

The efficiency losses calculated from M&V data for PY2016 were lower than the stipulated efficiency losses for three of the four categories that were analyzed. In addition, for three of the four categories, the efficiency losses represent a historical low compared to previous years. Finally, the efficiency losses for Residential tune-ups were much lower than the corresponding values for Commercial tune-ups in PY2016. These may represent trends in the marketplace over time, where A/C units are receiving tune ups sooner, or possibly the effects of more accurate testing procedures, such as the adoption of iManifold.

**Table 4-6. PY2014-PY2016 Texas Efficiency Losses**

| Sector | Refrigerant Charge Adjusted | Efficiency Loss |
|---|---|---|
| Commercial | No | 0.086 |
| | Yes | 0.149 |
| Residential | No | 0.087 |
| | Yes | 0.152 |

***Recommendation #1A: The EM&V team recommends using a rolling 3-year average[16] of the efficiency losses to reflect this potential change over time and reduce the volatility from year-to-year that is currently seen in the year-to-year efficiency loss values.***

***Key Finding #1b: Annual efficiency losses were found significantly different between Residential and Commercial tune-ups.***

The PY2015 tune-ups' claimed savings in Texas assumed the same efficiency loss values across residential and commercial sectors. The annual efficiency losses when compared between Residential and Commercial tune-ups, are significantly different. The 3-year average efficiency losses are similar, but the EM&V team believes this to be coincidental as averaging any other 3-year periods or comparing annual results indicate a much larger variation.

***Recommendation #1B: Calculate efficiency loss by RCA and Sector using a rolling 3-year average.***

***Key Finding #2: The TRM volume 4 M&V Protocol for A/C Tune-Ups indicate the deemed peak demand coincidence factor (CF) should be determined by Building Type and Climate Zone, while the 2016 CoolSaver M&V Plan provides a default value corresponding to Residential projects only.***

The 2016 CoolSaver Option A M&V Plan provides default values for coincident factors for summer and winter of 0.87 and 0.83, respectively, which correspond to the default Residential values for HVAC systems. The tracking system review indicated these are likely being used across commercial projects as well while the TRM volume 4 M&V protocol guides users to apply commercial HVAC deemed peak demand coincident factors based on the applicable Building Type and Climate Zone for commercial tune-up measures.

***Recommendation #2: Review database algorithms and confirm all projects are using the proper coincident factor values as specified by TRM volume 4. Make revisions as necessary.***

***Key Finding #3: Tune-up measures should continue to collect a robust M&V sample.***

Currently, approximately 10 percent of tune-up measures in Texas collect both test in and test out M&V field measurements by the programs. These M&V samples are used to calculate and

[16] The three-year average should use M&V data from the most recent completed program years. For example, PY2017 efficiency losses are to be calculated from the average of PY2014, PY2015 and PY2016, PY2018 from the average of PY2015, PY2016 and PY2017, etc.

calibrate efficiency losses for all tune-ups completed. Since there is a difference in the efficiency loss values observed in recent years between Commercial and Residential, collecting a large enough sample of sector will help determine if the recent observations are part of a trend in the marketplace.

***Recommendation #3: Continue to collect at least a 10 percent M&V sample for tune-up measures annually for the commercial and residential populations separately.***

***Key Finding #4: A review of the 2011 through 2016 statewide M&V datasets indicated the efficiency losses calculated for recent years is diverging from the aggregated average since PY2011.***

The diverge of the efficiency losses in recent years may be due to potential changes in the marketplace (e.g., more efficient units in current year measures, improved accuracy of results from more experienced contractors, new testing tools in use, automation of testing procedures) or other factors. Until these factors are more thoroughly investigated, it is unknown whether efficiency loss values will continue to change from year to year or remain stable.

**Recommendation #4: Trends over time should be examined to determine if changes in the marketplace are evident from year-to-year.**

**Key Finding #5: The 2016 statwide M&V dataset indicated the average efficiency loss for Residential tune-ups that did not receive a refrigerant charge adjustment (i.e., no RCA) was 0.026. This value is lower than the current stipulated efficiency loss value within the deemed tune-up savings approach in TRM version 4.0.**

The PY2017 TRM version 4.0 includes a new deemed tune-up measure in Volume 2: Residential Measures in addition to the M&V Protocol for the CoolSaver tune-ups found in Volume 4:M&V Protocols. As part of the deemed tune-up savings approach, a stipulated efficiency loss of 0.05 was assumed for all tune-ups. This assumption is applied to residential tune-ups whether the units received a refrigerant charge adjustment or not. This was based on the tune-up results of the EM&V research efforts to identify a conservative efficiency loss for a deemed tune-up. Since that time, efficiency losses have declined to a point where the Residential tune-ups and in particular, those that did not receive a refrigerant charge adjustment, are lower than the TRM stipulation and an adjustment in the deemed measure may be needed in the near future. While the average efficiency loss for Residential units without a refrigerant charge was found to be 0.026 in PY2016, the overall average Residential efficiency loss was 0.072, which is still above the 0.05 TRM 4.0 stipulation. However, if efficiency losses continue to decline in PY2017, then the deemed tune-up efficiency loss assumption may need to be adjusted to stay conservative as compared to actual field results.

**Recommendation #5: The EM&V team will continue to assess tune-up efficiency results by sector and update the TRM deemed approach and efficiency loss stipulation to reflect a conservative value as compared to in-situ field measurements.**

## 4.3.8 Conclusions

The tune-up measures in Texas have continued to evolve from year to year. The EM&V team will work with the utilities and their implementation contractor(s) to assure that the appropriate savings methods and assumptions are adjusted appropriately. To do so, the EM&V team will

again conduct a census review of the CoolSaver tune-ups for PY2017. In addition, the EM&V team will analyze the PY2017 M&V data for tune-ups once it is available at the end of the 2017 program year to provide early identification of changes occurring in the field and confirm the appropriate PY2018 efficiency loss values for the new program year in order to assist utilities and their implementers in program forecasting. This would also allow the EM&V team to validate the deemed efficiency loss values for updates to the TRM.

The PY2016 tune-up evaluation suggests that the market may be evolving in a way that is resulting in impacts to tune-up measure savings that have not been fully accounted for by the TRM M&V Protocol. Further collaboration between the implementers and EM&V team is needed to develop the stipulated savings assumptions in a manner that provides stability to program savings and allows implementers to plan and act appropriately and to revise the M&V Protocol for the next update of the TRM, PY2018 TRM 5.0.

## 4.4 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 other states based on the EM&V team's experience.

### 4.4.1 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.

## 4.5 UPSTREAM LIGHTING

This section 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.

### 4.5.1 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.

### 4.5.2 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.

### 4.5.3 Research Summary

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

**Table 4-7: 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 |