Public Utility Commission of Texas

Volume II—Statewide Energy Efficiency Portfolio Report Program Year 2017

TETRA TECH

TEXAS ENERGY ENGINEERING SERVICES, INC. (www.tcesi.com)

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EM&V team primary report contributors include:

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ACRONYMS/ABBREVIATIONS/DEFINITIONS

Acronyms/Abbreviations	Definition
AC	Air conditioner
AEP TCC	American Electric Power Texas Central
AEP TNC	American Electric Power Texas North
CF	Coincidence factor
C&I	Commercial and industrial
CMTP	Commercial Market Transformation Program
CNP	CenterPoint Energy Houston Electric, LLC
CSOP	Commercial Standard Offer Program
DHP	Ductless heat pump
DI	Direct install
ECM	Energy conservation measure
EECRF	Energy Efficiency Cost Recovery Factor
EEIP	Energy Efficiency Implementation Project
EEPR	Energy Efficiency Plan and Report
EESP	Energy efficiency service provider
EISA	Energy Independence and Security Act of 2007
Entergy	Entergy Texas, Inc.
EPE	El Paso Electric Company
ER	Early replacement
ERCOT	Electric Reliability Council of Texas
ERS	Emergency Response Service
ESCO	Energy service company
ESIID	Electric Service Identifier ID
ESNH	ENERGY STAR® New Homes
EM&V	Evaluation, measurement, and verification
EUMMOT	Electric Utility Marketing Managers of Texas
GSHP	Ground-source heat pump
HCIF	Heating/cooling interactive factor
HOU	Hours of use
HPwES	Home Performance with ENERGY STAR®
HTR	Hard-to-reach
HVAC	Heating, ventilation, and air conditioning

Acronyms/Abbreviations	Definition
IECC	International Energy Conservation Code
IPMVP	International Performance Measurement and Verification Protocol
kW	Kilowatt
kWh	Kilowatt hour
LED	Light emitting diode
LI	Low-income
LI/HTR	Low-income/hard-to-reach
LM	Load management
mcf	1,000 cubic feet
MF	Multifamily
MTP	Market transformation program
M&V	Measurement and verification
NTG	Net-to-gross
PUCT	Public Utility Commission of Texas
PV	Photovoltaics
PY	Program Year
QA/QC	Quality assurance/quality control
RCx	Retro-commissioning
RFP	Request For Proposals
RMTP	Residential Market Transformation Program
ROB	Replace-on-burnout
RSOP	Residential Standard Offer Program
Sharyland	Sharyland Utilities, L.P.
SIR	Savings-to-investment ratio
SOP	Standard offer program
SRA	Self-report approach
SWEPCO	Southwestern Electric Power Company
TMY	Typical meteorological year
TNMP	Texas New Mexico Power Company
TRM	Technical Reference Manual
WACC	Weighted average cost of capital
Xcel SPS	Southwestern Public Service Company (subsidiary of Xcel Energy)

1.0 INTRODUCTION

This document presents the utility impact evaluation results from the third-party evaluation, measurement, and verification (EM&V) results for energy efficiency portfolios implemented in program year (PY) 2017. It is a companion document to Volume I of the Statewide Energy Efficiency Portfolio Report.

PY2017 is the sixth program year evaluated as part of the statewide EM&V effort. The PY2017 scope is targeted impact evaluations for the savings areas of the highest uncertainty identified in the prior EM&V results or changes in programs and/or technologies. The targeted impact evaluations are concentrated on particular commercial and residential programs and end-uses. At the same time, a combination of interval meter data analysis and tracking system reviews provide a due-diligence review of claimed savings for each utility portfolio.

The reviews provided an independent assessment of claimed savings and the accuracy of the program data. Documentation reviewed were tracking data, interval meter data, project files, energy savings calculations (including a review of input assumptions and algorithms to verify claimed program savings), and utilities' existing measurement and verification (M&V) information.

The PY2017 EM&V plans[1] are based on the prioritization for the EM&V effort. To briefly summarize, the EM&V team identified program types across utilities that have similar program design, delivery, and target markets. We reviewed each program type and prioritized (high, medium, low) based on the following considerations:

- Magnitude of savings—percentage of contribution to the portfolio of programs' impacts
- Level of relative uncertainty in estimated savings
- Level and quality of existing quality assurance (QA/QC) and verification data from on-site inspections completed by utilities or their contractors
- Stage of program or programmatic component (e.g., pilot, early implementation, mature)
- Importance to future portfolio performance
- PUCT and Texas utilities' priorities Prior EM&V results
- Known and anticipated changes in the markets in which the programs operate.

1.1 REPORT ORGANIZATION

Section 1.2 summarizes the evaluation approach. Section 2 through Section 11 details the EM&V results for each utility's portfolio.

This report contains several appendices. A visual representation of the EM&V database import, review, and validation process can be found in Appendix A. The calculations used for the program administrator cost test (PACT) (also known as the Utility Cost Test) cost-effectiveness methodology are in Appendix B. The EM&V team's quality assurance plan for the reported evaluated savings is in Appendix C.

[1] *Public Utility Commission of Texas EM&V Plans for Texas Utilities' Energy Efficiency and Load Management Portfolios—Program Year 2017*, June 2018.

1.2 EVALUATION APPROACH

This section discusses the PY2017 EM&V methodology. The foundation of the evaluation process was to create a statewide EM&V database with a streamlined data request process and secure retrieval system. Complete PY2017 program data was requested from utilities and integrated into the database. A visual representation of the EM&V database import, review, and validation process can be found in Appendix A.

The EM&V database allowed the EM&V team to complete:

- Due-diligence review of claimed savings
- Program tracking system reviews
- Efficient sampling across utilities and programs.

Next, the impact evaluation approach is summarized.

1.2.1 Implementing Impact Evaluations

The impact evaluations are used to calculate realization rates. The realization rate is determined by dividing the evaluated savings by the utility claimed savings. Utility claimed savings are verified in the EM&V database from the tracking systems.

The EM&V team performed a tracking system review and series of desk reviews for an initial assessment of the reasonableness of the claimed savings. Primary data was then collected for sampled projects to further assess the accuracy of the claimed savings.

Demand side management program evaluations routinely employ 90 percent confidence intervals with ± 10 percent as the industry standard (“90/10”). The “90 percent” in the confidence interval represents a level of certainty about the estimate. If we were to repeatedly obtain new estimates using exactly the same procedure (by drawing a new sample and calculating new estimates and new confidence intervals), the confidence intervals would contain the average of all the estimates 90 percent of the time. Evaluation activities were designed to achieve 90/10 relative precision for gross evaluated savings estimates at the utility portfolio level based on the sampling process used to select a random sample of commercial participants that received desk reviews and census reviews of residential deemed savings and load management savings. The tracking system and desk reviews are discussed next.

1.2.1.1 Tracking System and Desk Reviews

For each residential program, the EM&V team reviewed the program tracking system and its linkage to any deemed savings tools or methods used to estimate savings at the measure and site level. Then for each medium or high priority program, the EM&V team reviewed a sample of applications entered into the utilities’ tracking systems for accuracy and completeness.

Our review accomplished two primary objectives. First, it ensured that the measures installed are consistent with those listed in the tracking system. Second, the desk reviews verified that the savings estimates in the tracking system are consistent with the savings calculated in the deemed calculation tools or tables or M&V methods used to estimate project savings.

The desk reviews included a review of the assumptions used for the savings assumptions and, when available, utility M&V reports gathered through the supplemental data request for sampled projects.

1.2.1.2 On-Site M&V

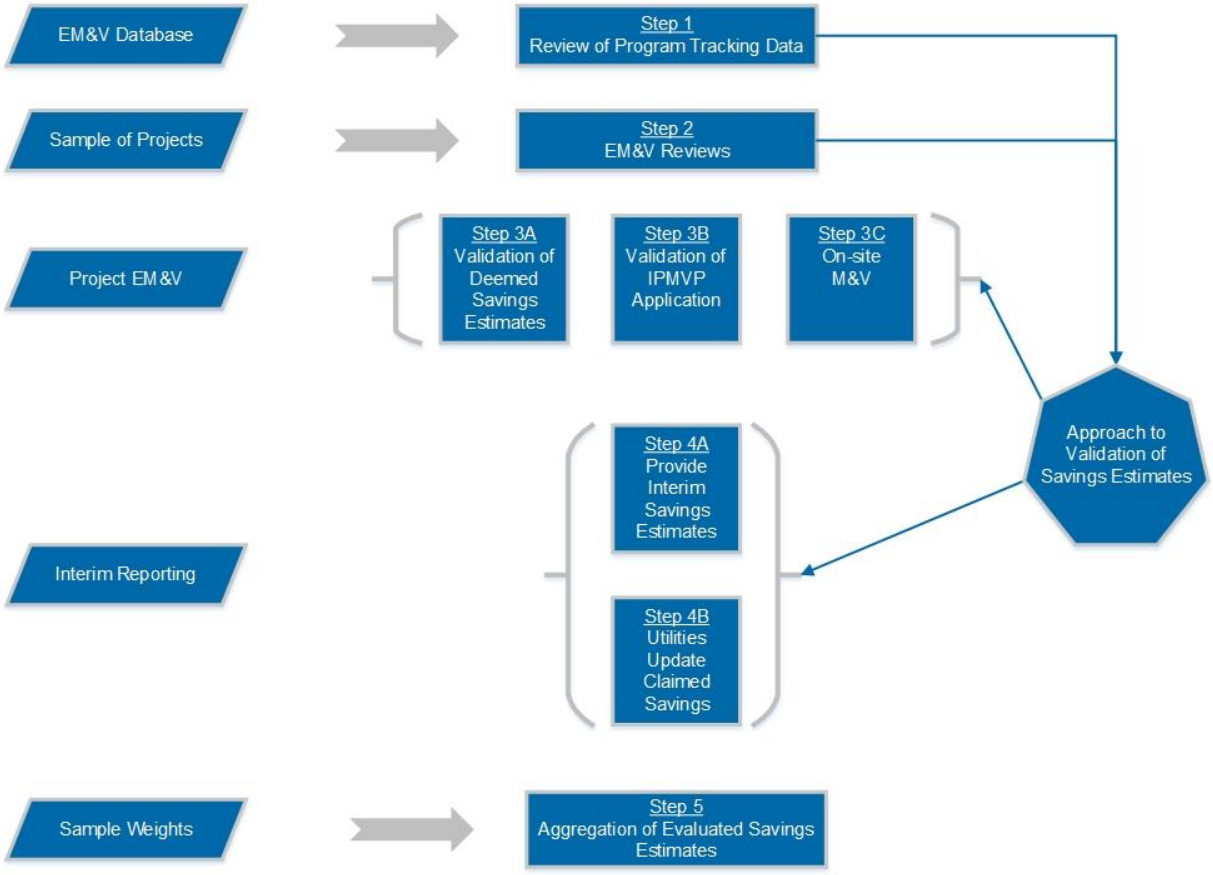
For sampled projects across each utility portfolio, the EM&V team conducted on-site M&V. The on-site visits had two principal objectives — (1) verify installation and operation of the equipment/systems and (2) verify key assumptions made in calculating claimed savings estimates.

- Installations were verified by collecting data on-site related to the number of measures installed, the location of the systems, equipment nameplate information, and a visual inspection to ensure the systems are working as intended. This was a basic inspection audit that took approximately one to two hours to complete.
- Site measurements, spot metering, and/or short and in some cases, long-term metering to develop an independent estimate of savings to compare to the utility's claimed savings estimates. This was a more comprehensive audit that sought to verify key input assumptions used to develop ex-ante claimed savings estimates from deemed savings algorithms or M&V plans for custom projects such as baseline energy use, operating hours, efficiency performance, and potentially interactive effects.

1.2.1.3 Realization Rates

The evaluated savings are based on project-level realization rate calculations that are then weighted to represent program-level and then portfolio-level realization rates. These realization rates incorporate any adjustments for incorrect application of deemed savings values and any equipment details determined through the tracking system and desk reviews. For example, baseline assumptions or hours of use may be corrected through the evaluation and thus affect the realization rates. In order to calculate evaluated savings, we apply the realization rate determined from the EM&V sample to the population of projects. A flow chart of the realization rate calculations is below.

Figure 1-1. Realization Rate Flowchart



1.2.1.4 Program Documentation Score

The EM&V team assigned a "program documentation" score of Good, Fair, or Limited based on the level of program documentation provided to complete a third-party, due-diligence review of claimed savings.

Program documentation scores were assigned as follows:

- **Good:** >=90 percent of sampled projects have sufficient documentation.
- **Fair:** 70 percent–<90 percent of sampled projects have sufficient documentation; the remaining sampled projects had Limited or no documentation. Medium uncertainty was also given to nonresidential programs that had utility M&V results available to verify savings in place of other supporting documentation with the needed equipment quantity and specification information such as equipment cut sheets.
- **Limited:** <70 percent of sampled projects have sufficient documentation; the remaining sampled projects had Limited or no documentation.

Sufficient documentation is defined as the necessary information required to verify savings. For nonresidential programs, this included completed savings calculators, customer invoices, pre- and post-inspection reports, and equipment cut sheets. For residential programs, documentation provided all

inputs needed to replicate the savings calculations based on the deemed savings manual or the approved calculation method as well as supporting materials.

Limited documentation is defined as documentation was provided to verify some, but not all key inputs to savings calculations.

No documentation is defined as only the savings calculator or measure attributes was provided with no supporting materials.

1.2.2 Cost-Effectiveness Testing

The EM&V team conducted cost-effectiveness testing using the PACT method using PY2017 actual results, except for low-income programs, as discussed below. Cost-effectiveness tests were run using a uniform model for all utilities. The EM&V team collected required inputs for the model from several sources, including program tracking data, deemed savings, and the PUCT and utilities. Table 1-1 below lists the required inputs to the cost-effectiveness model and the sources of information.

Table 1-1. Cost-Effectiveness Model Inputs and Sources

Model Input	Measurement Level	Source
Reported energy/demand savings	Measure type	EM&V database
Summer/winter peak coincidence factors	Measure type	Deemed savings
Effective useful life	Measure type	Deemed savings
Incentive payments	Program	EEPRs
Administrative and research and development (R&D) costs	Program/portfolio	EEPRs
EM&V costs[2]	Program/portfolio	EM&V team budgets
Performance bonus[3]	Portfolio	EEPRs
Avoided costs	Statewide	PUCT (utilities)
Weighted average cost of capital (WACC)	Utility	Utilities
Line loss factor (non-ERCOT utilities only)	Utility	Utilities
Realization rates	Program	Evaluation results

The EM&V team conducted PY2017 cost-effectiveness tests separately using claimed gross savings and evaluated gross savings. The model produces results at the portfolio, program category,[4] and program levels.

All benefits and costs are expressed in program year dollars. Benefits resulting from energy savings occurring in future years are net to program year dollars using the utility's weighted average cost of capital (WACC) as the discount rate.

When tests were conducted at a more disaggregated level than data was available, that data was allocated proportionate to costs (§ 25.181 (h)(6)). For example, the performance bonus was calculated for the overall portfolio and allocated to individual programs proportionate to the programs' costs

[2] EM&V costs were not known at the time of utilities' original cost-effectiveness analysis.
[3] Performance bonuses as an input into cost-effectiveness testing came into effect in 2012.
[4] Program categories are currently defined as Commercial, Residential, Low Income, Load Management, and Pilots.

associated with meeting demand and energy goals. These program costs include program administrative and incentive costs. Portfolio-level costs include the performance bonus, EM&V, administrative, and R&D costs.

Low-income programs were evaluated using the SIR. This model only includes net incentive payments under program costs. The SIR methodology is only used when specifically testing the low-income programs.

Portfolio-level cost-effectiveness analyses are based on the PACT and are shown including and excluding low-income and low-income/hard-to-reach customers.

The calculations used for the PACT cost-effectiveness methodology are in Appendix B.

In addition, the EM&V team reported the cost per lifetime kWh and kW. This is calculated by attributing costs to energy savings and avoided demand based on their portion of total benefits and applying that proportion to the total program costs.

1.2.3 Reporting

There are two EM&V report deliverables per program year—(1) Interim Impact Evaluation reports, and (2) the Annual Statewide Portfolio report. There are also a number of status reports, ad hoc reports, data collection and sampling deliverables, and interim results.

The Interim Impact Evaluation reports are delivered separately for each utility and discussed with the PUCT and each utility *prior* to drafting the Annual Statewide Portfolio Report. This allows the EM&V team to discuss the impact results with the PUCT and utilities, receive their input, and conduct supplemental analysis if needed prior to the Annual Statewide Portfolio report. The Annual Statewide Portfolio report is a comprehensive report across all utility portfolios.

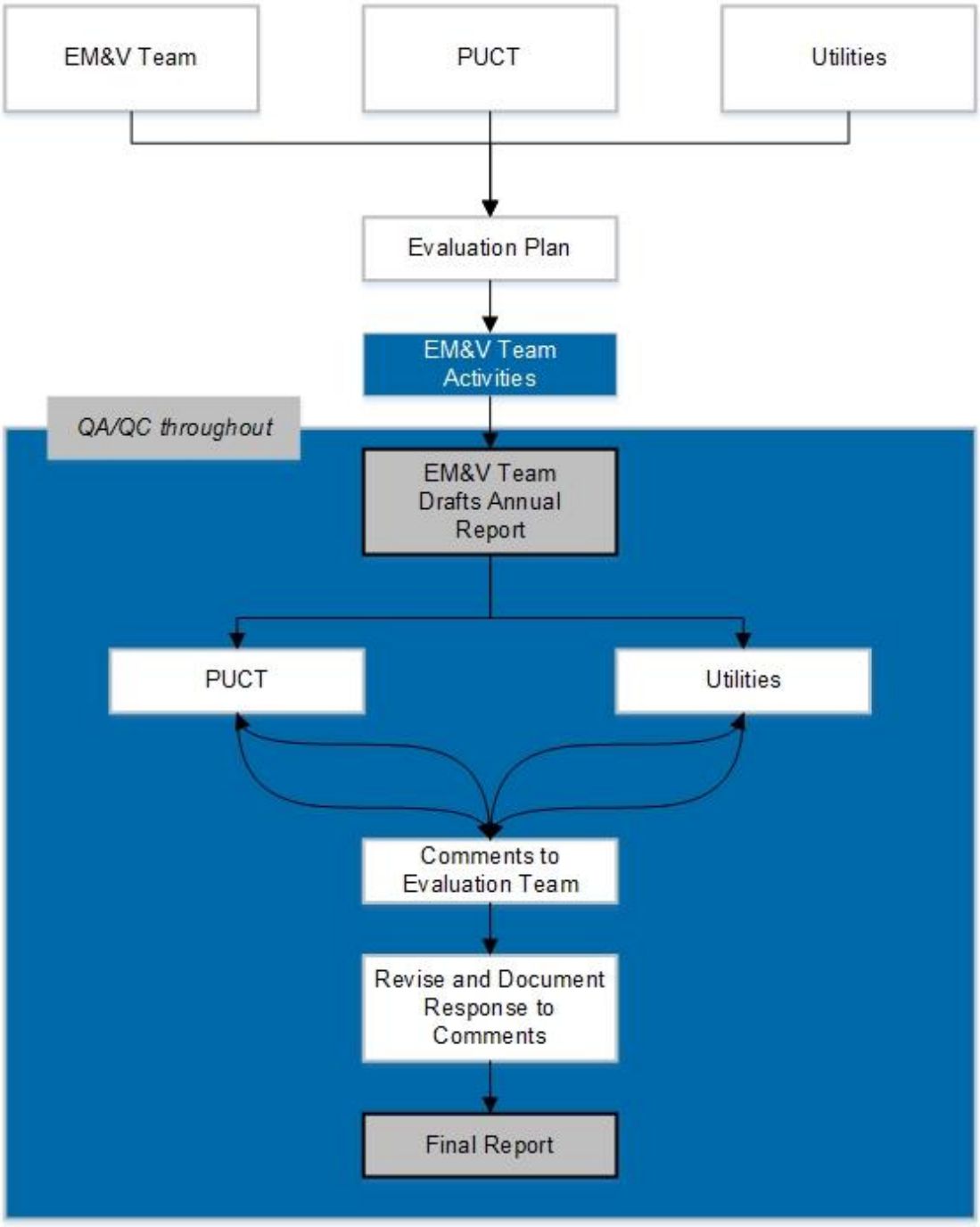
For PY2017, the metrics to be used as the basis for recommendations in the reports is the program's gross savings realization rate and associated program documentation score, tracking system and interval meter data reviews, desk review and on-site M&V findings including site-specific realization rates, and programs' cost-effectiveness.

The EM&V database is at the core of reporting results. It houses the claimed and evaluated savings. The database allows structured queries to provide results by utilities, program categories and types, measure types, and/or sectors. Quality assurance and control (QA/QC) is conducted to ensure that results being entered into and extracted from the database are accurate. The EM&V team's QA/QC plan for the reported evaluated savings are in Appendix C.

The EM&V team encourages feedback and comments on EM&V reports. The EM&V team reviews feedback and documents how it was taken into consideration in finalizing deliverables. While the interim impact reports are distributed and reviewed separately for each utility, the EM&V team seeks input from a larger group of stakeholders on the Annual Statewide Portfolio Report. These are presented and discussed at EEIP meetings between draft and final versions.

The following flow chart describes the general reporting process flow.

Figure 1-2. Reporting Flow Chart



2.0 IMPACT EVALUATION RESULTS—AMERICAN ELECTRIC POWER TEXAS CENTRAL COMPANY

This section presents the evaluated savings and cost-effectiveness results for AEP TCC's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

2.1 KEY FINDINGS

2.1.1 Evaluated Savings

AEP TCC's evaluated savings for PY2017 were 46,009 in demand (kW) and 65,021,306 in energy (kWh) savings. The overall kW and kWh portfolio realization rates are 100 percent. AEP TCC was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which also supported healthy realization rates.

Table 2-1 shows the claimed and evaluated demand savings for AEP TCC's portfolio and broad customer sector/program categories.

Table 2-1. AEP TCC PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**46,002**	**46,009**	**100.0%**	**0.2%**
Commercial	17.1%	7,858	7,865	100.1%	1.0%
Residential	18.0%	8,295	8,295	100.0%	0.0%
Low Income	1.8%	809	809	100.0%	0.0%
Load Management	53.9%	24,783	24,783	100.0%	0.0%
Pilot	9.3%	4,257	4,257	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 2-2 shows the claimed and evaluated energy savings for AEP TCC's portfolio and broad customer sector/program categories for PY2017.

Table 2-2. AEP TCC PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**64,978,871**	**65,021,306**	**100.1%**	**0.4%**
Commercial	57.8%	37,566,812	37,609,247	100.1%	0.7%

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Residential	40.0%	26,018,632	26,018,632	100.0%	0.0%
Low Income	2.1%	1,336,893	1,336,893	100.0%	0.0%
Load Management	0.1%	48,019	48,019	100.0%	0.0%
Pilot	0.0%	8,515	8,515	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of Good, Fair, or Limited as discussed in Section 3. For the overall utility program documentation score, the score of Good was given if 90 percent or more of the evaluated savings estimates received a score of Good or Fair due to program documentation received as indicated in detailed program findings. A score of Fair was given if 70 percent–89 percent of the evaluated savings estimates received a score of Good or Fair. A score of Limited was given if less than 70 percent of savings received score of Good or Fair. In general, a score of Good indicates the utility has established processes to collect sufficient documentation to verify savings; a score of Fair also indicates established processes with some areas of improvements identified; and a score of Limited indicates program documentation improvements across more individual programs and/or high savings programs have been identified.

AEP TCC received a Good program documentation score for its commercial programs, PV programs and load management/demand response programs. However, RSOP and HTR programs both received Limited scores indicating substantial improvement is needed in documentation for these programs. The low income program received a score of Fair indicating there is a need for improvement in consistency in documentation across the program. For all three programs, the EM&V team was limited in verifying key inputs and assumptions for direct installs such as LEDs, faucet aerators, and low flow showerheads. For RSOP and HTR programs, the EM&V team was limited in verifying key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration and duct efficiency, and ceiling insulation. Sufficient documentation was not provided for most of the measures per project across all the projects.

2.1.2 Cost-Effectiveness Results

AEP TCC's overall portfolio had a cost-effectiveness of 2.22, or 2.44 excluding low-income programs.

The more cost-effective programs were SCORE/CitySmart MTP and Commercial SOP. The less cost-effective programs were SMART Source Solar PV MTP and CoolSaver A/C Tune-Up MTP. The Commercial SMART Source Solar PV MTP did not pass cost-effectiveness.

The lifetime cost of evaluated savings was $0.010 per kWh and $21.87 per kW.

Table 2-3. AEP TCC Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**2.2**	**2.2**	**2.0**
Total Portfolio excluding low-income programs	**2.4**	**2.4**	**2.2**
Commercial	**2.8**	**2.8**	**2.6**
Commercial Solutions MTP	3.1	3.1	2.8
Commercial SOP	3.2	3.2	2.9
CoolSaver A/C Tune-up MTP	1.5	1.5	1.2
Open MTP	1.9	1.9	1.8
SCORE/CitySmart MTP	3.8	3.8	3.5
SMART Source Solar PV MTP	0.9	0.9	0.9
Residential	**2.1**	**2.1**	**1.9**
CoolSaver A/C Tune-up MTP	1.0	1.0	0.9
High Performance New Homes MTP	1.5	1.5	1.1
Residential SOP	2.8	2.8	2.5
SMART Source Solar PV MTP	1.1	1.1	1.0
Hard-to-Reach SOP	1.8	1.8	1.8
Low Income*	**1.4**	**1.4**	**1.4**
Targeted Low Income Energy Efficiency Program*	1.4	1.4	1.4
Load Management	**2.2**	**2.2**	**2.2**
Load Management SOP	2.2	2.2	2.2
Pilot	**1.6**	**1.6**	**1.6**
Whisker Labs Residential DR Pilot MTP	1.6	1.6	1.6

* The Low-Income sector and Low Income Weatherization program are evaluated using the savings-to-investment ratio (SIR).

2.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

2.2.1 Commercial Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
5.1%	2,344	2,341	99.9%	24.8%	16,092,365	16,108,279	100.1%	Good

Completed Desk Reviews*	On-Site M&V
10	5

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Commercial SOP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for seven projects. Two projects had adjustments of less than five percent and five projects had adjustments greater than five percent compared to the original claimed savings. AEP TCC accepted the evaluated results and matched the claimed savings to those of the evaluations for the five projects with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 983813. The energy efficiency project included exterior lighting retrofits for multiple roadside billboard signs at a single site. During the desk review and on-site M&V visit, the EM&V team verified the model numbers of the new lighting installed and verified the fixtures to have a rating of 81W compared to 80W claimed. The wattage correction for the project's lights resulted in a negligible decrease in energy and peak demand savings and realization rates of 100 percent kW and kWh.

Project ID # 983814. The energy efficiency project included an air-cooled chiller retrofit at a small hotel. During the desk review and on-site M&V visit, the EM&V team corrected the deemed building type selection used as the basis for the savings calculation. The predominant building type was changed from "Large Hotel" to "Other". The Texas TRM 4.0 Volume 3 defines a large hotel as a facility with an average of six floors and area of 122,120 square feet. The building was verified to be three-stories and a significantly small footprint that would be classified as a small hotel. However, since there is no deemed building type in the TRM for chiller replacement measures for a small hotel, the building type "Other" was determined to be the most appropriate building type selection. This correction reduced energy and demand savings as the deemed equivalent full load hours (EFLH) and coincidence factor (CF) assumptions for climate zone four were reduced from 2,904 to 839 hours per year and a CF of 0.74 to 0.45. Overall, the adjustment resulted in realization rates of 61 percent kW and 29 percent kWh.

Project ID # 1091553. The energy efficiency project included a retrofit of interior and exterior lighting at an office facility. Occupancy sensors were also added for some of the interior lighting while photosensor controls for the outdoor lighting were maintained. During the desk review and on-site M&V visit, the EM&V corrected the LED product wattage based on the site verified lighting installed and using the DLC qualified products list. The interior LED lamps claimed with a mix of

5W and 11W were all adjusted to 6W. The interior LED fixtures claimed at 100W were adjusted to 108W, and the interior LED fixtures claimed at 50W were adjusted to 150W. During the site visit, additional occupancy controls and fixture quantities were found. In addition, two buildings retrofit at the site were found with non-qualified lighting representing a significate portion of installed lighting (70-80 percent). While no incentive or savings were claimed for the non-qualified lighting, the inventory of this lighting was not captured in the project documentation and should be in the future to best reflect the project scope. Overall, the adjustments resulted in a decrease in savings, and a realization rates of 81 percent kW and kWh.

Project ID # 1091625. The energy efficiency project included the new construction installation of HVAC equipment and lighting with some controls within the interior and exterior areas of a secondary school. During the desk review for the HVAC portion of the project, the EM&V team found discrepancies in the documentation provided. The unit size and quantities between the invoice, post-installation photos and the claimed inventories of the ACE calculator were not in alignment. The savings calculations were updated to reflect the documented HVAC sizes and quantities. Overall, the number of HVAC units remained the same, but the total tonnage decreased by 22 tons. The corrections for the HVAC portion of the project resulted in realization rates of 89 percent kW and 94 percent kWh. The project also included an installation of interior and exterior LED lighting and occupancy sensor controls at the school. During the desk review for the lighting portion of the project, the EM&V team adjusted the savings calculations to account for non-qualified lighting that was installed at the site (less than 10 percent) to remove the non-qualified lighting's inclusion in the post lighting power density (LPD) calculations. Other minor corrections were made to fixture wattages to coincide with the LED qualification sheets provided (from 46W to 47W and from 169W to 171W). The corrections for the lighting portion of the project resulted in realization rates of 92 percent kW and 91 percent kWh. Combined, the adjustments resulted in realization rates of 91 percent kW and 92 percent kWh.

Project ID # 1091672. The energy efficiency project included an early replacement of HVAC equipment and interior lighting retrofits at a high school. During the desk review of the HVAC portion of the project, the EM&V team updated the post-installed HVAC unit cooling capacities from tons to BTU/hour to coincide with the air-conditioning, heating, and refrigeration institute (AHRI) rated capacities. The EM&V team also identified one additionally purchased (and likely installed) 7.5-ton unit and included it in the calculations. The corrections for the HVAC portion of the project resulted in realization rates of 97 percent kW and 99 percent kWh. During the desk review for the lighting portion of the project, the EM&V team adjusted the savings calculations to account for non-qualified lighting installed at the site to remove their inclusion in the project savings. Other minor corrections were made to fixture wattages to coincide with the LED model numbers and qualification sheets provided. Overall, the corrections for the lighting portion of the project resulted in realization rates of 82 percent kW and kWh. Combined, the adjustments resulted in realization rates of 92 percent kW and 90 percent kWh.

Project ID # 1091673. The energy efficiency project included the new construction installation of HVAC equipment and lighting within the interior and exterior areas of a medical facility. During the desk review and on-site M&V visit for the HVAC portion of the project, the EM&V team adjusted the rated cooling capacity for two units (from 137,800 to 137,300 Btu/hour, and from 166,900 to 160,700 Btu/hour), and the coefficient of performance (COP) or efficiency for two other units (from 3.9 to 3.99). The corrections for the HVAC portion of the project resulted in a negligible decrease in energy and peak demand savings and realization rates of 100 percent kW and kWh. During the desk review and on-site M&V visit for the lighting portion of the project, the EM&V team found slight differences in fixture quantities and minor corrections to fixture wattages to coincide with the site verified lighting model number installed and using the DLC qualified products list. The interior LED fixtures claimed at 37W were adjusted to 38W and the exterior LED fixtures claimed at 279W

were all adjusted to 225W. The corrections for the lighting portion of the project resulted in realization rates of 103 percent kW and kWh. Combined, the adjustments resulted in realization rates of 101 percent kW and kWh.

Project ID # 1091674. The energy efficiency project included an early replacement of a water cooled centrifugal chiller at a high school. During the desk review, the EM&V team adjusted the manufacturing year of the baseline chiller based on the documentation provided from 1998 claimed to 1999. Overall, the correction resulted in an increase in energy and peak demand savings, and realization rates of 106 percent kW and 102 percent kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for six of the ten projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 94 percent was assessed for the program, as partial documentation was provided for four projects. For one retrofit lighting project, a significant portion of the buildings lighting was found non-qualified. While no incentive or savings were claimed for the non-qualified lighting, it should be included in the building inventories to best reflect the project scope. For a second retrofit lighting project, the model numbers and lighting qualification types (e.g., DLC, ENERGY STAR, non-qualified) were not described for any of the lighting within the claimed lighting calculator. For one new construction lighting project, the project documentation provided Good backup documentation for the lighting fixture portion of the project, but did not included any materials regarding the lighting controls. For a second new construction lighting project, the model numbers and lighting qualification types (e.g., DLC, ENERGY STAR, non-qualified) were not described for any of the lighting within the claimed lighting calculator and non-qualified lighting was not removed from the lighting power density calculations. This type of detail should be documented in the future. Complete documentation enhances the accuracy and transparency of project savings along with ease of evaluation. Since sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of Good.

2.2.2 SCORE/CitySmart Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
4.7%	2,157	2,166	100.4%	15.3%	9,971,832	9,998,353	100.3%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 SCORE/CitySmart MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for three projects. Two projects had adjustments of less than five percent and one project had an adjustment greater than five percent compared to the original

claimed savings. AEP TCC accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 991937. The energy efficiency project included HVAC retrofits at a middle school. During the desk review and on-site M&V visit, the EM&V team adjusted the deemed building type selection used as the basis for the savings calculation. The predominant building type was changed from "School (Secondary)" to "School (Primary)." The Texas TRM 4.0 Volume 3 guides the assumptions that secondary schools are typically high schools with an average floor area of about 211-thousand square feet and are 2-story buildings, and that elementary and middle schools are classified as "primary schools" with typically 1-story and an average of about 74-thousand square feet. The evaluated school was verified during the onsite visit as a single story, 115-thousand square foot middle school, therefore, the most appropriate building type is "primary school." As the project occurred in 2016, the 2016.4 version of the ACE calculator was used along with the TRM 3.0/3.1 assumptions. Therefore, this correction increased energy and demand savings as the deemed equivalent full load hours (EFLH) and coincidence factor (CF) assumptions for climate zone four were increased from 1,704 to 1,738 hours per year and a CF of 0.96 to 0.99. Overall, the adjustment resulted in a slight increase in savings, and realization rates of 103 percent kW and 102 percent kWh.

Project ID # 1043089. The energy efficiency project included a mix of early retirement and replace on burnout retrofits of HVAC equipment at a primary school. During the desk review, the EM&V team adjusted the baseline capacity of seven existing HVAC units based on differences between nominal and rated capacities verified with manufacturers' specifications. In addition, two of the largest baseline units, we found claimed at 12 tons nominal when the actual model numbers indicated 10 tons nominal. This finding had the most impact to savings compared to the adjustments between nominal and rated capacities. Overall, the adjustment resulted in realization rates of 82 percent kW and 87 percent kWh.

Project ID # 1056019. The energy efficiency project included interior and exterior lighting retrofits at high school. During the desk review, the EM&V team corrected lighting wattages for a small number of lighting fixtures and found 14 7W LED lamps and 10 5W LED lamps were described as non-qualified and were not claimed. However, the EM&V team verified the lamps to be ENERGY STAR® qualified and included them in the project savings. The corrections resulted in a negligible increase in energy and peak demand savings and realization rates of 100 percent kW and kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for four of the four projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

2.2.3 CoolSaver A/C Tune-Up Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
3.8%	1,735	1,735	100.0%	5.7%	3,721,860	3,721,860	100.0%	Good

Completed Desk Reviews*	On-Site M&V
Census Tracking Review	0

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 CoolSaver program evaluation efforts focused on a targeted engineering review for a census of tune-up measures reported by the program as listed above.

For PY2017 the EM&V team conducted a complete tracking system review for all four utilities and nine programs that reported tune-ups in 2017 including AEP TCC's commercial CoolSaver program. 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. In PY2016, the efficiency loss factors, which are the major driver of the claimed savings for this measure, for the state-wide population of tune-ups were much lower than in previous years (PY2011-PY2015). In PY2017, the EM&V team examined the efficiency loss factors for both the commercial and residential sectors and found that they were similar to previous program years and the decline observed by the EM&V team in PY2016 did not continue. This alleviates the concern with the efficiency loss factors approaching the deemed values currently in the Texas TRM 4.0 and 5.0 versions. The EM&V team also examined the percentage of projects with full M&V, and found that the utility achieved over 10 percent M&V on their projects. This confirmed that a robust M&V sample was collected.

The EM&V team made no adjustments to any of the savings calculations for the projects reviewed. Therefore, evaluated savings were equal to the claimed savings, with realization rates for both kW and kWh equaling 100 percent.

Document Score

This program only received a tracking system review and the EM&V team did not obtain any project level documentation and is therefore not able to comment on the documentation sufficiency.

2.2.4 Commercial Solutions Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
1.6%	754	754	100.0%	5.7%	3,701,977	3,701,977	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Commercial Solutions MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for one project. The project had an adjustment greater than five percent compared to the original claimed savings. AEP TCC accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 1043220. The energy efficiency project included the retrofit of exterior parking lot lighting and the new construction installation of lighting for a parking garage at a mall facility. During the desk review and on-site M&V visit of the parking lot lighting portion of the project, the EM&V team corrected the LED product wattage based on the site verified lighting installed and using the DLC qualified products list. A total of 187 LED fixtures were adjusted from 380W claimed to 395W. Also, the parking lot lighting operation was found programmed by the site building automation system to shut the lighting off one hour after mall closing, resulting in an estimated 1,314 hours of operation per year with a winter peak coincidence of 0.697 compared to the deemed Texas TRM 4.0 values for the Outdoor building type claimed of 3,996 hours per year and 0.61 coincidence factor. Overall, the corrections for the parking lot retrofit portion of the project resulted in realization rates of 112 percent kW and 32 percent kWh. During the desk review and on-site M&V visit of the new construction parking garage portion of the project, the EM&V team adjusted the LED product wattage based on the site verified lighting installed and using the DLC qualified products list. A total of 218 LED fixtures were adjusted from 80W claimed to 79W. In addition, the parking garage lighting was confirmed to operate based on motion sensor controls that had not been claimed. Overall, the corrections for the new construction parking garage portion of the project resulted in realization rates of 130 percent kW and kWh. Combined, the adjustments resulted in realization rates of 116 percent kW and 58 percent kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for three of the four projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 92 percent was assessed for the program, as partial documentation was provided for two lighting projects. For one lighting project, the project documentation included what appeared to be a calculator as a result of a post inspection, however, no field notes or photos from the post inspection were provided and it was not clear what project details were reviewed during the site

visit or whether a post inspection even occurred. For a second lighting project, the post inspection photographic documentation indicated occupancy sensor controls installed, however, no controls were claimed. The site visit performed by the EM&V team confirmed the lighting controls. In addition, the EM&V team found a building management system in use during the baseline and new case conditions for lighting operation that the claimed project savings did not account for such effects. Care should be taken to investigate the attributes (e.g., existing controls, new controls) necessary for savings calculations of lighting equipment operation. When possible, the existing equipment details and conditions should be cross referenced with the site personnel who are familiar with the equipment history. Complete documentation enhances the accuracy and transparency of project savings along with ease of evaluation. Since sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of Good.

2.2.5 SMART Source Solar PV Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.1%	28	28	100.0%	0.1%	87,121	87,121	100.0%	Good

Completed Desk Reviews*	On-Site M&V
2	1

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 SMART Source Solar PV MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for one project. The project had an adjustment greater than five percent compared to the original claimed savings. AEP TCC accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 1096857. The energy efficiency project included solar PV installation on a commercial space roof. During the desk review, the EM&V team adjusted the azimuth value used for savings calculations, which was verified during the onsite visit, to 28 degrees compared to claimed 180 degrees. Overall, the correction resulted in a decrease in savings, and realization rates of 76 percent kW and 95 percent kWh.

Since sufficient documentation was provided for SMART Source Solar PV MTP, the EM&V team assigned a program documentation score of Good.

2.3 DETAILED FINDINGS—RESIDENTIAL (MEDIUM EVALUATION PRIORITY)

2.3.1 Residential Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
11.4%	5,254	5,254	100.0%	24.9%	16,177,034	16,177,034	100.0%	Limited

Completed Desk Reviews*	On-Site M&V
12	6

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for measures within six projects. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities.

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for 12 projects, and resulted in overall desk review realization rates of 97.5 percent and 100.3 percent for demand and energy savings, respectively. These overall desk review realization rates for the 12 projects were driven by the six projects where an adjustment was made to measures within those projects. For these projects, the energy savings realization rates were 90.6 percent, 92.1 percent, 119.1 percent, 112.5 percent, 107.3 percent, and 102.9 percent, and the demand savings realization rates were 82.1 percent, 83.5 percent, 125.9 percent, 107.9 percent, 104.6 percent and 103.4 percent. The EM&V team identified various factors that led to the differences in calculating evaluated savings for these projects. In particular, the EM&V team determined that the required documentation for air infiltration was missing, which led to the differences between claimed and evaluated savings for two of the projects. More information about the documentation required is below.

- **Air infiltration, pre-leakage cap.** The PY2017 TRM V4.0 contains an eligibility requirement for the air infiltration measure, the application of which led to a difference in claimed and evaluated savings for two projects. The TRM requires all contractors to provide sufficient evidence such as pictures capturing the scope/type of retrofit implemented and blower door test readings for all RSOP homes that reach a CFM reduction percentage within the range of 30–40 percent. In the absence of any evidence, the TRM places a cap of 30 percent CFM reduction for calculating energy and demand savings.

The remaining four projects that affected desk review adjustments were adjusted due to on-site results, and are detailed below.

Additionally, there were minor differences between claimed and evaluated savings for direct installs such as LEDs, faucet aerators, and low flow showerheads due to rounding.

On-site M&V was completed for six projects, and resulted in overall on-site realization rates of 104.1 percent and 105.0 percent for demand and energy savings, respectively. These overall on-site realization rates for the six projects were driven by the EM&V team's on-site testing resulted in substantially higher reduction in air infiltration and duct efficiency than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's blower door test results were quite a bit lower than the results found in the tracking data for two of the projects. Likewise, the duct blaster test results were quite a bit lower for the remaining two projects. These projects had energy savings realization rates of 119.1 percent, 112.5 percent, 107.3 percent, and 102.9 percent and demand savings realization rates of 125.9 percent, 107.9 percent, 104.6 percent, and 103.4 percent.

The EM&V team was Limited in verifying key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration and duct efficiency, as well as direct installs such as LEDs, faucet aerators, and low flow showerheads.

Because sufficient documentation was not provided for most of the measures per project across all the projects, the EM&V team assigned a program documentation score of Limited.

2.3.2 Hard-to-Reach Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
3.0%	1,399	1,399	100.0%	6.0%	3,883,139	3,883,139	100.0%	Limited

Completed Desk Reviews*	On-Site M&V
8	4

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for measures within four projects. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for eight projects, and resulted in overall desk review realization rates of 100.9 percent and 98.2 percent for demand and energy savings, respectively. These overall desk

review realization rates for the eight projects were driven by the four projects where an adjustment was made to specific measures, and were a result of on-site M&V results which are detailed below.

Additionally, there were minor differences between claimed and evaluated savings for low flow showerheads due to rounding. All identified variations due to rounding were within 1 kWh and 0.01 kW.

On-site M&V was completed for four projects, and resulted in overall on-site realization rates of 101.4 percent and 96.8 percent for demand and energy savings, respectively. These overall on-site realization rates for the four projects were driven by the EM&V team's on-site testing resulted in substantially higher or lower reduction in air infiltration and duct efficiency than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's blower door test results were quite a bit lower than the results found in the tracking data for two projects and quite a bit higher for one project. Likewise, the duct blaster test results were quite a bit higher for one project and quite a bit lower for one project. One project had adjustments made to both measures. These projects had energy savings realization rates of 106.3 percent, 79.3 percent, 89.7 percent, and 110.2 percent and demand savings realization rates of 113.3 percent, 90.0 percent, 79.8 percent, and 122.7 percent.

The EM&V team was Limited in verifying key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and low flow showerheads.

Because sufficient documentation was not provided for most of the measures per project across all the projects, the EM&V team assigned a program documentation score of Limited.

2.3.3 CoolSaver A/C Tune-up Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
2.0%	925	925	100.0%	4.8%	3,101,501	3,101,501	100.0%	Good

Completed Desk Reviews*	On-Site M&V
Census Tracking Review	0

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 CoolSaver program evaluation efforts focused on a targeted engineering review for a census of tune-up measures reported by the program as listed above.

For PY2017 the EM&V team conducted a complete tracking system review for all four utilities and nine programs that reported tune-ups in 2017 including AEP TCC's residential CoolSaver program. 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. In PY2016, the efficiency loss factors, which are the major driver of the claimed savings for this measure, for the state-wide population of tune-ups were much lower than in previous years (PY2011-PY2015). In PY2017, the EM&V team examined the efficiency loss factors for both the commercial and residential sectors and found that they were similar to previous program years and the decline observed by the EM&V team in PY2016 did not continue. This alleviates the concern with the efficiency loss factors approaching the deemed values currently in the Texas TRM 4.0 and 5.0 versions. The EM&V team also examined the percentage of projects with

full M&V, and found that the utility achieved over 10 percent M&V on their projects. This confirmed that a robust M&V sample was collected.

The EM&V team made no adjustments to any of the savings calculations for the projects reviewed. Therefore, evaluated savings were equal to the claimed savings, with realization rates for both kW and kWh equaling 100 percent.

Document Score

This program only received a tracking system review and the EM&V team did not obtain any project level documentation and is therefore not able to comment on the documentation sufficiency.

2.3.4 SMART Source Solar PV Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.3%	124	124	100.0%	0.6%	394,641	394,641	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The Residential SMART Source Solar PV MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for one project. The project had an adjustment greater than five percent compared to the original claimed savings. AEP TCC accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 1018371. This project is a solar PV installation on a residential roof. During the desk review, the EM&V team calculated the evaluated ex post savings using the TRM algorithms. Key parameters such as equipment type, number of panels, and azimuth were captured from pre-approval application and supporting documents such as PVWatts print out and equipment spec sheets. The EM&V team found that kW savings were understated by AEP TCC, 26 percent. The kWh savings were confirmed during desk review. The difference in kW savings may have been driven by an incorrect selection of the climate zone. Overall, the correction resulted in an increase in kW savings and no change to kWh savings, with a realization rate of 126 percent for kW and 100 percent for kWh.

Since sufficient documentation was provided for SMART Source Solar PV MTP, the EM&V team assigned a program documentation score of Good.

2.4 DETAILED FINDINGS—LOW INCOME (HIGH/MEDIUM EVALUATION PRIORITY)

2.4.1 Targeted Low Income Energy Efficiency Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
1.8%	809	809	100.0%	2.1%	1,336,893	1,336,893	100.0%	Fair

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews. The sampled number of completed desk reviews for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for measures within three projects. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for four projects and resulted in overall desk review realization rates of 100 percent and 103.4 percent for demand and energy savings, respectively. The overall desk review energy realization rate for the four projects was mainly driven by the three projects where an adjustment was made to the central heat pump measure within those projects. For these three projects, the energy savings realization rates were 80.0 percent, 118.2 percent, and 118.2 percent. The demand savings realization rates were all 100 percent. For the three projects, the EM&V team could not replicate claimed energy savings and determined that an incorrect savings algorithm was used to calculate claimed energy savings resulting in a difference in evaluated energy savings.

Additionally, there were minor differences between claimed and evaluated savings for LEDs due to rounding. All identified variations due to rounding were within 1 kWh and 0.01 kW.

The EM&V team was able to verify key inputs and assumptions for central heat pumps, air infiltration, and ceiling insulation. There was Limited documentation for LEDs, pipe insulation, and low flow showerheads.

Because sufficient documentation was provided for some of the measures per project across all the projects, the EM&V team assigned a program documentation score of Fair.

2.5 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

2.5.1 Load Management Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
53.9%	24,783	24,783	100.0%	0.1%	48,019	48,019	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the AEP TCC Load Management Program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the Electric Service Identifier (ESI ID) level. Load management events occurred on the following dates and times.

- May 25, 2017 from 4:00 p.m.to 5:00 p.m. (scheduled)
- June 7, 2017 from 4:00 p.m.to 5:00 p.m. (scheduled)
- June 22, 2017 from 3:30 p.m.to 5:30 p.m. (unscheduled)
- August 4, 2017 from 1:00 p.m.to 2:00 p.m. (scheduled)
- August 11, 2017 from 1:00 p.m.to 2:00 p.m. (scheduled).

The EM&V team received the interval meter data as well as a spreadsheet detailing the AEP TCC calculated event level savings for each ESI ID enrolled in the program. All ESI IDs participated in at least one scheduled event. In cases where an ESI ID participated only in a single scheduled event, that event became the basis for calculating kW and kWh savings. For those that participated in an unscheduled event and a scheduled event, the unscheduled event was the basis for calculating kW savings, though kWh savings were summed across all events, whether scheduled or unscheduled. The EM&V Team found that all savings calculated by AEP TCC matched those of the EM&V Team.

Evaluated savings for the AEP TCC Load Management program are 24,783 kW and 48,019 kWh. The realization rate for both kW and kWh is 100.0 percent.

2.6 DETAILED FINDINGS—PILOTS (HIGH/MEDIUM EVALUATION PRIORITY)

2.6.1 Whisker Labs Residential Demand Response Pilot Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
9.3%	4,257	4,257	100.0%	0.0%	8,515	8,515	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The EM&V team evaluated the AEP TCC Whisker Labs Residential DR Pilot MTP program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the Electric Service Identifier (ESI ID) level. A single demand response event occurred on June 22, 2017 from 3:30 p.m.to 5:30 p.m.

The EM&V team received interval meter data from Whisker Labs, the program implementer. In an initial calculation, the EM&V team was unable to arrive at the same results as the implementer. In extensive discussions with the implementer, two challenges emerged that caused a deviation in results. First, the interval meter data was found to have been incorrect. Once resolved, the EM&V team and implementer re-ran calculations to develop savings. The result still showed substantial deviation. In further discussion with the implementer and testing several cases in detail, the implementer found that its application of the TRM methodology was not being done correctly. After recalculating savings, the results were close, but lower than the EM&V team's calculations. No further modifications were made to the program's calculations and AEP TCC accepted the EM&V team's results.

Evaluated savings for the AEP TCC Whisker Labs Residential DR Pilot MTP program are 4,257 kW and 8,515 kWh. The realization rate for both kW and kWh is 100.0 percent.

2.7 SUMMARY OF LOW PRIORITY EVALUATION PROGRAMS

Table 2-4 provides a summary of claimed savings for AEP TCC's low evaluation priority programs in PY2017, including programs' overall contribution to portfolio savings. Low priority programs' claimed savings were verified against the final PY2017 tracking data provided to the EM&V team for the EM&V database.

Table 2-4. PY2017 Claimed Savings (Low Evaluation Priority Programs)

Program	Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)
Open MTP	1.8%	842	842	100.0%	6.1%	3,991,657	3,991,657	100.0%
High Performance New Homes MTP	1.3%	592	592	100.0%	3.8%	2,462,317	2,462,317	100.0%

3.0 IMPACT EVALUATION RESULTS—AMERICAN ELECTRIC POWER TEXAS NORTH COMPANY

This section presents the evaluated savings and cost-effectiveness results for AEP TNC's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

3.1 KEY FINDINGS

3.1.1 Evaluated Savings

AEP TNC's evaluated savings for PY2017 were 6,733 in demand (kW) and 12,012,255 in energy (kWh) savings. The overall kW and kWh portfolio realization rates are approximately 100 percent. AEP TNC was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which also supported healthy realization rates. AEP TNC was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which also supported healthy realization rates.

Table 3-1 shows the claimed and evaluated demand savings for AEP TNC's portfolio and broad customer sector/program categories.

Table 3-1. AEP TNC PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**6,739**	**6,733**	**99.9%**	**0.6%**
Commercial	23.9%	1,608	1,602	99.6%	2.9%
Residential	27.5%	1,853	1,853	100.0%	0.0%
Low Income	1.3%	90	90	100.0%	0.0%
Load Management*	41.9%	2,822	2,822	100.0%	0.0%
Pilot	5.4%	367	367	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 3-2 shows the claimed and evaluated energy savings for AEP TNC's portfolio and broad customer sector/program categories for PY2017.

Table 3-2. AEP TNC PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**12,039,118**	**12,012,255**	**99.8%**	**1.7%**
Commercial	66.2%	7,965,126	7,938,263	99.7%	2.8%
Residential	32.4%	3,904,326	3,904,326	100.0%	0.0%
Low Income	1.3%	157,336	157,336	100.0%	0.0%
Load Management*	0.1%	11,231	11,231	100.0%	0.0%
Pilot	0.0%	1,100	1,100	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of Good, Fair, or Limited as discussed in Section 3. For the overall utility program documentation score, the score of Good was given if 90 percent or more of the evaluated savings estimates received a score of Good or Fair due to program documentation received as indicated in detailed program findings. A score of Fair was given if 70 percent–89 percent of the evaluated savings estimates received a score of Good or Fair. A score of Limited was given if less than 70 percent of savings received score of Good or Fair. In general, a score of Good indicates the utility has established processes to collect sufficient documentation to verify savings; a score of Fair also indicates established processes with some areas of improvements identified; and a score of Limited indicates program documentation improvements across more individual programs and/or high savings programs have been identified. AEP TNC received Good documentation scores for all of their commercial, PV and load management programs. RSOP and HTR programs received Fair documentation scores because there was limited documentation to verify direct installs such as LEDs, low flow showerheads, and faucet aerators.

3.1.2 Cost-Effectiveness Results

AEP TNC's overall portfolio had a cost-effectiveness of 2.02, or 2.23 excluding low-income programs.

The more cost-effective programs were Commercial SOP and Commercial Solutions MTP. The less cost-effective programs were the Targeted Low Income Energy Efficiency program and SMART Source Solar PV MTP. The Low Income program fell slightly short of passing the SIR cost-effectiveness test.

The lifetime cost of evaluated savings was $0.011 per kWh and $22.65 per kW.

Table 3-3. AEP TNC Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**2.0**	**2.0**	**1.9**
Total Portfolio excluding low-income programs	**2.2**	**2.2**	**2.1**
Commercial	**2.3**	**2.3**	**2.1**
Commercial Solutions MTP	2.8	2.8	2.5
Commercial SOP	3.0	3.0	2.7
Open MTP	1.4	1.4	1.4
SCORE/CitySmart MTP	2.7	2.8	2.5
SMART Source Solar PV MTP	1.2	1.2	1.2
Residential	**2.2**	**2.2**	**2.0**
Residential SOP	2.6	2.6	2.4
SMART Source Solar PV MTP	1.1	1.1	1.1
Hard-to-Reach SOP	1.8	1.8	1.8
Low Income*	**0.9**	**0.9**	**0.9**
Targeted Low Income Energy Efficiency Program*	0.9	0.9	0.9
Load Management	**1.7**	**1.7**	**1.7**
Load Management SOP	1.7	1.7	1.7
Pilot	**1.4**	**1.4**	**1.4**
Whisker Labs Residential DR Pilot MTP	1.4	1.4	1.4

* The Low-Income sector and Low Income Weatherization program are evaluated using the savings-to-investment ratio (SIR).

3.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

3.2.1 Commercial Solutions Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
8.1%	549	544	99.1%	24.5%	2,947,342	2,923,281	99.2%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Commercial Solutions MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for two projects. One project had an adjustment of less than 5 percent and one project had an adjustment greater than 5 percent compared to the original claimed savings. AEP TNC accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 99 percent. Further details of the EM&V findings are provided below.

Project ID # 990880. The energy efficiency project included interior LED lighting retrofits at an auto parts store. During the desk review and on-site M&V visit, the EM&V team corrected the lighting retrofit quantities, which were assumed to be lower based on the utilities post inspection results at two other similar locations. The EM&V team found this project to be different from the others sampled due to additional space at the facility which included a parts distribution operation in addition to the retail space. This adjustment resulted in an increase in energy and demand savings. The EM&V team also corrected the deemed building type from "Food Sales—Non-24 Hour Supermarket/Retail" to "Retail (Excluding Mall and Strip Center)", which decreased energy and demand savings as the deemed annual operating hours and coincidence factor (CF) assumptions were decreased from 4,706 to 3,668 hours per year and a CF of 0.95 to 0.90. Overall, both adjustments resulted in realization rates of 118 percent kW and 97 percent kWh.

Project ID # 1043276. The energy efficiency project included interior lighting retrofits at a Food Sales—Non-24 Hour Supermarket/Retail Store. During the desk review and on-site M&V visit, the EM&V team corrected the baseline used as the basis for the savings calculation. The project assumed a new construction baseline which may have been due to the absence of a pre-project inspection. However, details from all data and documentation sources, including pre-project drawings, indicated the existing lighting primarily consisted of T8 linear fluorescent lighting. The EM&V team adjusted the calculations to account for a retrofit project instead of new construction. Overall, the adjustments resulted in realization rates of 96 percent kW and kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for four of the four projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 100 percent was assessed for the program, as complete documentation was provided for the four projects reviewed. However, the EM&V team did find that for one retrofit lighting project, a significant portion of the buildings lighting was found not incentivized or claimed by the program for an auto parts store. The additional lighting was originally submitted by the project, but was reduced based on the utilities post inspection results at two other similar locations. The EM&V team found this site to be different from the others sampled due to additional space at the site which included a parts distribution operation at the facility (i.e., the parts storage stockroom was larger) which contributed to the higher lighting quantities as compared to the two sites that received post inspections. When multiple similar projects are claimed, inspection of only a sample of the projects is standard, however, if any of the projects appear unique from the group, then those should be included in the sample. This may have avoided the additional work the utility completed to adjust the sites claims and further adjustments by the EM&V team. In addition, for a new construction lighting project reviewed, the EM&V team confirmed it was actually a retrofit project. Although the utility completed a post-inspection, they did not complete a pre-inspection. The EM&V team found solid details from all data and documentation sources, including pre-project drawings and although new construction may have been viewed as a more conservative path to qualify the project, that was not the case for the project. Care should be taken to investigate the qualification paths of projects and the effects to savings for those qualification selections. Since sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of Good.

3.2.2 Commercial Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
5.8%	393	391	99.5%	17.0%	2,047,551	2,039,881	99.6%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Commercial SOP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for three projects. One project had an adjustment of less than five percent and two projects had adjustments greater than five percent compared to the original claimed savings. AEP TNC accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 983815. The energy efficiency project included lighting retrofits and the early retirement of HVAC equipment at a shared campus facility that is used by both middle school and high school students. During the desk review and on-site M&V visit for the lighting portion of the project, the largest impact was due to the adjustment of the deemed building type from "Education Summer" to "Education No Summer" as the building is typically closed for the summer months. This correction decreased energy and demand savings as the deemed annual operating hours and coincidence factor (CF) assumptions were decreased from 3,577 to 2,777 hours per year and a CF of 0.69 to 0.47. The EM&V team also corrected the indoor LED fixtures to match the site verified lighting model numbers and quantities installed in the facility. Overall, the corrections for the lighting portion of the project resulted in realization rates of 66 percent kW and 75 percent kWh. During the desk review and on-site M&V visit for the HVAC portion of the project, the EM&V team corrected the deemed building type from “Education (Secondary)” to “Education (Primary)” due to the size of the facility and equipment, and its mixed use in supporting primary school operations. The correction for the HVAC portion of the project resulted in a realization rate of 86 percent kW and no change in kWh as no energy savings resulted. Combined, the corrections resulted in realization rates of 66 percent kW and 75 percent kWh.

Project ID # 983819. The energy efficiency project included interior lighting retrofits at a non-mall/strip retail store. During the desk review and on-site M&V visit, the EM&V team corrected pre-and post-retrofit quantities, and post-retrofit wattages for several lighting fixtures at the site. Pre-and post-retrofit quantities of fixtures located within the refrigerated area of the store were adjusted from 14 to 11, in addition to the fixture length, which was adjusted from 5-foot to 4-foot. These corrections resulted in about a four percent savings reduction. The EM&V team also found slight differences in other fixture quantities; in one case, pre- and post-quantities were increased from 16 to 18, and in the other case, post-quantities were decreased from 140 to 114. A minor correction was made to fixture wattage (from 18W to 19W) that was applied to coincide with the site verified lighting model number installed and using the DLC qualified products list. Overall, the adjustments resulted in realization rates of 96 percent kW and kWh.

Project ID # 1039517. The energy efficiency project included interior lighting retrofits at a retail enclosed mall facility. During the desk review, the EM&V team corrected the baseline to include two types of linear fluorescent fixtures compared to just one type in the claimed savings calculations. The post-retrofit fixture quantities were also increased to reflect the project documentation (invoices and post-installation photos). The LED tube wattage was also adjusted from 15W to 13W to coincide with DLC qualified products list. Overall, these corrections resulted in an increase in energy and demand savings, primarily due to the adjusted fixture quantities, and realization rates of 110 percent kW and kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for four of the four projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

3.2.3 SCORE/CitySmart MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
3.7%	251	252	100.2%	10.4%	1,257,884	1,262,751	100.4%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 SCORE/CitySmart MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for three projects. Two projects had adjustments of less than five percent and one project had an adjustment greater than five percent compared to the original claimed savings. AEP TNC accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 991045. The energy efficiency project included interior and exterior lighting retrofits at a college facility. During the desk review and on-site M&V visit, the EM&V team corrected the types and quantities of LED fixtures in two areas at the site. The on-site visit found six 36W LED fixtures in one of the classrooms instead of the four claimed, and found two 36W LED fixtures in the supervisor's office instead of the three claimed. Overall, the adjustments resulted in a slight decrease in savings, and realization rates of 100 percent kW and 99 percent kWh.

Project ID # 991043. The energy efficiency project included lighting retrofits at a college facility. During the desk review and on-site M&V visit, the EM&V team corrected the wattages of interior LEDs to coincide with the site verified lighting model numbers installed and using the DLC qualified products list, from 36W claimed and 118W claimed to 32W and 116W respectively. Overall, the adjustments resulted in a slight increase in savings, and realization rates of 102 percent kW and kWh.

Project ID # 1058720. The energy efficiency project included the custom M&V replacement of an HVAC system with a high-efficiency variable refrigerant flow (VRF) air conditioning system in addition to the new construction installation of air-cooled DX equipment at a secondary school. Note that new construction was assumed versus replace on burnout as the existing air-cooled DX unit data was not captured. During the desk review, the EM&V team did not make any adjustments to the VRF system, but did correct the air-cooled DX portion of the project. The EM&V team found that documentation was not provided (e.g., invoices, specification sheets, AHRI certificates) to indicate that the 89,000 Btu/hour DX unit claimed was installed. Also, no pre- or post-project photographic documents or field notes indicated its presence. Therefore, this unit was removed from the savings calculation. The overall impact to the project by the HVAC unit removal was minimal. The adjustment resulted in realization rates of 97 percent kW and 98 percent kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for eight of the ten projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 96 percent was assessed for the program, as partial documentation was provided for one project. For a new construction HVAC project, a post-inspection included capturing the model number and photographic documentation to verify the equipment installed along with capturing AHRI certificates which are significant efforts by the utility. However, the documents lacked invoices for all units and specification sheets or AHRI certificates for one of the 89,000 Btu/hour DX units claimed. Also, no photographic documents or field notes indicated its presence and the unit was removed from the final savings estimates. While the overall impact to the project by the HVAC unit removal was minimal, care should be taken to investigate the attributes (e.g., quantity, rated capacity) necessary for all units claimed. When invoice documentation is not gathered, the post-inspection field notes and photos should confirm and document all equipment information. Complete documentation enhances the accuracy and transparency of project savings along with ease of evaluation. Since sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of Good.

3.2.4 SMART Source Solar PV MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.7%	45	45	100.0%	1.2%	146,956	146,956	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Commercial SMART Source Solar PV MTP evaluation efforts focused on desk reviews and on-site M&V. During the desk review, the EM&V team calculated the evaluated ex post savings using the TRM algorithms. Key parameters such as equipment type, number of panels, and azimuth were captured from pre-approval application and supporting documents such as PVWatts print out and equipment spec sheets. For projects receiving site visit verification, the site visit observations were used as the basis for the key parameters. The key parameter information was entered into the PVWatts online calculator and created a kWh savings value and the peak kW savings were calculated using the TRM methodology. The EM&V team was able to verify each project did not suggest any savings adjustments. As a result, the final program realization rate is 100 percent for both kW and kWh.

Since sufficient documentation was provided for the AEP TNC Commercial SMART Source Solar PV MTP, the EM&V team assigned a program documentation score of Good.

3.3 DETAILED FINDINGS—RESIDENTIAL (MEDIUM EVALUATION PRIORITY)

3.3.1 Residential SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
19.0%	1,280	1,280	100.0%	22.4%	2,701,122	2,701,122	100.0%	Fair

Completed Desk Reviews*	On-Site M&V
6	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. All on-site M&V projects also had desk reviews. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for measures within two projects. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for six projects, and resulted in overall desk review realization rates of 95.4 percent and 96.2 percent for demand and energy savings, respectively. These overall desk review realization rates for the six projects were driven by the two projects where an adjustment was made to specific measures. For these projects, the energy savings realization rates were 101.6 percent and 15.8 percent, and the demand savings realization rates were 100.6 percent and 15.5 percent. For one of the adjusted projects, the EM&V team could not replicate claimed savings and determined through savings calculations that a different wattage for the LED measure was used for the calculations than was tracked, though limited documentation was available for this project. The other project that was adjusted at the measure-level as part of the desk review process was based on the on-site M&V, and is described in the on-site M&V text below.

Additionally, there were minor differences between claimed and evaluated savings for air infiltration, ceiling insulation, duct efficiency, and low flow showerheads in a number of projects due to rounding.

On-site M&V was completed for three projects, and resulted in overall on-site realization rates of 93.1 percent and 93.5 percent for demand and energy savings, respectively. These overall on-site realization rates were driven by one project where the EM&V team's on-site testing resulted in substantially lower reduction in air infiltration and duct efficiency than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's blower door test results were quite a bit higher than the results found in the tracking data. Additionally, the duct blaster test results were quite a

bit higher. This project had an energy savings realization rate of 15.8 percent, and a demand savings realization rate of 15.5 percent.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, ceiling insulation, and duct efficiency, but was limited on documentation for direct installs such as LEDs and low flow showerheads.

Because sufficient documentation was provided for most, but not all, of the measures per project across all the projects, the EM&V team assigned a program documentation score of Fair.

3.3.2 Hard-to-Reach SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
7.6%	512	512	100.0%	8.4%	1,016,481	1,016,481	100.0%	Fair

Completed Desk Reviews*	On-Site M&V
6	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. All on-site M&V projects also had desk reviews. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for measures within four projects. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for six projects, and resulted in overall desk review realization rates of 100.4 percent and 102.3 percent for demand and energy savings, respectively. These overall desk review realization rates for the six projects were driven by the four projects where an adjustment was made. For these projects, the energy savings realization rates were 117.1 percent, 88.5 percent, 102.5 percent, and 100.1 percent, and the demand savings realization rates were 106.3 percent, 88.7 percent, 100.9 percent, and 100.1 percent. For one of the adjusted projects, the EM&V team could not replicate claimed savings. Due to the claimed savings varying from the evaluated savings by the same factor for the two different measures, the EM&V team determined that an unidentified adjustment factor for the air infiltration and duct efficiency measures was used but we could not verify due to limited documentation for this project. For two of the projects, the EM&V team's calculated LED demand savings had variations greater than 0.001 kW, making the demand realization rates 68.8 percent and 105.9 percent. Energy savings were not adjusted for these two projects. The final project that was adjusted at the measure-level as part of the desk review process was based on the on-site M&V, and is described in the on-site M&V text below.

Additionally, there were minor differences between claimed and evaluated savings for LEDs, due to rounding. All identified variations due to rounding were within 1 kWh and 0.01 kW.

On-site M&V was completed for three projects, and resulted in overall on-site realization rates of 98.2 percent and 99.0 percent for demand and energy savings, respectively. These overall on-site realization rates for the three projects were driven by one project where the EM&V team's on-site testing resulted in substantially lower reduction in duct efficiency than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's duct blaster test results were quite a bit higher than the results found in the tracking data. This project had an energy savings realization rate of 76.2 percent and a demand savings realization rate of 76.2 percent.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and ceiling insulation but was limited in verifying direct installs such as LEDs, low flow showerheads, and faucet aerators.

Because sufficient documentation was provided for some of the measures per project across some of the projects, the EM&V team assigned a program documentation score of Fair.

3.3.3 SMART Source Solar PV MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.9%	61	61	100.0%	1.6%	186,723	186,723	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The Residential SMART Source Solar PV MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for one project. The project had an adjustment greater than five percent compared to the original claimed savings. AEP TNC accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 1018386. This project is a solar PV installation on a residential roof. During the desk review, the EM&V team calculated the evaluated ex post savings using the TRM algorithms. Key parameters such as equipment type, number of panels, and azimuth were captured from pre-approval application and supporting documents such as PVWatts print out and equipment spec sheets. This information was entered into the PVWatts online calculator and created a savings value that is 127 percent of the original AEP TNC calculation for peak kW and 101 percent for kWh. The difference in peak kW is result of a change in the initially proposed design (seven panels were at azimuth 90 in the proposed design, but three of the seven were installed at azimuth 180 and the remaining 4 at azimuth

270). The change in azimuth had a strongly positive effect on energy production at peak times. AEP TNC accepted the EM&V team's calculations and adjusted savings accordingly.

Since sufficient documentation was provided for SMART Source Solar PV MTP, the EM&V team assigned a program documentation score of Good.

3.4 DETAILED FINDINGS—LOW INCOME (HIGH/MEDIUM EVALUATION PRIORITY)

3.4.1 Targeted Low Income Energy Efficiency Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
1.3%	90	90	100.0%	1.3%	157,336	157,336	100.0%	Good

Completed Desk Reviews*	On-Site M&V
2	1

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews. All on-site M&V projects also had desk reviews. The sampled number of completed desk reviews for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for one project. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for two projects, and resulted in desk review realization rates of 100 percent and 97.8 percent for demand and energy savings, respectively. The overall desk review energy realization rate for these two projects was mainly driven by the one project where an adjustment was made. For this one project, the energy savings realization rate was 94.5 percent and the demand savings realization rate was 100 percent. The project that was adjusted at the measure-level as part of the desk review process was based on the on-site M&V, and is described in the on-site M&V text below.

On-site M&V was completed for one project, and resulted in on-site realization rates of 100 percent and 94.5 percent for demand and energy savings, respectively. The project included early retirement savings for a central heat pump measure. As a result of the on-site, the EM&V team determined the baseline equipment was over 20 years old, which is the cut off for early retirement heat pump projects. The EM&V team adjusted the project type to replace-on-burnout, which decreased the savings.

The EM&V team was able to verify key inputs and assumptions for duct efficiency, air infiltration, and central heat pumps.

Because sufficient documentation was provided for all of the measures per project across all the projects, the EM&V team assigned a program documentation score of Good.

3.5 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

3.5.1 Load Management Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
41.9%	2,822	2,822	100.0%	0.1%	11,231	11,231	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the AEP TNC Commercial Load Management program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the Electric Service Identifier (ESI ID) level. Load management events occurred on the following dates and times:

- May 30, 2017 from 3:00 p.m. to 4:00 p.m. (scheduled)
- June 23, 2017 from 3:00 p.m. to 6:00 p.m. (unscheduled)
- June 23, 2017 from 4:00 p.m. to 6:00 p.m. (unscheduled).

The EM&V team received the interval meter data as well as a spreadsheet detailing the AEP TNC calculated event level savings for each ESI ID enrolled in the program. All ESI IDs participated in at least one scheduled event. In cases where an ESI ID participated only in a single scheduled event, that event became the basis for calculating kW and kWh savings. For those that participated in an unscheduled event and a scheduled event, the unscheduled event was the basis for calculating kW savings, though kWh savings were summed across all events, whether scheduled or unscheduled. The EM&V Team found that all savings calculated by AEP TNC matched those of the EM&V Team.

Evaluated savings for the AEP TNC Commercial Load Management program are 2,822 kW and 11,231 kWh. The realization rate for both kW and kWh is 100.0 percent.

3.6 DETAILED FINDINGS—PILOTS (HIGH/MEDIUM EVALUATION PRIORITY)

3.6.1 Whisker Labs Residential DR Pilot MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
5.4%	367	367	100.0%	0.0%	1,100	1,100	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the AEP TNC Whisker Labs Residential DR Pilot MTP program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the Electric Service Identifier (ESI ID) level. A single demand response event occurred on June 23, 2017 from 3:00 p.m. to 6:00 p.m.

The EM&V team received interval meter data from Whisker Labs, the program implementer. In an initial calculation, the EM&V team was unable to arrive at the same results as the implementer. In extensive discussions with the implementer, two challenges emerged that caused a deviation in results. First, the interval meter data was found to have been incorrect. Once resolved, the EM&V team and implementer re-ran calculations to develop savings. The result still showed substantial deviation. In further discussion with the implementer and testing several cases in detail, the implementer found that its application of the TRM methodology was not being done correctly. After recalculating savings, the results were close, but lower than the EM&V team's calculations. No further modifications were made to the program's calculations and AEP TNC accepted the EM&V team's results.

Evaluated savings for the AEP TNC Whisker Labs Residential DR Pilot MTP program are 367 kW and 1,100 kWh. The realization rate for both kW and kWh is 100.0 percent.

3.7 SUMMARY OF LOW PRIORITY EVALUATION PROGRAMS

Table 2-4 provides a summary of claimed savings for AEP TNC's low evaluation priority programs in PY2017, including programs' overall contribution to portfolio savings. Low priority programs' claimed savings were verified against the final PY2017 tracking data provided to the EM&V team for the EM&V database.

Table 3-4. PY2017 Claimed Savings (Low Evaluation Priority Programs)

Program	Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)
Open MTP	5.5%	369	369	100.0%	13.0%	1,565,393	1,565,393	100.0%

4.0 IMPACT EVALUATION RESULTS—CENTERPOINT ENERGY HOUSTON ELECTRIC, LLC

This section presents the evaluated savings and cost-effectiveness results for CenterPoint's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

4.1 KEY FINDINGS

4.1.1 Evaluated Savings

CenterPoint's evaluated savings for PY2017 were 188,410 in demand (kW) and 183,472,379 in energy (kWh) savings. The overall kW and kWh portfolio realization rates are 100 percent. CenterPoint was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which also supported healthy realization rates.

Table 4-1 shows the claimed and evaluated demand savings for CenterPoint's portfolio and broad customer sector/program categories.

Table 4-1. CenterPoint PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**188,424**	**188,410**	**100.0%**	**0.0%**
Commercial	7.0%	13,263	13,267	100.0%	0.2%
Residential	15.2%	28,552	28,552	100.0%	0.0%
Low Income	2.0%	3,858	3,858	100.0%	0.0%
Load Management	75.8%	142,750	142,733	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 4-2 shows the claimed and evaluated energy savings for CenterPoint's portfolio and broad customer sector/program categories for PY2017.

Table 4-2. CenterPoint PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**183,438,548**	**183,471,882**	**100.0%**	**0.2%**
Commercial	46.7%	85,673,525	85,705,552	100.0%	0.2%
Residential	49.6%	90,902,602	90,902,602	100.0%	0.2%

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Low Income	3.3%	6,007,326	6,007,326	100.0%	0.0%
Load Management	0.5%	855,095	856,402	100.2%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of Good, Fair, or Limited as discussed in Section 3. For the overall utility program documentation score, the score of "Good" was given if 90 percent or more of the evaluated savings estimates received a score of Good or Fair due to program documentation received as indicated in detailed program findings. A score of "Fair" was given if 70 percent–89 percent of the evaluated savings estimates received a score of Good or Fair. A score of "Limited" was given if less than 70 percent of savings received score of Good or Fair. In general, a score of "Good" indicates the utility has established processes to collect sufficient documentation to verify savings; a score of "Fair" also indicates established processes with some areas of improvements identified; and a score of "Limited" indicates program documentation improvements across more individual programs and/or high savings programs have been identified. CenterPoint received Good documentation scores for all commercial and residential programs with the exception of the low-income program. The low-income program received a Limited documentation score because the EM&V team was unable to verifying key inputs and assumptions for refrigerators and LEDs.

4.1.2 Cost-Effectiveness Results

CenterPoint's overall portfolio had a cost-effectiveness of 2.42, or 2.64 excluding low-income programs.

The more cost-effective programs were Advanced Lighting and New Homes MTP. The less cost-effective programs were Retail Electric Provider (REP—all sectors), Residential & Small Commercial SOP, Energy Wise Resource Action Program, and Smart Pool program, all of which did not pass cost-effectiveness.

The lifetime cost of evaluated savings was $0.009 per kWh and $18.87 per kW.

Table 4-3. CenterPoint Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**2.4**	**2.4**	**2.0**
Total Portfolio excluding low-income programs	**2.6**	**2.6**	**2.2**
Commercial	**2.0**	**2.0**	**1.8**
Large Commercial SOP	2.5	2.5	2.2
Commercial MTP	1.6	1.6	1.4
Retro-commissioning MTP	1.4	1.4	1.2
Sustainable Schools	2.5	2.5	2.2
REP (CoolSaver) (Com)	0.5	0.5	0.4
Data Centers Program	1.5	1.5	1.3
Advanced Lighting (Com)	5.1	5.1	4.6
Residential	**3.5**	**3.5**	**2.7**
New Homes MTP	6.4	6.4	4.5
Residential & SC SOP	0.6	0.6	0.5
Advanced Lighting	6.8	6.8	6.1
Residential & SC A/C Distributor MTP	1.6	1.6	1.4
REP (CoolSaver & Efficiency Connection) (Res)	0.7	0.7	0.7
Multifamily MTP (Res)	3.3	3.3	2.7
Smart Pool Program	1.2	1.2	1.0
Energy Wise Resource Action MTP	0.9	0.9	0.7
Hard-to-Reach SOP	1.2	1.2	1.2
Multifamily MTP (HTR)	2.4	2.4	2.4
REP (CoolSaver) (HTR)	0.1	0.1	0.1
Low Income*	**2.3**	**2.3**	**2.3**
Targeted Low Income MTP*	2.3	2.3	2.3
Total Portfolio	**2.4**	**2.4**	**2.0**
Total Portfolio excluding low-income programs	**2.6**	**2.6**	**2.2**
Commercial	**2.0**	**2.0**	**1.8**

* The Low Income sector and Low Income Weatherization program are evaluated using the savings-to-investment ratio.

4.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

4.2.1 Large Commercial Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
3.9%	7,340	7,343	100.1%	24.5%	44,918,995	44,951,704	100.1%	Good

Completed Desk Reviews*	On-Site M&V
12	6

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Large Commercial SOP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for nine projects. Five projects had adjustments of less than 5 percent and four projects had an adjustment greater than 5 percent compared to the original claimed savings. CenterPoint accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 986078. The energy efficiency project included lighting retrofits at a manufacturing facility. During the desk review, the EM&V team corrected the type and quantity of pre-retrofit fixtures from 110 Metal Halide fixtures to 100 Metal Halide fixtures and six T12 fluorescent fixtures, which were replaced by 116 LED fixtures. Overall, the increase in the baseline condition resulted in higher savings, and realization rates of 101 percent kW and kWh.

Project ID # 986103. The energy efficiency project included the new construction installation of lighting, HVAC equipment and glazed performance windows at the office area of a warehouse. During the desk review and on-site M&V visit, the EM&V team made adjustments to the HVAC and window savings and did not adjust the lighting savings. For the HVAC portion of the project, the largest impact was due to the adjustment of the 4-ton unit Energy Efficiency Ratio (EER) and Seasonal Energy Efficiency Ratio (SEER) from 12.0 and 14.0 claimed to 11.2 and 13.0 respectively. The corrections for the HVAC portion of the project resulted in an increase in energy savings, and realization rates of 146 percent kW and 140 percent kWh. During the desk review and on-site M&V visit of the glass replacement portion of the project, slight differences in savings calculations were due to rounding of refrigeration efficiencies. The corrections for the window portion of the project resulted in a slight increase in energy savings, and realization rates of 101 percent kW and 100 percent kWh. The lighting portion of the project resulted in realization rates of 100 percent kW and kWh. Combined, the projects at the site resulted in realization rates of 100 percent kW and kWh.

Project ID # 986104. The energy efficiency project included the new construction installation of lighting, HVAC equipment and glazed performance windows at the office area of a warehouse. During the desk review and on-site M&V visit, the EM&V team made adjustments to the HVAC and window savings and did not adjust the lighting savings. For the HVAC portion of the project,

the EM&V team corrected the model number for one of the rooftop units, which resulted in increased efficiencies and savings. The corrections for the HVAC portion of the project resulted in increased energy savings, and realization rates of 138 percent kW and 118 percent kWh. During the desk review and on-site M&V visit of the glass replacement portion of the project, slight differences in savings calculations were due to rounding of refrigeration efficiencies. The corrections for the window portion of the project resulted in a slight increase in energy savings, and realization rates of 101 percent kW and 100 percent kWh. The lighting portion of the project resulted in realization rates of 100 percent kW and kWh. Combined, the projects at the site resulted in realization rates of 100 percent kW and kWh.

Project ID # 1101270. The energy efficiency project included lighting retrofits at a large fitness facility. During the desk review, the EM&V team corrected post-retrofit lighting quantities and wattages to match those of the documentation provided. In addition, the invoice detailed retrofit kits for standard 2'x4' fluorescent fixtures to be a mix of either 15W, 17W, 20W or 21W fixtures, but the reported savings appeared to claim 17W for the 20W LEDs. The EM&V team limited the 17W fixtures to be equal to the invoice quantity and corrected the others to the 20W proposed condition. Overall, the adjustments resulted in realization rates of 101 percent kW and kWh.

Project ID # 1101281. The energy efficiency project included exterior lighting retrofits at a used car dealership. During the desk review and on-site M&V visit, the EM&V team adjusted the quantity of LED pole lights from 213 claimed to 212. This minor adjustment resulted in a negligible effect to the project savings and realization rates of 100 percent kW and kWh.

Project ID # 1101305. The energy efficiency project included an HVAC replacement in addition to interior and exterior lighting retrofits at a midrise apartment facility. During the desk review, the EM&V team made adjustments to the lighting savings and did not adjust the HVAC savings. For the lighting portion of the project, the EM&V adjusted the quantities of exterior lighting fixtures to align with quantities noted in the pre- and post-project inspection notes. In one case, the pre- and post-retrofit quantities were corrected from 3 to 1. In three other cases, post-retrofit quantities were corrected from 12 to 23. Overall, the adjustments resulted in a negligible effect to the project savings, and realization rates of 100 percent kW and kWh.

Project ID # 1101325. The energy efficiency project included implementing multiple refrigeration system upgrades at a food processing facility. During the desk review, the EM&V team found savings very close to reported and believe a negligible difference between claimed and reported savings were likely due to rounding differences. Overall, these adjustments resulted in no change in demand savings and a negligible decrease in energy savings resulting in realization rates of 100 percent kW and kWh.

Project ID # 1101326. The energy efficiency project included interior and exterior lighting retrofits at a non-refrigerated warehouse. During the desk review and on-site M&V visit, the EM&V team corrected the fixture wattages based on the site verified lighting installed and using the DLC qualified products list. The 141 interior high bay LED fixtures were adjusted from 150W claimed to 145W, two exterior pole mounted LED fixtures were adjusted from 201W claimed to 205W, three exterior flood LED fixtures were adjusted from 156W claimed to 147W. Also, the 141 interior high bay fixtures, two exterior pole mounted fixtures, and five (100W) exterior flood fixtures had savings set to zero in the claimed calculator. These were corrected in the evaluations calculations as they were confirmed to be on the DLC qualified product list. During the site visit, the EM&V team verified occupancy sensor controls on 14 LED fixtures in select areas of the warehouse that had not been claimed. Overall, these adjustments resulted in an increase in savings, and realization rates of 131 percent kW and 133 percent kWh.

Project ID # 1101346. The energy efficiency project included the early retirement and replacement of rooftop packaged HVAC units at a movie theater. During the desk review and on-site M&V visit, the EM&V team corrected the unit capacities due to differences between nominal and actual rated values verified with AHRI specifications. The post-installed unit rated capacities were used for the baseline capacities because the rated capacity of the baseline units were unknown and could not be determined from the data provided or the site visit. This adjustment had the largest impact in reducing energy and demand savings. In addition, the building type was changed from "Retail (Stand Alone)" to "Public Assembly," which best represents the building type for a movie theater. This correction increased energy savings and decreased demand savings as the deemed equivalent full load hours (EFLH) was increased from 1,399 to 1,940 hours per year, and the deemed coincidence factor (CF) was reduced from 0.95 to 0.88. The EM&V team also corrected the phase type for one of the HVAC units installed. In the claimed ACE calculations, the phase type was not selected and the calculator defaulted to single phase power, and therefore zero savings were claimed. During the onsite, the unit installed was verified to be a three-phase unit. This correction resulted in an increase in savings for the project. Combined, the adjustments resulted in realization rates of 75 percent kW and 120 percent kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for twelve of the twelve projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

4.2.2 Retrocommissioning Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.1%	172	172	100.0%	1.2%	2,111,423	2,111,423	100.0%	Good

Completed Desk Reviews*	On-Site M&V
2	1

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Retro-commissioning MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team made no adjustments to any of the savings calculations for the projects reviewed. Therefore, evaluated savings were equal to the claimed savings, with realization rates for both kW and kWh equaling 100 percent.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for twelve of the twelve projects that had desk reviews

completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

4.2.3 Commercial Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
2.3%	4,427	4,427	100.0%	16.2%	29,649,151	29,648,469	100.0%	Good

Completed Desk Reviews*	On-Site M&V
12	6

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Commercial MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for six projects. One project had adjustments of less than 5 percent and five projects had an adjustment greater than 5 percent compared to the original claimed savings. CenterPoint accepted the evaluated results and matched the claimed savings to those of the evaluations for all projects with adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 992585. The energy efficiency project included multiple retro-commissioning improvements (e.g., replacing and relocating thermostats, reconfiguring the Energy Management System, delamping, updating lighting schedules, and upgrading lighting fixtures) at a religious facility. During the desk review and on-site M&V visit, the EM&V team used the guidelines of the International Performance Measurement and Verification Protocol (IPMVP) Option C, which included a weather normalized methodology using the pre-and post-regressions in isolation. The normalized method removed the impacts from unseasonable weather during the monitoring periods and resulted in a slight increase in peak demand savings and a slight decrease in energy savings compared to the claimed savings approach. Overall, the adjustments resulted in realization rates of 107 percent kW and 93 percent kWh.

Project ID # 992602. The energy efficiency project included retro-commissioning of the HVAC and lighting equipment as well as lighting retrofits at a religious facility. During the desk review, the EM&V team used the IPMVP Option C, which included a weather normalized methodology using the pre-and post-regressions in isolation. The normalized method removed the impacts from unseasonable weather during the monitoring periods and resulted in a slight reduction in peak demand and energy savings compared to claimed. Overall, the adjustments resulted in realization rates of 90 percent kW and 97 percent kWh.

Project ID # 1039434. The energy efficiency project included the new construction installation of lighting, lighting controls and HVAC equipment at an elementary school. During the desk review and on-site M&V visit, the EM&V team made adjustments to the lighting savings and did not adjust the HVAC savings. For the lighting portion of the project, the EM&V team corrected the high bay lighting fixture wattage from 228W claimed to 235W. The corrections for the lighting

portion of the project were negligible and resulted in realization rates of 100 percent kW and kWh. The HVAC portion of the project resulted in realization rates of 100 percent kW and kWh. Combined, the projects at the site resulted in realization rates of 100 percent kW and 100 percent kWh.

Project ID # 1039440. The energy efficiency project included an HVAC system retrofit, interior lighting retrofits and the installation of occupancy sensors at a primary school. During the desk review, the EM&V team made adjustments to the lighting savings and did not adjust the HVAC savings. For the lighting portion of the project, the EM&V team corrected post-retrofit fixture codes and wattages for exit signs in the building from F42ILL (58W) to EF8/1 (12W) using pre-site submittal notes. In addition, one exit sign was noted to have an occupancy sensor, which was corrected to “no control”. The corrections for the lighting portion of the project resulted in a slight decrease in energy savings, and realization rates of 95 percent kW and 96 percent kWh. The HVAC portion of the project resulted in realization rates of 100 percent kW and kWh. Combined, the projects at the site resulted in realization rates of 97 percent kW and kWh.

Project ID # 1039446. The energy efficiency project included the new construction installation of HVAC equipment, interior lighting with controls, and exterior lighting within a parking lot at an elementary school. During the desk review, the EM&V team corrected the assumptions claimed in the HVAC portion of the project. The largest impact was due to the adjustment of the predominant building type from " School (University/College)" to “School (Primary)”. The building type correction reduced energy and demand savings significantly as the deemed equivalent full load hours (EFLH) and coincidence factor (CF) assumptions for climate zone three were reduced from 1,858 to 818 hours per year and a CF of 0.80 to 0.45. The HVAC portion of the project resulted in realization rates of 56 percent kW and 54 percent kWh. During the desk review of the lighting portion of the project, the EM&V team adjusted the wattage of 247 interior LED lighting fixtures from 20W to 37W. This correction increased the wattage of post-installed interior lighting and decreased the project savings slightly. In addition, the gross lighted area of the outdoor space was adjusted from 6,164 to 96,415 square feet which resulted in the installed exterior lighting fixtures meeting the applicable energy code Lighting Power Density (LPD) for which the claims did not result in savings. The correction for the exterior lighting added 4.58 Winter kW and 29,984 kWh savings to the lighting portion of the project and resulted in realization rates of 104 percent kW and 106 percent kWh. Combined, the projects at the site resulted in realization rates of 84 percent kW and 81 percent kWh.

Project ID # 1039449. The energy efficiency project included the new construction installation of chillers, interior and exterior lighting, and lighting controls at a high school. During the desk review and on-site M&V visit, the EM&V team made adjustments to the lighting savings and did not adjust the chiller savings. For the lighting portion of the project, the EM&V team added 15 metal halide spot lighting fixtures for parking lot illumination to the LED fixtures claimed. This correction resulted in a decrease in exterior lighting savings. For interior lighting, controls claimed for one room of the high school could not be verified. The EM&V team added controls to four rooms in the building that had not been claimed, but verified as installed. The interior lighting inventory corrections increased the project savings slightly. The corrections for the lighting portion of the project resulted in a slight decrease in energy savings, and realization rates of 97 percent kW and 95 percent kWh. The HVAC portion of the project resulted in realization rates of 100 percent kW and kWh. Combined, the projects at the site resulted in realization rates of 97 percent kW and 98 percent kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for 10 of the 12 projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 96 percent was assessed for the program, as partial documentation was provided for two projects. For two new construction projects that consisted of HVAC and lighting installations, a post-inspection included capturing the model number, photographic documentation, and field notes to verify the HVAC equipment installed along with capturing AHRI certificates and equipment proposals which are significant efforts by the utility. However, the only documentation provided for the lighting portion of one project was the lighting calculator. The lighting documentation lacked inspection notes, photos, drawings, specifications, QPL screen shot, and/or invoices. For the second lighting project, the documentation was fairly extensive; however, the equipment specifications and invoices only supported a portion of the lighting installed. Complete documentation enhances the accuracy and transparency of project savings along with ease of evaluation. Since sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of Good.

4.2.4 Data Centers Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.3%	544	544	100.0%	2.3%	4,161,345	4,161,345	100.0%	Good

Completed Desk Reviews*	On-Site M&V
2	1

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Data Centers program evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team made no adjustments to any of the savings calculations for the project reviewed. Therefore, evaluated savings were equal to the claimed savings, with realization rates for both kW and kWh equaling 100 percent.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for twelve of the twelve projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

4.2.5 Retail Electric Provider (CoolSaver) (Commercial)

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.1%	126	126	100.0%	0.1%	223,456	223,456	100.0%	Unranked

Completed Desk Reviews*	On-Site M&V
Census Tracking Review	0

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 CoolSaver program evaluation efforts focused on a targeted engineering review for a census of tune-up measures reported by the program as listed above.

For PY2017 the EM&V team conducted a complete tracking system review for all four utilities and nine programs that reported tune-ups in 2017, including CenterPoint's Commercial CoolSaver program. 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. In PY2016, the efficiency loss factors, which are the major driver of the claimed savings for this measure, for the state-wide population of tune-ups were much lower than in previous years (PY2011–2015). In PY2017, the EM&V team examined the efficiency loss factors for both the commercial and residential sectors and found that they were similar to previous program years and the decline observed by the EM&V team in PY2016 did not continue. This alleviates the concern with the efficiency loss factors approaching the deemed values currently in the Texas TRM 4.0 and 5.0 versions. The EM&V team also examined the percentage of projects with full M&V, and found that the utility achieved over 10 percent M&V on their projects. This confirmed that a robust M&V sample was collected.

The EM&V team made no adjustments to any of the savings calculations for the projects reviewed. Therefore, evaluated savings were equal to the claimed savings, with realization rates for both kW and kWh equaling 100 percent.

Document Score

This program only received a tracking system review, and the EM&V team did not obtain any project level documentation. Therefore, the team was not able to comment on the documentation sufficiency.

4.3 DETAILED FINDINGS—RESIDENTIAL (MEDIUM EVALUATION PRIORITY)

4.3.1 Hard-to-Reach Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.3%	540	540	100.0%	0.3%	587,204	587,204	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	0

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews. The sampled number of completed desk reviews for this program are listed in the table above.

The EM&V team made an adjustment of over 5 percent to the claimed savings for measures within two projects. Overall, the EM&V team assessed claimed energy and demand savings based on desk reviews, which were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system.

Desk reviews were completed for four projects, and resulted in overall desk review realization rates of 86.3 percent and 77.3 percent for demand and energy savings, respectively. These overall desk review realization rates for the four projects were driven by the two projects where an adjustment was made. For these projects, the energy savings realization rates were 46.0 percent and 93.4 percent, and the demand savings realization rates were 46.7 percent and 100 percent. For one of the adjusted projects, the EM&V team found that heating savings were claimed in addition to cooling savings, but the documentation showed the house had no heating system resulting in lower evaluated savings. The summer demand was properly claimed resulting in a 100 percent realization rate. For the other adjusted project, the EM&V team determined that the required documentation for ceiling insulation was missing, which led to the differences between claimed and evaluated savings. More information about the documentation required is below.

- **Ceiling insulation, baseline restriction.** The TRM contains an eligibility requirement for the ceiling insulation measure, the application of which led to a difference in claimed and evaluated savings for one project. TRM V4.0 states for any reported pre-retrofit R-value that falls below R-5, all contractors are required to provide sufficient evidence including two pictures—(1) a picture showing the entire attic floor, and (2) a close-up picture of a ruler that shows the measurement of the depth of the insulation. In the absence of evidence demonstrating pre-retrofit ceiling insulation below R-5, the lowest level of pre-retrofit ceiling insulation that can be claimed is the R-5 to R-8 range.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition) for ceiling insulation for a majority of the projects.

Because sufficient documentation was provided for almost all of the measures per project, except for one, the EM&V team assigned a program documentation score of Good.

4.3.2 Residential & Small Commercial Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.0%	72	72	100.0%	0.1%	134,764	134,764	100.0%	Good

Completed Desk Reviews*	On-Site M&V
3	0

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews. The sampled number of completed desk reviews for this program are listed in the table above.

The EM&V team made an adjustment of over 5 percent to the claimed savings for measures within two projects. Overall, the EM&V team assessed claimed energy and demand savings based on the desk reviews, which were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system.

Desk reviews were completed for three projects, and resulted in overall desk review realization rates of 100 percent and 93.6 percent for demand and energy savings, respectively. These overall desk review realization rates for the three projects were driven by the two projects where an adjustment was made to the energy savings. For these projects, the energy savings realization rates were 91.0 percent and 91.1 percent, and the demand savings realization rates were both 100 percent. The EM&V team determined an incorrect version of the TRM was used to calculate the claimed savings, resulting in higher savings than the evaluated savings.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- equipment) for central air conditioners.

Because sufficient documentation was provided across all the projects, the EM&V team assigned a program documentation score of Good.

4.3.3 Retail Electric Provider (CoolSaver & Efficiency Connection)

Sector	Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
Res	1.0%	1,849	1,849	100.0%	2.9%	5,284,572	5,284,572	100.0%	Unranked
HTR	0.0%	1	1	100.0%	0.0%	2,958	2,958	100.0%	Unranked

Completed Desk Reviews*	On-Site M&V
Census Tracking Review	0

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 CoolSaver program evaluation efforts focused on a targeted engineering review for a census of tune-up measures reported by the program as listed above.

For PY2017 the EM&V team conducted a complete tracking system review for all four utilities and nine programs that reported tune-ups in 2017, including CenterPoint's Commercial CoolSaver program. 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. In PY2016, the efficiency loss factors, which are the major driver of the claimed savings for this measure, for the state-wide population of tune-ups were much lower than in previous years (PY2011-PY2015). In PY2017, the EM&V team examined the efficiency loss factors for both the commercial and residential sectors and found that they were similar to previous program years and the decline observed by the EM&V team in PY2016 did not continue. This alleviates the concern with the efficiency loss factors approaching the deemed values currently in the Texas TRM 4.0 and 5.0 versions. The EM&V team also examined the percentage of projects with full M&V, and found that the utility achieved over 10 percent M&V on their projects. This confirmed that a robust M&V sample was collected.

The EM&V team made no adjustments to any of the savings calculations for the projects reviewed. Therefore, evaluated savings were equal to the claimed savings, with realization rates for both kW and kWh equaling 100 percent.

Document Score

This program only received a tracking system review, and the EM&V team did not obtain any project level documentation. Therefore, the team was not able to comment on the documentation sufficiency.

4.4 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

4.4.1 Large Commercial Load Management Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
66.6%	125,559	125,540	100.0%	0.4%	751,943	753,243	100.2%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the CenterPoint Large Commercial Load Management program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the Electric Service Identifier (ESI ID) level. Load management events occurred on the following dates and times:

- July 27, 2017 from 2:00 p.m. to 5:00 p.m.
- August 8, 2017 from 2:00 p.m. to 5:00 p.m.

The EM&V team received the interval meter data as well as spreadsheets detailing the CenterPoint calculated baseline load, event load, and savings results for each event and ESI ID. The EM&V team found calculation differences on eight ESI IDs and identified that enrollees with negative savings were being included in CenterPoint's calculations. The eight cases with savings differences were resolved with CenterPoint correcting a calculation error. In the case of enrollees with negative savings, CenterPoint elected to have them treated as non-participants for specific events, in accordance with EM&V team guidance and general practice. The total program savings were adjusted slightly higher. Minor calculation differences were attributed to aggregate rounding effects across the ESI IDs.

Evaluated savings for the CenterPoint Large Commercial Load Management program are 125,540 kW and 753,243 kWh. The realization rate for kW is 100.0 percent and kWh is 100.2 percent.

4.4.2 Residential Demand Response Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
9.1%	17,192	17,193	100.0%	0.1%	103,152	103,159	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

*The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the PY2016 CenterPoint Residential Demand Response program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the ESI ID level. Load management events occurred on the following dates and times:

- July 27, 2017 from 2:00 p.m. until 5:00 p.m.
- August 17, 2017 from 2:00 p.m. until 5:00 p.m.

The EM&V team received the interval meter data as well as spreadsheets detailing the CenterPoint calculations for each ESI ID. In the initial round of calculations, the EM&V team did not calculate results that aligned with CenterPoint. In collaborating with CenterPoint, it was found that there was a calculation error made in applying the adjustment cap to the wrong set of hours. Additionally, a few hundred homes were found to have had an incorrect time stamp applied to their data. CenterPoint provided the corrected interval data and recalculated savings, with aggregate results very close to the EM&V Team's results. The remaining differences were insignificant.

Evaluated savings for the CenterPoint Residential Demand Response Program are 17,193 kW and 103,159 kWh. The realization rate for kW is 100.0 percent and kWh is 100.0 percent.

4.5 DETAILED FINDINGS—LOW INCOME (HIGH/MEDIUM EVALUATION PRIORITY)

4.5.1 Targeted Low-Income Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
2.0%	3,858	3,858	100.0%	3.3%	6,007,326	6,007,326	100.0%	Limited

Completed Desk Reviews*	On-Site M&V
2	0

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews. The sampled number of completed desk reviews for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for measures within one project. Overall, the EM&V team assessed claimed energy and demand savings based on the desk reviews, which were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system.

Desk reviews were completed for two projects, and resulted in overall desk review realization rates of 21.1 percent and 33.2 percent for demand and energy savings, respectively. The overall desk review realization rate for these two projects was mainly driven by the one project where an adjustment was made. For this one project, the energy savings realization rate was 28.9 percent and the demand savings realization rate was 16.2 percent. Because the project was missing key variables to calculate the site-specific savings, the EM&V team instead used the alternative deemed method as described in the TRM to determine evaluated savings. This resulted in substantially lower savings.

Additionally, the EM&V team was Limited in verifying key inputs and assumptions for refrigerators and LEDs.

Because sufficient documentation was not provided for all the measures per project, the EM&V team assigned a program documentation score of Limited.

4.6 SUMMARY OF LOW PRIORITY EVALUATION PROGRAMS

Table 2-4 provides a summary of claimed savings for CenterPoint's low evaluation priority programs in PY2017, including programs' overall contribution to portfolio savings. Low priority programs' claimed savings were verified against the final PY2017 tracking data provided to the EM&V team for the EM&V database.

Table 4-4. PY2017 Claimed Savings (Low Evaluation Priority Programs)

Program	Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)
Sustainable Schools	0.2%	466	466	100.0%	2.0%	3,661,656	3,661,656	100.0%
Advanced Lighting (Com)	0.1%	189	189	100.0%	0.5%	947,499	947,499	100.0%
New Homes MTP	8.3%	15,708	15,708	100.0%	28.0%	51,344,879	51,344,879	100.0%
Advanced Lighting (Res)	1.9%	3,596	3,596	100.0%	9.8%	18,002,485	18,002,485	100.0%
Multifamily MTP (Res)	0.9%	1,616	1,616	100.0%	1.5%	2,794,741	2,794,741	100.0%
Multifamily MTP (HTR)	0.5%	1,035	1,035	100.0%	0.5%	991,265	991,265	100.0%
Smart Pool Program	0.4%	723	723	100.0%	1.5%	2,757,330	2,757,330	100.0%
Energy Wise Resource Action MTP	0.3%	475	475	100.0%	0.7%	1,302,387	1,302,387	100.0%

5.0 IMPACT EVALUATION RESULTS—EL PASO ELECTRIC COMPANY

This section presents the evaluated savings and cost-effectiveness results for El Paso Electric's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

5.1 KEY FINDINGS

5.1.1 Evaluated Savings

El Paso Electric's evaluated savings for PY2017 were 15,276 in demand (kW) and 23,258,304 in energy (kWh) savings. The overall kW and kWh portfolio realization rates are 100 percent. El Paso Electric was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which also supported healthy realization rates.

Table 5-1 shows the claimed and evaluated demand savings for El Paso Electric's portfolio and broad customer sector/program categories.

Table 5-1. El Paso Electric PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**15,276**	**15,276**	**100.0%**	**0.0%**
Commercial	25.5%	3,897	3,897	100.0%	0.0%
Residential	11.1%	1,699	1,699	100.0%	0.0%
Load Management*	63.4%	9,679	9,679	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 5-2 shows the claimed and evaluated energy savings for El Paso Electric's portfolio and broad customer sector/program categories for PY2017.

Table 5-2. El Paso Electric PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**23,258,304**	**23,258,304**	**100.0%**	**0.0%**
Commercial	83.9%	19,524,626	19,524,626	100.0%	0.0%
Residential	15.9%	3,708,678	3,708,678	100.0%	0.0%
Load Management*	0.1%	25,000	25,000	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of good, fair, or limited as discussed in Section 3. For the utility program documentation score, the score of "good" was given if 90 percent or more of the evaluated savings estimates received a score of good or fair due to program documentation received as indicated in detailed program findings. A score of "fair" was given if 70–89 percent of the evaluated savings estimates received a score of good or fair. A score of "limited" was given if less than 70 percent of savings received score of good or fair. In general, a score of "good" indicates the utility has established processes to collect sufficient documentation to verify savings; a score of "fair" also indicates established processes with some areas of improvements identified; and a score of "limited" indicates program documentation improvements across more individual programs and/or high savings programs have been identified.

El Paso Electric received a good program documentation score for its Commercial, Load Management and Residential Solutions programs. The Hard-to-Reach program had sufficient document to verify key inputs and assumptions (e.g., pre- and post- condition test results) for LEDs and ceiling insulation. However, there was limited documentation for direct installs, such as faucet aerators and low flow showerheads; therefore, the program received a "fair" score overall.

5.1.2 Cost-Effectiveness Results

El Paso Electric's overall portfolio had a cost-effectiveness of 2.74.

The more cost-effective programs were Large C&I Solutions MTP and Commercial SOP though this program was discontinued in PY2017 and therefore only represents the program wrap-up. The less cost-effective programs were Hard-to-Reach Solutions MTP And Load Management SOP.

The lifetime cost of PY2017 evaluated savings was $0.010 per kWh and $19.74 per kW.

Table 5-3. El Paso Electric Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**2.7**	**2.7**	**2.5**
Commercial	**2.7**	**2.7**	**2.5**
Commercial SOP	3.5	3.5	3.2
Small Commercial Solutions MTP	3.6	3.6	3.3
Large C&I Solutions MTP	2.7	2.7	2.6
Texas SCORE MTP	4.3	4.3	3.9
Residential	**2.7**	**2.7**	**2.5**
Residential Solutions MTP	1.8	1.8	1.6
LivingWise MTP	2.1	2.1	1.9
Hard-to-Reach Solutions MTP	1.7	1.7	1.3
Load Management	**1.6**	**1.6**	**1.6**
Load Management SOP	1.5	1.5	1.5

5.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

5.2.1 Large C&I Solutions MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
14.6%	2,230	2,230	100.0%	48.0%	11,162,028	11,162,028	100.0%	Good

Completed Desk Reviews*	On-Site M&V
7	4

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Large C&I Solutions MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for six projects. Two projects had an adjustment of less than five percent and four projects had an adjustment of greater than five percent compared to the original claimed savings. El Paso Electric accepted the evaluated results and matched the claimed savings to those of the evaluations for the four projects with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 990284. The energy efficiency project included lighting retrofits of incandescent lighting with LED lamps within the interior areas of a non-24 hour restaurant. During the desk review and on-site M&V visit, the EM&V team verified the model number of the new lamp installed throughout the restaurant which was verified to have a rating of 9W compared to 8W claimed. This correction resulted in a small decrease in energy and peak demand savings and realization rates of 98 percent kW and kWh.

Project ID # 990841. The energy efficiency project included lighting retrofits within the interior and exterior areas of a manufacturing facility. During the desk review and on-site M&V visit, the EM&V team completed corrections for the deemed building type selection and lighting quantities verified at the site. The deemed building type for a portion of the lighting was changed from an "office" building type to "manufacturing" to reflect the overall facility use and predominant building type. The building type correction increased energy savings and decreased demand savings slightly. The on-site visit found one less parking lot 300W LED fixture compared to the quantity claimed. This correction increased energy and demand savings slightly. Overall, the corrections resulted in a realization rates of 100 percent kW and 106 percent kWh.

Project ID # 991152. The energy efficiency project involved the early retirement of packaged roof top HVAC equipment at an office facility. During the desk review, the EM&V team corrected the deemed building type selection used as the basis for the savings calculation. The predominant building type was changed from "office (large)" to "office (medium)". The Texas TRM 4.0 Volume 3 defines a commercial large office building as having an area on average of 498,588 square feet, a medium office of having an area on average of 53,628 square feet and a small office of having an area on average of 5,500 square feet. The building was verified to be approximately 35,000 square feet and aligned most appropriately with the size of a medium office building type. This correction reduced energy and demand savings as the deemed equivalent full load hours (EFLH) and coincidence factor (CF) assumptions for climate zone five were reduced from 2,423 to 1,173 hours per year and a CF of 0.98 to 0.77. Overall, these corrections resulted in a realization rates of 79 percent kW and 48 percent kWh.

Project ID # 991787. The energy efficiency project included the new construction installation of lighting within the interior areas of a stand-alone retail store. During the on-site M&V visit, the EM&V team found one additional 20W LED fixture compared to the quantity claimed. This correction resulted in a very small decrease in peak demand and energy savings and realization rates of nearly 100 percent kW and kWh.

Project ID # 1101065. The energy efficiency project included the new construction installation of HVAC equipment and lighting with some controls within the interior and exterior areas of a strip mall. During the desk review and on-site M&V visit, the EM&V team corrected the assumptions claimed by the HVAC portion of the project. The updates were driven by the EM&V team's use of the 2017.2 version of the ACE calculator compared to the 2016.3 version used to claim savings. The 2017.2 ACE includes the PY2017 Texas TRM 4.0 Volume 3 updates for EFLH and CF assumptions along with updates to the baseline efficiencies for <5.4 ton HVAC units compared to the assumptions of the PY2016 Texas TRM 3.0/3.1 Volume 3. These factors contributed to reducing the HVAC portion of the project's energy and demand savings and realization rates of 87 percent kW and 72 percent kWh. In addition, during the on-site M&V visit, the EM&V team found minor corrections to lighting quantities verified at the site. Two additional 126W LEDs were found in the interior spaces and two less 42W LED wall packs were found in the exterior spaces. These corrections for the lighting portion of the project resulted in a very small decrease in peak demand and energy savings and realization rates of nearly 100 percent kW and kWh.

Project ID # 1101085. The energy efficiency project involved a custom analysis for the installation of an HVAC building automation system (BAS) to provide more efficient and effective operation of the HVAC equipment. During the desk review, the EM&V team used the peak demand analysis as guided by the

Texas TRM 4.0 volume 1 which resulted in different pre- and post-install peak demand values as compared to those claimed. The impacts to the winter peak demand turned out to be greater than the impacts to the summer peak demand reduction claimed, resulting in increased peak demand savings. No changes to energy savings resulted. Overall, the corrections resulted in a realization rates of 313 percent kW and 100 percent kWh.

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for six of the seven projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 95 percent was assessed for the program, as partial documentation was provided for one project. For a lighting project, the project documentation included an inspection and direct install report along with photographic documentation of the existing lamps which are significant efforts by the utility to verify equipment existing conditions and quantities. However, the lighting calculator was limited as it did not detail the manufacturer make or model number and the qualification type was not described. In addition, the manufacturer's specification sheet or QPL documentation was not provided. Without a site visit to capture the lighting model number, the QPL and wattage could not be verified from the documentation provided. Since sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of Good.

5.2.2 Texas SCORE MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
5.7%	870	870	100.0%	18.9%	4,397,426	4,397,426	100.0%	Good

Completed Desk Reviews*	On-Site M&V
7	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Texas SCORE MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for two projects. One project had an adjustment of less than five percent and one project had an adjustment of greater than five percent compared to the original claimed savings. El Paso Electric accepted the evaluated results and matched the claimed savings to those of the evaluations for the one project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 991154. The energy efficiency project included the new construction installation of lighting with some controls within the interior areas of a large office. During the desk review and on-site M&V visit, the EM&V team verified the model numbers of the new lighting installed throughout the office and one of the fixtures was verified to have a rating of 43W compared to 46W claimed. The wattage correction for 102 of the project's lights resulted in a small increase in energy and peak demand savings and realization rates of 101 percent kW and kWh.

Project ID # 1101159. The energy efficiency project included the new construction installation of lighting within the interior areas of a high school facility field house. During the desk review, the EM&V team corrected the facility size slightly as verified from the supporting documents which reduced savings slightly. Also, the documents had indicated that 11 of the 131W LED high bays were not qualified and were not claimed. However, the EM&V team verified that the LED was indeed DLC qualified and photos clearly illustrated their presence in the project. This fixture was delisted in April 2017, but was eligible at the time of the project and included as part of the evaluated savings. Overall, including the additional LEDs within the project lowered energy and demand savings for the project and resulted in realization rates of 91 percent kW and kWh.

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for seven of the seven projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

5.3 DETAILED FINDINGS—RESIDENTIAL (HIGH/MEDIUM EVALUATION PRIORITY)

5.3.1 Hard-to-Reach Solutions MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
4.8%	731	731	100.0%	6.2%	1,451,768	1,451,768	100.0%	Fair

Completed Desk Reviews*	On-Site M&V
6	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team did not adjust any projects in this program. Overall, the EM&V team assessed ex-ante claimed energy and demand savings based on the following two activities:

- For a sample of projects, desk reviews were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for six projects, and resulted in desk review realization rates of 99.9 percent and 100.4 percent for demand and energy savings, respectively.

Additionally, there were minor differences between ex-ante and ex post savings for all measures due to rounding. All identified variations due to rounding were within 1 kWh and 0.01 kW.

On-site M&V was completed for three projects, and resulted in on-site realization rates of 99.9 percent and 100.4 percent for demand and energy savings, respectively.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for LEDs and ceiling insulation. There was limited documentation for direct installs, such as faucet aerators and low flow showerheads.

Because sufficient documentation was provided for only some of the measures per project across all the projects, the EM&V team assigned a program documentation score of Fair.

5.3.2 Residential Solutions MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
2.8%	429	429	100.0%	3.7%	870,851	870,851	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY17 evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team did not adjust any projects in this program. Overall, the EM&V team assessed ex-ante claimed energy and demand savings based on the following two activities:

- For a sample of projects, desk reviews were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system.
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for four projects, all of which included windows measures, and resulted in desk review realization rates of 99.9 percent and 100.4 percent for demand and energy savings, respectively.

Additionally, there were minor differences between ex-ante and ex post savings for all measures due to rounding. All identified variations due to rounding were within 1 kWh and 0.01 kW.

On-site M&V was completed for two projects, and resulted in on-site realization rates of 99.9 percent and 100.4 percent for demand and energy savings, respectively.

The EM&V team was able to verify key inputs and assumptions for almost all of the ENERGY STAR windows projects. However, there was limited documentation for one of the ENERGY STAR window projects.

Because sufficient documentation was provided across all the projects, the EM&V team assigned a program documentation score of Good.

5.4 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

5.4.1 Load Management SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
63.4%	9,679	9,679	100.0%	0.1%	24,993	24,993	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the El Paso Electric Load Management program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 30-minute increments at the meter level. Load management events occurred on the following dates and times:

- June 9, 2017, from 1p.m. to 2:30 p.m. (scheduled)
- June 19, 2017, from 5:30 p.m. to 6:30 p.m. (unscheduled).

The EM&V team received the interval meter data as well as spreadsheets detailing the El Paso Electric calculated baseline load, event load, and savings results for each event and meter. During the review process, the EM&V Team collaborated with El Paso Electric to develop savings for a participant on an interruptible tariff that received the interruption request during one of the events. Additionally, the EM&V Team identified two cases in which two days had “ties” in terms of selection of the five baseline days. The protocol is to select the day closest to the event to resolve the “tie.” The EM&V Team worked with El Paso Electric to finalize the savings for these two cases.

Evaluated savings for the El Paso Electric Load Management program are 9,679 kW and 24,993 kWh. The realization rate for both kW and kWh is 100.0 percent.

5.5 SUMMARY OF LOW PRIORITY EVALUATION PROGRAMS

Table 2-4 provides a summary of claimed savings for El Paso Electric’s low evaluation priority programs in PY2017, including programs’ overall contribution to portfolio savings. Low priority programs’ claimed savings were verified against the final PY2017 tracking data provided to the EM&V team for the EM&V database.

Table 5-4. PY2017 Claimed Savings (Low Evaluation Priority Programs)

Program	Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)
Small Commercial Solutions MTP	4.9%	746	746	100.0%	15.9%	3,687,641	3,687,641	100.0%
Commercial SOP	.3%	51	51	100.0%	1.2%	277,531	277,531	100.0%
LivingWise MTP	3.5%	539	539	100.0%	6.0%	1,386,059	1,386,059	100.0%

6.0 IMPACT EVALUATION RESULTS—ENTERGY TEXAS, INC.

This section presents the evaluated savings and cost-effectiveness results for Entergy's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

6.1 KEY FINDINGS

6.1.1 Evaluated Savings

Entergy's evaluated savings for PY2017 were 21,199 in demand (kW) and 50,574,728 in energy (kWh) savings (Table 4-1 and Table 4-2). The overall kW and kWh portfolio realization rates are 100 percent. Entergy was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which helped support healthy realization rates.

Table 6-1 shows the claimed and evaluated demand savings for Entergy's portfolio and broad customer sector/program categories.

Table 6-1. Entergy PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**21,199**	**21,199**	**100.0%**	**0.0%**
Commercial	27.4%	5,810	5,810	100.0%	0.0%
Residential	32.1%	6,810	6,810	100.0%	0.0%
Load Management*	40.5%	8,579	8,579	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 6-2 shows the claimed and evaluated energy savings for Entergy's portfolio and broad customer sector/program categories for PY2017.

Table 6-2. Entergy PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**50,574,661**	**50,574,728**	**100.0%**	**0.0%**
Commercial	63.3%	31,989,575	31,989,642	100.0%	0.0%
Residential	36.7%	18,569,631	18,569,631	100.0%	0.0%
Load Management*	0.0%	15,455	15,455	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of good, fair, or limited as discussed in Section 3. For the utility program documentation score, the score of "good" was given if 90 percent or more of the evaluated savings estimates received a score of good or fair due to program documentation received as indicated in detailed program findings. A score of "fair" was given if 70–89 percent of the evaluated savings estimates received a score of good or fair. A score of "limited" was given if less than 70 percent of savings received score of good or fair. In general, a score of "good" indicates the utility has established processes to collect sufficient documentation to verify savings; a score of "fair" also indicates established processes with some areas of improvements identified; and a score of "limited" indicates program documentation improvements across more individual programs and/or high savings programs have been identified.

Entergy received good documentation scores for their Commercial MTP and Commercial Load Management program as there was sufficient documentation to verify savings. While both the Residential and Hard-to-Reach SOPs had sufficient documentation to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and ceiling insulation, there was limited documentation for direct installs such as low flow showerheads and LEDs. Therefore, the documentation score for these programs is "fair."

6.1.2 Cost-Effectiveness Results

Entergy's overall portfolio had a cost-effectiveness of 2.84.

The more cost-effective programs were High Performance Homes MTP and Commercial Solutions MTP. The less cost-effective programs were Load Management SOP and A/C Distributor Program. The A/C Distributor program did not pass cost-effectiveness, and 2017 marked its second year of operation. Given this, the program was expected to pass cost-effectiveness in 2017.

The lifetime cost of PY2017 evaluated savings was $0.007 per kWh and $15.54 per kW.

Table 6-3. Entergy Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**2.8**	**2.8**	**2.5**
Total Portfolio excluding low-income programs	**2.8**	**2.8**	**2.5**
Commercial	**3.4**	**3.4**	**3.0**
Commercial Solutions MTP	3.4	3.4	3.0
Residential	**2.5**	**2.5**	**2.1**
Residential SOP	2.6	2.6	2.3
Entergy Solutions High Performance Homes MTP	5.0	5.0	3.5
A/C Distributor Program	0.9	0.9	0.8
Hard-to-Reach SOP	1.7	1.7	1.7
Load Management	**1.7**	**1.7**	**1.7**
Load Management SOP	1.7	1.7	1.7

6.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

6.2.1 Commercial Solutions MTP[5]

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
27.4%	5,810	5,810	100.0%	63.3%	31,989,575	31,989,642	100.0%	Good

Completed Desk Reviews*	On-Site M&V
10	5

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Commercial Solutions MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

[5] Commercial Solutions MTP also includes two sub-programs, Commercial Midstream Lighting and Resource Management Services (RMS), that have distinct program design and delivery. These sub-programs were not included in the PY2017 EM&V due to a higher priority on these sub-programs in PY2016 and anticipated program savings. However, these programs ended up accounting for more than a third of the PY2017 Commercial Solutions MTP program savings. They will be included in PY2018 EM&V.

The EM&V team adjusted the claimed savings for five projects. One project had an adjustment of less than five percent and four projects had an adjustment of greater than five percent compared to the original claimed savings. Entergy accepted the evaluated results and matched the claimed savings to those of the evaluations for the four projects with adjustments over five percent and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 991119. The energy efficiency project included lighting retrofits within the interior areas of a non-24 hour retail store that assumed custom (i.e., non-TRM/non-deemed) hours of operation and coincidence factor that were based on a fixed operating schedule controlled by a building automation system (BAS). During the desk review and on-site M&V visit, the EM&V team verified the custom hours of operation claimed and adjusted the custom coincidence factor from 0.9 to 1.0 to account for the continuous operation of the lights throughout the peak demand period as defined by the PY2017 Texas TRM 4.0 Volume 1. This change increased peak demand savings slightly. Overall, the correction resulted in realization rates of 111 percent kW and 100 percent kWh.

Project ID # 991668. The energy efficiency project involved a custom analysis of an early retirement of a large centrifugal chiller and re-sequencing the control system at a university central plant. During the desk review and on-site M&V visit, additional utility data was gathered to achieve a 12-month post-implementation dataset, whereas the claimed savings had only used a seven-month dataset. Also, the regression analysis was changed to include a dependency with the maximum average daily temperature in each period, resulting in decreased peak demand savings. No energy savings were claimed or identified by the EM&V team for the project. Overall, the corrections resulted in a realization rate of 88 percent kW.

Project ID # 991795. The energy efficiency project included the early retirement and replacement of an air-cooled chiller at a school. During the desk review and on-site M&V visit, the baseline capacity of the retrofit chiller was corrected from a nominal capacity of 177 tons to a rated capacity of 168.4 tons. In addition, the age of the baseline chiller was corrected from unknown age (21 years) to 2005 (12 years). The corrections to the baseline conditions decreased project savings and resulted in realization rates of 51 percent kW and 83 percent kWh.

Project ID # 991831. The energy efficiency project included the new construction installation of HVAC equipment at a retail non-mall/strip facility. During the desk review, the post inspection photos and other documents clearly indicated the presence of 26 units installed compared to only 25 units claimed. Thus, the total number of units included in the savings was raised from 25 to 26 which increased project savings. The correction resulted in realization rates of 110 percent kW and kWh.

Project ID # 1043278. The energy efficiency project included the new construction installation of interior and exterior lighting and controls at a strip mall retail store. During the desk review and on-site M&V visit, the EM&V team verified the lighting in the Janitor Room (line 6 of lighting calculator) had a fixture rating of 37W compared to 44W claimed. This correction resulted in a very small increase in energy savings and negligible impact to peak demand. Overall, this correction resulted in realization rates of nearly 100 percent kW and kWh.

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for eight of the ten projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 95 percent was assessed for the program, as partial documentation was provided for two projects. For a lighting project, the project documentation included the manufacturer's specification sheet that described the model number for a pin based fluorescent lamp installed at the project site, however, the QPL could not be verified. For a chiller project, a pre-inspection included capturing the model number and photographic documentation to verify equipment existing conditions

and quantities which are significant efforts by the utility. However, the assumptions of the baseline chiller from the information collected were limited and the age and rated capacity were not clearly sought or documented. Care should be taken to investigate the attributes (e.g., age, baseline rated capacity) necessary for savings calculations of HVAC equipment. When possible, the existing equipment details and conditions should be cross referenced with the site personnel who are familiar with the equipment history.

For deemed HVAC measure savings, when the rated baseline capacity was clearly obtained and documented, then it should be used for the savings calculations. When the rated baseline capacity is unknown and cannot be clearly documented or obtained, then the new equipment's rated capacity should be assumed for the baseline rated capacity. Complete documentation enhances the accuracy and transparency of project savings along with ease of evaluation. Since sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of good.

6.3 DETAILED FINDINGS—RESIDENTIAL (MEDIUM EVALUATION PRIORITY)

6.3.1 Residential Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
16.9%	3,586	3,586	100.0%	18.2%	9,210,498	9,210,498	100.0%	Fair

Completed Desk Reviews*	On-Site M&V
8	4

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY17 evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team made an adjustment over five percent to the claimed energy savings for five projects and claimed demand savings for four projects. The realization rates were driven by adjustments to claimed energy and demand savings based on the following activities:

- For a sample of projects, desk reviews were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation
- Desk reviews.

Desk reviews were completed for eight projects, and resulted in desk review realization rates of 97.7 percent and 97.3 percent for demand and energy savings, respectively. These overall desk review realization rates for the eight projects were driven by the five projects where an adjustment was made to one or more measures within the project. For these projects, the energy savings realization rates

were 96.4 percent, 93.2 percent, 95.7 percent, 79.5 percent, and 105.5 percent, and the demand savings realization rates were 90.5 percent, 86.7 percent, 97.4 percent, and 82.7 percent. One of the adjusted projects only had an energy savings adjustment, and demand savings were not adjusted. The EM&V team identified various factors that led to the differences in calculated savings for these projects. In particular, the EM&V team determined that the required documentation for air infiltration was missing, which led to the differences between ex-ante and ex post savings for two of the projects. More information about the documentation required is below.

- **Air infiltration, pre-leakage cap.** TRM V4.0 contains an eligibility requirement for the air infiltration measure, the application of which led to a difference in reported and evaluated savings for two projects. The TRM requires all contractors to provide sufficient evidence such as pictures capturing the scope/type of retrofit implemented and blower door test readings for all RSOP homes that reach a CFM reduction percentage within the range of 30–40 percent. In the absence of any evidence, the TRM places a cap of 30 percent CFM reduction for calculating energy and demand savings.

Additionally, the EM&V team identified minor differences between *ex-ante* and *ex post* savings for LEDs due to rounding. All identified variations due to rounding were within 1 kWh and 0.001 kW

The remaining project adjustments were due to substantial differences in measurements determined by our on-site M&V team, detailed in the next section.

- On-site M&V was completed for four projects, and resulted in on-site realization rates of 98.7 percent and 97.0 percent for demand and energy savings, respectively. These overall on-site realization rates for the four projects were driven by two projects where the EM&V team's on-site testing resulted in a substantially lower reduction in duct leakage than what was documented by the program. Using a threshold of +/- 10%, the EM&V team's duct blaster test results were quite a bit higher than the results found in the tracking data. For these two projects, the energy savings realization rates were 91.7 percent and 73.0 percent, and the demand savings realization rates were 91.8 percent and 72.8 percent.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and ceiling insulation. There was limited documentation for direct installs such as low flow showerheads and LEDs.

Because sufficient documentation was provided for only some of the measures per project across all the projects, the EM&V team assigned a program documentation score of "fair."

6.3.2 Hard-to-Reach Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
7.4%	1,560	1,560	100.0%	7.7%	3,908,876	3,908,876	100.0%	Fair

Completed Desk Reviews*	On-Site M&V
6	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY17 evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team made an adjustment over five percent to the claimed savings for one project. Overall, the EM&V team assessed ex-ante claimed energy and demand savings based on the following two activities:

- For a sample of projects, desk reviews were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation

Desk reviews were completed for six projects, and resulted in desk review realization rates of 80.4 percent and 84.9 percent for demand and energy savings, respectively. These overall desk review realization rates for the six projects were driven by the one project where an adjustment was made. For this one project, the energy savings realization rate was 47.8 percent and the demand savings realization rate was 48.5 percent. For this one project, the EM&V team determined that the required documentation for ceiling insulation was missing, which led to the differences between ex-ante and ex post savings. More information about the documentation required is below.

- **Ceiling insulation, baseline restriction.** The PY2017 TRM contains an eligibility requirement for the ceiling insulation measure, the application of which led to a difference in reported and evaluated savings for one project. The TRM states for any reported pre-retrofit R-value that falls below R-5, all contractors are required to provide sufficient evidence including two pictures (1) a picture showing the entire attic floor, and (2) a close-up picture of a ruler that shows the measurement of the depth of the insulation. In the absence of evidence demonstrating pre-retrofit ceiling insulation below R-5, the lowest level of pre-retrofit ceiling insulation that can be claimed is the R-5 to R-8 range.

Additionally, there are minor differences between ex-ante and ex post savings for LEDs due to rounding. All identified variations due to rounding were within 1 kWh and 0.001 kW.

On-site M&V was completed for three projects, and resulted in on-site realization rates of 71.2 percent and 71.7 percent for demand and energy savings, respectively. These overall on-site realization rates for the three projects was driven by the one project where the EM&V team's on-site testing resulted in a substantially lower reduction in air infiltration than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's blower door test results were quite a bit higher than the results found in the tracking data. For this one project, the energy savings realization rate was 47.8 and the demand savings realization rate was 48.4.

6.3.2.1 Documentation

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and ceiling insulation. There was limited documentation for direct installs such as low flow showerheads and LEDs.

Because sufficient documentation was provided for only some of the measures per project across all the projects, the EM&V team assigned a program documentation score of "fair."

6.4 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

6.4.1 Load Management Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
40.5%	8,579	8,579	100.0%	0.0%	15,455	15,455	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated Entergy's Load Management program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments. Load management events occurred on the following dates and times:

- June 28, 2017 from 1:00 p.m. to 2:00 p.m. (scheduled)
- June 28, 2017 from 2:00 p.m. to 3:00 p.m. (scheduled)
- June 29, 2017 from 3:00 p.m. to 4:00 p.m. (scheduled)
- June 30, 2017 from 2:00 p.m. to 3:00 p.m. (scheduled)
- August 22, 2017 from 2:00 p.m. to 3:00 p.m. (unscheduled).

Scheduled events are treated as test events and had varying levels of participation. The unscheduled event on August 22, 2017 had all enrollees called to participate. Due to issues associated with Hurricane Harvey, several enrollees had meter data lost following the hurricane, with their potential savings during the August 22nd event not being counted for purposes of program savings calculations.

The EM&V team received the interval meter data as well as spreadsheets detailing the Entergy calculated baseline load, event load, and savings results for each event and meter. The spreadsheet included those cases indicating meter data loss due to Hurricane Harvey.

The savings calculated by the EM&V team matched those calculated by Entergy.

Evaluated savings for the Entergy Load Management program are 8,579 kW and 15,455 kWh. The realization rate for both kW and kWh is 100.0 percent.

6.5 SUMMARY OF LOW PRIORITY EVALUATION PROGRAMS

Table 2-4 provides a summary of claimed savings for Entergy's low evaluation priority programs in PY2017, including programs' overall contribution to portfolio savings. Low priority programs' claimed savings were verified against the final PY2017 tracking data provided to the EM&V team for the EM&V database.

Table 6-4. PY2017 Claimed Savings (Low Evaluation Priority Programs)

Program	Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)
Entergy Solutions High Performance Homes MTP	6.6%	1,399	1,399	100.0%	9.3%	4,711,437	4,711,437	100.0%
A/C Distributor Program	1.2%	264	264	100.0%	1.5%	738,820	738,820	100.0%

7.0 IMPACT EVALUATION RESULTS—ONCOR

This section presents the evaluated savings and cost-effectiveness results for Oncor's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

7.1 KEY FINDINGS

7.1.1 Evaluated Savings

Oncor's evaluated savings for PY2017 were 155,221 in demand (kW) and 169,931,372 in energy (kWh) savings. The overall kW and kWh portfolio realization rates are approximately 100 percent. Oncor was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which also supported healthy realization rates.

Table 7-1 shows the claimed and evaluated demand savings for Oncor's portfolio and broad customer sector/program categories.

Table 7-1. Oncor PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**155,226**	**155,221**	**100.0%**	**0.1%**
Commercial	10.8%	16,750	16,745	100.0%	0.9%
Residential	25.2%	39,070	39,070	100.0%	0.0%
Low Income	2.1%	3,195	3,195	100.0%	0.0%
Load Management	62.0%	96,211	96,211	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 7-2 shows the claimed and evaluated energy savings for Oncor's portfolio and broad customer sector/program categories for PY2017.

Table 7-2. Oncor PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**170,123,969**	**169,931,372**	**99.9%**	**0.4%**
Commercial	57.1%	97,088,950	96,896,354	99.8%	0.7%
Residential	39.6%	67,356,507	67,356,507	100.0%	0.0%

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Low Income	3.1%	5,317,425	5,317,425	100.0%	0.0%
Load Management	0.2%	361,086	361,086	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of Good, Fair, or Limited as discussed in Section 3. For the overall utility program documentation score, the score of "Good" was given if 90 percent or more of the evaluated savings estimates received a score of Good or Fair due to program documentation received as indicated in detailed program findings. A score of "Fair" was given if 70 percent–89 percent of the evaluated savings estimates received a score of Good or Fair. A score of "Limited" was given if less than 70 percent of savings received score of Good or Fair. In general, a score of "Good" indicates the utility has established processes to collect sufficient documentation to verify savings; a score of "Fair" also indicates established processes with some areas of improvements identified; and a score of "Limited" indicates program documentation improvements across more individual programs and/or high savings programs have been identified.

Oncor received Good documentation scores for all commercial, residential, PV and load management programs.

7.1.2 Cost-Effectiveness Results

Oncor's overall portfolio had a cost-effectiveness of 1.92, or 2.08 excluding low-income programs.

The more cost-effective programs were Commercial SOP (Basic and Custom) and Home Energy Efficiency SOP. The less cost-effective programs were Solar PV SOP (Com and Res) and Residential Demand Response SOP. Healthcare MTP appears low, but the program was cancelled in 2016 and the 2017 results only reflect a small number of projects finalized in 2017 to wrap up the program.

The lifetime cost of evaluated savings was $0.010 per kWh and $22.42 per kW.

Table 7-3. Oncor Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**1.9**	**1.9**	**1.8**
Total Portfolio excluding low-income programs	**2.1**	**2.1**	**1.9**
Commercial	**2.4**	**2.4**	**2.2**
Custom Commercial SOP	2.6	2.6	2.3
Basic Commercial SOP	2.9	2.9	2.6
Solar PV SOP (Com)	1.3	1.3	1.3
Small Business Direct Install MTP	1.5	1.5	1.4
Healthcare MTP	0.1	0.1	0.1
Residential	**1.9**	**1.9**	**1.8**
Home Energy Efficiency SOP	2.1	2.1	1.9
Solar PV SOP (Res)	1.3	1.3	1.2
Hard-to-Reach SOP	1.8	1.8	1.8
Low Income*	**1.6**	**1.6**	**1.6**
Targeted Weatherization Low-Income SOP*	1.6	1.6	1.6
Load Management	**1.7**	**1.7**	**1.7**
Commercial Load Management SOP	1.8	1.8	1.8
Residential Demand Response SOP	1.4	1.4	1.4

* The Low Income sector and Targeted Weatherization Low-Income SOP are evaluated using the savings-to-investment ratio.

7.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

7.2.1 Basic Commercial SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
7.3%	11,381	11,361	99.8%	39.5%	67,247,365	67,049,014	99.7%	Good

Completed Desk Reviews*	On-Site M&V
9	4

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Basic Commercial SOP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for three projects. All projects had adjustments of less than 5 percent compared to the original claimed savings and therefore the final program realization rate is nearly 100 percent. Further details of the EM&V findings are provided below.

Project ID # 992213. The energy efficiency project included HVAC and lighting retrofits and installation of occupancy controls at an in-patient healthcare facility. During the desk review, the EM&V team made adjustments to the deemed building type selection used as the basis for the lighting savings and did not adjust the HVAC savings. For the lighting portion of the project, the EM&V team corrected the predominant building type from a mix of "Lodging (Common Areas)" and "Lodging (Rooms)" to "In-Patient Health Care". The Texas TRM 4.0 defines the use of Lodging for large hotel, small hotel and nursing home facilities (e.g., retirement home, nursing home, assisted living, or other residential care) and In-Patient Health Care for medical care facilities (e.g., hospitals, in-patient rehabilitation). The areas of the building retrofit were clearly marked as mostly "Hospital" common and room areas. This correction resulted in a slight increase in demand savings and a slight reduction in energy savings, as the deemed coincidence factor (CF) assumptions was slightly increased from a mix of 0.82 and 0.25 to 0.78 and annual operating hours were slightly reduced from a mix of 6,630 and 3,055 hours per year to 5,730 hours per year. The corrections for the lighting portion of the project resulted in realization rates of 100 percent kW and 99 percent kWh. The HVAC portion of the project resulted in realization rates of 100 percent kW and kWh. Combined, the projects at the site resulted in realization rates of 100 percent kW and 100 percent kWh.

Project ID # 992214. The energy efficiency project included interior lighting and controls retrofits within the office areas of a manufacturing facility. During the desk review and on-site M&V visit, the EM&V team adjusted pre- and post-fixture codes (i.e., wattages) and quantities of the lighting. In addition, several lighting fixtures were adjusted from having been claimed as installed with "occupancy sensor" controls to having "no controls measures" to reflect actual equipment verifications during the on-site visit. The post-inspection documentation had noted no controls were found for those lighting fixtures adjusted by the EM&V team, but that was not reflected in the final calculator or savings claimed. Overall, the adjustments resulted in realization rates of 98 percent kW and kWh.

Project ID # 992333. The energy efficiency project included interior lighting retrofits and controls at a refrigerated warehouse facility. During the desk review, the EM&V team corrected wattages for a limited number of lights based on the equipment model numbers documented and DLC qualified products list (from 122W claimed to 182W). Quantities were also corrected for few fixtures to match post-inspection notes. Overall, the adjustments resulted in a slight reduction in savings, and realization rates of 99 percent kW and kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for nine of the nine projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

7.2.2 Custom Commercial SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
1.6%	2,552	2,557	100.2%	9.8%	16,591,708	16,611,578	100.1%	Good

Completed Desk Reviews*	On-Site M&V
8	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Custom Commercial SOP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for three projects. All projects had adjustments of less than five percent compared to the original claimed savings and therefore the final program realization rate is nearly 100 percent. Further details of the EM&V findings are provided below.

Project ID # 992579. The energy efficiency project included the replacement of constant speed cooling tower fan, condenser water pump and chilled water pump motors with high efficiency motors and variable frequency drives (VFD). During the desk review, the EM&V team adjusted the calculation to utilize the more statistically significant post monitoring data for hours of operation and pump operating wattages compared to the data used for the claimed savings analysis. This correction resulted in a slight decrease in savings, and realization rates of 96 percent kW and 99 percent kWh.

Project ID # 992582. The energy efficiency project included the replace on burnout retrofit of HVAC equipment at a large office facility. During the desk review, the EM&V team adjusted the calculations to account for pre- and post-installation tonnages of the units separately. The reported HVAC calculator assumed a "weighted average" to estimate savings where the summed tonnages (170-ton and 123-ton units) of pre- and post-installation were used. In addition, instead of applying the proper post-installation tonnage of 300 tons (two 150-ton units), the pre-installation tonnage of 293-tons was entered. The EM&V team corrected the calculator to consider the proper

pre- and post- tonnages and other technical parameters for each unit separately. Overall, the adjustments resulted in a slight increase in demand and energy savings, and realization rates of 102 percent kW and kWh.

Project ID # 1044266. The energy efficiency project included custom lighting retrofits and installation of controls within non-refrigerated areas of a warehouse. During the desk review, the EM&V team corrected post-retrofit lighting quantities to match post inspection notes (from 0 and 29 to 3 and 34 respectively within the small dock 2 and battery charging areas of the facility). Overall, the adjustments resulted in a slight increase in savings, and realization rates of 100 percent kW and 101 percent.

Document Score

The EM&V team could verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for eight of the eight projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

7.2.3 Solar PV SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
1.0%	1,488	1,499	100.8%	2.9%	4,917,963	4,903,848	99.7%	Good

Completed Desk Reviews*	On-Site M&V
8	4

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Solar PV SOP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team found a difference in the savings between Oncor and the EM&V team for one project. While Oncor accepted the evaluated results, as the realization rates were greater than 95 percent, Oncor elected to not adjust savings. Further details about this project are provided below.

Project ID # 1044241. The project is a solar installation on the roof of a commercial facility. This site did not receive a site visit, but the EM&V team inspected Oncor's post-installation inspection results. These results showed different key parameters than were presented in the project savings calculation. As such, the EM&V team utilized the post-installation inspection information to develop verified savings. The changes included correcting the solar zone used to select the peak kW deemed factor (from zone 2 to zone 1) and adjusted the azimuth and tilt to match those of the post-installation inspection. The EM&V team found that the realization rates were 108 percent for kW and 97 percent for kWh.

An additional project at a new hotel received a site visit by the EM&V team and was found to be inoperable. At the time of Oncor's post-inspection site visit, the system had been operational. Further investigation into the project revealed a warranty claim by the owner that was being resolved between

a contractor and the inverter manufacturer, with some uncertainty over the responsible party. Given that it was likely the solar PV system would eventually be operable, but the timing on resolution was unknown, the EM&V team and Oncor recommended, with agreement by PUCT staff, that the most appropriate resolution would be to remove the claimed savings from PY2017 and claim them in the program year the system became operational once again. As such, claimed savings for Oncor's Solar PV SOP were adjusted downward by the claimed savings (reflected in Table 1-4). As of this report, there is information that the warranty issue had been resolved, with the system becoming operational in PY2018.

Since sufficient documentation was provided for Oncor Solar PV SOP, the EM&V team assigned a program documentation score of Good.

7.3 DETAILED FINDINGS—RESIDENTIAL (MEDIUM EVALUATION PRIORITY)

7.3.1 Home Energy Efficiency SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
16.8%	26,135	26,135	100.0%	26.0%	44,290,771	44,290,771	100.0%	Good

Completed Desk Reviews*	On-Site M&V
18	9

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team made an adjustment of over 5 percent to the claimed savings for measures within one project. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for 18 projects, and resulted in overall desk review realization rates of 100.5 percent and 99.9 percent for demand and energy savings, respectively. These overall desk review realization rates for the 18 projects were driven by the one project where an adjustment was made. For this project, the energy savings realization rate was 100.9 percent, and the demand savings realization rate was 103.8 percent. This project was adjusted at the measure-level as part of the desk review process and was based on the on-site M&V, and is described in the on-site M&V text below.

Additionally, there were minor differences between claimed and evaluated savings for ceiling insulation and air infiltration due to rounding.

On-site M&V was completed for nine projects, and resulted in overall on-site realization rates of 96.9 percent and 100.5 percent for demand and energy savings, respectively. These overall on-site realization rates for the nine projects were driven by the EM&V team's testing at one site and resulted in substantially higher reduction in air infiltration than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's blower door test results were quite a bit lower than the results found in the tracking data. This project had an energy savings realization rate of 113.1 percent and a demand savings realization rate of 113.1 percent for the air infiltration measure.

The EM&V team could verify key inputs and assumptions for air infiltration, ceiling insulation, central AC, and central heat pump measures.

Because sufficient documentation was provided across all the projects, the EM&V team assigned a program documentation score of Good.

7.3.2 Hard-to-Reach SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
7.1%	11,081	11,081	100.0%	9.9%	16,823,965	16,823,965	100.0%	Good

Completed Desk Reviews*	On-Site M&V
10	5

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team did not make an adjustment of over five percent to the claimed energy and demand savings for any of the projects. The realization rates were based on the following activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for 10 projects, and resulted in overall desk review realization rates of 98.5 percent and 99.7 percent for demand and energy savings, respectively.

On-site M&V was completed for five projects, and resulted in overall on-site realization rates of 100.0 percent and 100.0 percent for demand and energy savings, respectively.

The EM&V team could verify key inputs and assumptions for air infiltration and ceiling insulation.

Because sufficient documentation was provided across all the projects, the EM&V team assigned a program documentation score of Good.

7.3.3 Solar PV SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
1.2%	1,854	1,854	100.0%	3.7%	6,241,771	6,241,771	100.0%	Good

Completed Desk Reviews*	On-Site M&V
12	5

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Residential Solar PV SOP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for twelve projects, and resulted in overall desk review realization rates of 100.0 percent and 100.0 percent for demand and energy savings, respectively. While the EM&V found minor differences for two of the projects that received site visits, the differences had a minor effect on energy production estimates and no difference in kW savings. The EM&V team accepted the program's energy production estimates as reasonable.

Since sufficient documentation was provided for Oncor Residential Solar PV SOP, the EM&V team assigned a program documentation score of Good.

7.4 DETAILED FINDINGS—LOW INCOME (HIGH/MEDIUM EVALUATION PRIORITY)

7.4.1 Targeted Weatherization Low Income SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
2.1%	3,195	3,195	100.0%	3.1%	5,317,425	5,317,425	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	11

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews. The sampled number of completed desk reviews for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for one project. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for four projects, and resulted in overall desk review realization rates of 100 percent and 96.0 percent for demand and energy savings, respectively. The overall desk review energy realization rate for the four projects was mainly driven by the one project where an adjustment was made. For this project, the energy savings realization rate was 93.6 percent and the demand savings realization rate was 100 percent. For the one project, the EM&V team determined the incorrect SEER rating was used for claimed savings calculations, resulting in lower calculated evaluated savings.

On-site M&V was completed for 11 projects, and resulted in overall on-site realization rates of 100.0 percent and 100.0 percent for demand and energy savings, respectively.

The EM&V team could verify key inputs and assumptions for central heat pumps.

Because sufficient documentation was provided across all the projects, the EM&V team assigned a program documentation score of Good.

7.5 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

7.5.1 Commercial Load Management Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
46.4%	72,060	72,060	100.0%	0.1%	216,181	216,181	100.0%	Good

Completed Desk Reviews*	On-Site M&V
NA	NA

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the Oncor Commercial Load Management program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the Electric Service Identifier (ESI ID) level. Load management events occurred on the following dates and times:

- June 6, 2017 from 3:00 p.m. to 6:00 p.m.
- August 1, 2017 from 3:00 p.m. to 6:00 p.m.

The EM&V team received the interval meter data as well as spreadsheets detailing the Oncor calculated baseline load, event load, and savings results for each event and ESI ID. The EM&V team found that its savings calculations were higher than Oncor's total initial savings (58,376 kW). In discussion with Oncor, it was found that Oncor's initial total reflected goal-level savings, though Oncor's own calculation of ESI ID savings and its summed results matched those of the EM&V team. Oncor agreed to utilize the total ESI ID savings as the basis for program claimed savings, with the EM&V team's verified savings matching those calculated by Oncor.

Evaluated savings for the Oncor Commercial Load Management program are 72,060 kW and 216,181 kWh. The realization rate for both kW and kWh is 100.0 percent.

7.5.2 Residential Demand Response SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
15.6%	24,151	24,151	100.0%	0.1%	144,904	144,904	100.0%	Good

Completed Desk Reviews*	On-Site M&V
NA	NA

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the Oncor Residential Demand Response program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the Electric Service Identifier (ESI ID) level. Load management events occurred on the following dates and times:

- June 6, 2017, from 3:00 p.m. to 6:00 p.m.
- August 22, 2017, from 3:00 p.m. to 6:00 p.m.

The EM&V team received the interval meter data as well as spreadsheets detailing the Oncor calculated baseline load, event load, and savings results for each event and ESI ID. Additionally, Oncor provided documentation on their treatment of meters that required exceptions. For some ESIIDs, there were cases that were inactive for one event or other, which were dropped from the event-level savings calculation. For others, meter data was unavailable due to meter maintenance or other factors, though operability of the program indicated them as participants. For this second set of cases, which totaled less than one percent of the program population, the average savings of the remaining participants was applied to these meters, per the TRM and EM&V guidance. Oncor's presentation and discussion of these exceptions was excellent and the EM&V team could confirm that verified savings matched Oncor's savings calculation.

Evaluated savings for the Oncor Residential Demand Response program are 24,151 kW and 144,904 kWh. The realization rate for both kW and kWh is 100.0 percent.

7.6 SUMMARY OF LOW PRIORITY EVALUATION PROGRAMS

Table 2-4 provides a summary of claimed savings for Oncor's low evaluation priority programs in PY2017, including programs' overall contribution to portfolio savings. Low priority programs' claimed savings were verified against the final PY2017 tracking data provided to the EM&V team for the EM&V database.

Table 7-4. PY2017 Claimed Savings (Low Evaluation Priority Programs)

Program	Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)
Healthcare MTP	0.1%	138	138	100.0%	0.7%	1,202,060	1,202,060	100.0%
Small Business Direct Install MTP	0.8%	1,190	1,190	100.0%	4.2%	7,129,854	7,129,854	100.0%

8.0 IMPACT EVALUATION RESULTS—SHARYLAND

This section presents the evaluated savings and cost-effectiveness results for Sharyland's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

8.1 KEY FINDINGS

8.1.1 Evaluated Savings

Sharyland's evaluated savings for PY2017 were 964 in demand (kW) and 829,841 in energy (kWh) savings. The overall kW and kWh portfolio realization rates are 100 percent. Oncor was responsive to all EM&V recommendations to adjust Sharyland's claimed savings based on EM&V results, which also supported healthy realization rates.

Table 8-1 shows the claimed and evaluated demand savings for Sharyland's portfolio and broad customer sector/program categories.

Table 8-1. Sharyland PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**964**	**964**	**100.0%**	**n/a**
Commercial	2.6%	25	25	100.0%	n/a
Residential	27.1%	261	261	100.0%	n/a
Low Income	3.7%	35	35	100.0%	n/a
Load Management*	66.6%	642	642	100.0%	n/a

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 8-2 shows the claimed and evaluated energy savings for Sharyland's portfolio and broad customer sector/program categories for PY2017.

Table 8-2. Sharyland PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**829,841**	**829,841**	**100.0%**	**n/a**
Commercial	9.5%	78,568	78,568	100.0%	n/a
Residential	82.3%	682,603	682,603	100.0%	n/a
Low Income	8.1%	67,386	67,386	100.0%	n/a

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Load Management*	0.2%	1,284	1,284	100.0%	n/a

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of Good, Fair, or Limited as discussed in Section 3. For the overall utility program documentation score, the score of Good was given if 90 percent or more of the evaluated savings estimates received a score of Good or Fair due to program documentation received as indicated in detailed program findings. A score of Fair was given if 70 percent–89 percent of the evaluated savings estimates received a score of Good or Fair. A score of Limited was given if less than 70 percent of savings received score of Good or Fair. In general, a score of Good indicates the utility has established processes to collect sufficient documentation to verify savings; a score of Fair also indicates established processes with some areas of improvements identified; and a score of Limited indicates program documentation improvements across more individual programs and/or high savings programs have been identified. Sharyland received a Good program documentation score for the evaluated commercial and residential programs.

8.1.2 Cost-Effectiveness Results

Sharyland's overall portfolio had a cost-effectiveness of 1.29, or 1.41 excluding low-income programs.

The more cost-effective programs were the Targeted Low-Income Weatherization Program and Residential SOP. The less cost-effective programs were Hard-to-Reach SOP and Load Management SOP.

The lifetime cost of evaluated savings was $0.014 per kWh and $28.98 per kW.

Table 8-3. Sharyland Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**1.29**	**1.29**	**1.10**
Total Portfolio excluding low-income programs	**1.41**	**1.41**	**1.18**
Commercial	**0.60**	**0.60**	**0.51**
Commercial SOP*	n/a	n/a	n/a
Customized Commercial MTP	1.28	1.28	1.09
Open for Small/Medium Business MTP*	n/a	n/a	n/a
Residential	**1.69**	**1.69**	**1.39**
Residential SOP	1.91	1.91	1.49

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Hard-to-Reach SOP	1.10	1.10	1.10
Low Income**	**2.65**	**2.65**	**2.65**
Targeted Low-Income Weatherization Program**	2.65	2.65	2.65
Load Management	**1.25**	**1.25**	**1.25**
Load Management SOP	1.25	1.25	1.25

* Commercial SOP and Open for Small/Medium Business MTP incurred costs but did not claim savings for 2017. They are included here to note that they contributed costs to the overall portfolio's cost-effectiveness.

** The Low-Income sector and Targeted Low-Income Weatherization Program are evaluated using the savings-to-investment ratio.

8.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

8.2.1 Customized Commercial MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
2.6%	25	25	100.0%	9.5%	78,568	78,568	100.0%	Good

Completed Desk Reviews*	On-Site M&V
2	1

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The Customized Commercial Market Transformation program (MTP) evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for one project. The project had an adjustment of greater than five percent compared to the original claimed savings. Sharyland accepted the evaluated results and matched the claimed savings to those of the evaluations for the one project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 1018358. The project is a solar installation on the roof of a commercial facility. During the desk review, the EM&V team corrected the azimuth value used in the savings calculations from 180 degrees claimed to 255 degrees, which was verified using Google Earth. This adjustment resulted in a peak demand savings reduction, and realization rates of 90 percent for kW and 100 percent for kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity) for both of the projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

8.3 DETAILED FINDINGS—RESIDENTIAL (MEDIUM EVALUATION PRIORITY)

8.3.1 Residential Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
22.7%	218	218	100.0%	66.9%	554,920	554,920	100.0%	Good

Completed Desk Reviews*	On-Site M&V
6	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for measures within two projects. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for six projects, and resulted in overall desk review realization rates of 84.4 percent and 87.1 percent for demand and energy savings, respectively. These overall desk review realization rates for the six projects were driven by the two projects where an adjustment was made. For these projects, the energy savings realization rates were 46.4 percent and 98.8 percent, and the demand savings realization rates were 46.6 percent and 122.4 percent. For one of the projects, the EM&V team determined that the required documentation for ceiling insulation was missing, which led to the differences between claimed and evaluated savings. More information about the documentation required is below.

- **Ceiling insulation, baseline restriction.** The TRM contains an eligibility requirement for the ceiling insulation measure, the application of which led to a difference in claimed and evaluated savings for one project. TRM V4.0 states for any reported pre-retrofit R-value that falls below R-5, all contractors are required to provide sufficient evidence including two pictures (1) a picture showing the entire attic floor, and (2) a close-up picture of a ruler that shows the measurement

of the depth of the insulation. In the absence of evidence demonstrating pre-retrofit ceiling insulation below R-5, the lowest level of pre-retrofit ceiling insulation that can be claimed is the R-5 to R-8 range.

The other project that was adjusted at the measure-level as part of the desk review process was based on the on-site M&V, and is described in the on-site M&V text below.

Additionally, there were minor differences between claimed and evaluated savings for duct efficiency due to rounding.

On-site M&V was completed for three projects, and resulted in overall on-site realization rates of 105.4 percent and 99.6 percent for demand and energy savings, respectively. These overall on-site realization rates for the three projects were driven by the EM&V team's on-site testing at one site, resulting in substantially higher reduction in air infiltration and lower reduction in duct efficiency than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's blower door test results were quite a bit lower than the results found in the tracking data. Additionally, the duct blaster test results were quite a bit higher than the results found in the tracking data. This project had an energy savings realization rate of 98.8 percent and a demand savings realization rate of 122.4 percent.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and ceiling insulation for all but one project.

Because sufficient documentation was provided for all the measures per project across most of the projects, the EM&V team assigned a program documentation score of Good.

8.3.2 Hard-to-Reach SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
4.5%	43	43	100.0%	15.4%	127,683	127,683	100.0%	Good

Completed Desk Reviews*	On-Site M&V
6	4

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed savings for one project, and that adjustment was based on the on-site visit. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for six projects, and resulted in overall desk review realization rates of 99.0 percent and 99.1 percent for demand and energy savings, respectively. These overall desk review realization rates for the six projects were driven by the one project where an adjustment was made. The other project that was adjusted at the measure-level as part of the desk review process was based on the on-site M&V, and is described in the on-site M&V text below.

On-site M&V was completed for four projects, and resulted in overall on-site realization rates of 98.5 percent and 98.7 percent for demand and energy savings, respectively. These overall on-site realization rates for the four projects were driven by the EM&V team's on-site testing at one site, resulting in substantially lower reduction in duct efficiency than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's duct blaster test results were quite a bit higher than the results found in the tracking data. This project had an energy savings realization rate of 78.2 percent and a demand savings realization rate of 45.1 percent.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for duct efficiency and ceiling insulation.

Because sufficient documentation was provided for most of the measures per project across all the projects, the EM&V team assigned a program documentation score of Good.

8.4 DETAILED FINDINGS—LOW INCOME (HIGH/MEDIUM EVALUATION PRIORITY)

8.4.1 Targeted Low-Income Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
3.7%	35	35	100.0%	8.1%	67,386	67,386	100.0%	Unranked

Completed Desk Reviews*	On-Site M&V
n/a	n/a

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

8.5 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

8.5.1 Load Management Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
66.6%	642	642	100.0%	0.2%	1,284	1,284	100.0%	Good

Completed Desk Reviews*	On-Site M&V
n/a	n/a

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the Sharyland Commercial Load Management Program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the Electric Service Identifier (ESI ID) level. A single load management event occurred on June 6, 2017 from 4:00 p.m. to 6:00 p.m.

The EM&V team received the interval meter data as well as a spreadsheet that detailed the Sharyland calculated savings results. The EM&V team was able to exactly replicate the savings provided by Sharyland using the meter data and TRM method.

Evaluated savings for the Sharyland Commercial Load Management Program are 642 kW and 1,284 kWh. The realization rate for both kW and kWh is 100.0 percent.

9.0 IMPACT EVALUATION RESULTS—SOUTHWESTERN ELECTRIC POWER COMPANY

This section presents the evaluated savings and cost-effectiveness results for SWEPCO's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

9.1 KEY FINDINGS

9.1.1 Evaluated Savings

SWEPCO's evaluated savings for PY2017 were 13,628 in demand (kW) and 18,885,477 in energy (kWh) savings. The overall portfolio realization rates for kW and kWh are 100 percent. SWEPCO was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which also supported healthy realization rates.

Table 9-1 shows the claimed and evaluated demand savings for SWEPCO's portfolio and broad customer sector/program categories.

Table 9-1. SWEPCO PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**13,625**	**13,628**	**100.0%**	**0.1%**
Commercial	16.4%	2,236	2,239	100.1%	0.8%
Residential	24.8%	3,379	3,379	100.0%	0.0%
Load Management	57.8%	7,878	7,878	100.0%	0.0%
Pilot	1.0%	132	132	100.0%	n/a

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 9-2 shows the claimed and evaluated energy savings for SWEPCO's portfolio and broad customer sector/program categories for PY2017.

Table 9-2. SWEPCO PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**18,854,548**	**18,877,979**	**100.1%**	**0.6%**
Commercial	62.9%	11,865,591	11,889,021	100.2%	1.0%
Residential	33.8%	6,381,355	6,381,355	100.0%	0.0%
Load Management	0.2%	37,969	37,969	100.0%	0.0%
Pilot	3.0%	569,633	569,633	100.0%	n/a

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of good, fair, or limited as discussed in Section 3. For the utility program documentation score, the score of "good" was given if 90 percent or more of the evaluated savings estimates received a score of good or fair due to program documentation received as indicated in detailed program findings. A score of "fair" was given if 70–89 percent of the evaluated savings estimates received a score of good or fair. A score of "limited" was given if less than 70 percent of savings received score of good or fair. In general, a score of "good" indicates the utility has established processes to collect sufficient documentation to verify savings; a score of "fair" also indicates established processes with some areas of improvements identified; and a score of "limited" indicates program documentation improvements across more individual programs and/or high savings programs have been identified.

SWEPCO received a good program documentation score for all of its programs except SCORE, which received a "fair" score due to lack of documentation for two M&V projects. The EM&V team would like to take this opportunity to point out these projects to SWEPCO as the M&V will be completed in PY2018 for these two projects when the remainder of savings will be claimed. It is unclear from the documentation provided if the correct peak demand approach is being taken.

9.1.2 Cost-Effectiveness Results

SWEPCO's overall portfolio had a cost-effectiveness of 2.34.

The more cost-effective programs were SCORE MTP and Commercial SOP. The less cost-effective programs were Load Management SOP and LED Retail Pilot. The LED Retail Pilot program was in its first year of operation.

The lifetime cost of evaluated savings was $0.009 per kWh and $19.14 per kW.

Table 9-3. SWEPCO Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**2.3**	**2.3**	**2.2**
Total Portfolio excluding low-income programs	**2.3**	**2.3**	**2.2**
Commercial	**2.8**	**2.8**	**2.5**
Commercial Solutions MTP	2.9	2.9	2.6
Commercial SOP	3.0	3.0	2.7
Open MTP	1.7	1.7	1.6
SCORE MTP	3.3	3.3	2.9
Residential	**2.2**	**2.2**	**2.1**
Residential SOP	2.3	2.3	2.1
Hard-to-Reach SOP	2.1	2.1	2.1
Load Management	1.5	1.5	1.5
Load Management SOP	1.5	1.5	1.5
Pilot	**1.4**	**1.4**	**1.3**
LED Retail Pilot (Com)	0.9	0.9	0.8
LED Retail Pilot (Res)	1.4	1.4	1.3

9.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

9.2.1 Commercial Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
7.3%	992	996	100.4%	28.7%	5,410,073	5,442,291	100.6%	Good

Completed Desk Reviews*	On-Site M&V
8	4

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 CSOP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for four projects. Two projects had an adjustment of less than five percent and two projects had an adjustment of greater than five percent compared to the

original claimed savings. SWEPCO accepted the evaluated results and matched the claimed savings to those of the evaluations for the two projects with significant adjustments and therefore the final program realization rate is close to 100 percent. Further details of the EM&V findings are provided below.

Project ID # 983823. The energy efficiency project included lighting retrofits within the interior areas of a retail (non-mall/strip) facility. During the desk review and on-site M&V visit, the EM&V team completed corrections to the baseline and post retrofit fixture types within some areas of the site. The fixtures within the body shop area were found to be retrofit kit installations and did not match the new fixtures installed in the rest of the facility. This resulted in a correction of the post-retrofit fixture code and wattage from LED150-FIXT (150W per fixture) to LED072-FIXT (72W per fixture). In addition, the baseline lighting type was corrected from 453W metal halide lighting to a 110W fluorescent lighting fixtures. Overall, the corrections resulted in realization rates of 93 percent kW and kWh.

Project ID # 983840. The energy efficiency project included the new construction installation of lighting within the interior areas of a manufacturing facility. During the desk review and on-site M&V visit, the EM&V team verified the model numbers of the new lighting installed and found one of the predominant lighting fixtures installed at the site to have a rating of 150W compared to 169W claimed. The wattage correction for 121 of the project's lights resulted in a slight increase in energy and peak demand savings and realization rates of 101 percent kW and kWh.

Project ID # 983843. The energy efficiency project included lighting retrofits within the interior areas of a retail (non-mall/strip) facility. During the desk review and on-site M&V visit, the EM&V team completed corrections to post retrofit fixture wattages and air conditioning types within some areas of the site based on verified conditions. The fixtures within the sales floor area were found to have a rating of 105W compared to 100W claimed. The fixtures within the shop area were found to have a rating of 241W compared to 90W claimed. The change in the shop area was confirmed to be due to the need for more light in the service portion of the facility compared to the other high bay areas. In addition, no air conditioning was found in the warehouse areas of the facility for which interactive effects for air conditioning were claimed. Overall, the corrections resulted in realization rates of 87 percent kW and 88 percent kWh.

Project ID # 1095480. The energy efficiency project included lighting retrofits within the interior areas of a retail (non-mall/strip) facility. During the desk review and on-site M&V visit, the EM&V team completed corrections to post retrofit fixture wattages within some areas of the site based on verified conditions. Some of the four-foot four lamp fluorescent fixtures that were retrofit to LEDs were found to have a post retrofit fixture rating of 39W compared to 38W claimed. Also, the two-foot two lamp fluorescent fixtures that were retrofit to LEDs were found to have a post retrofit fixture rating of 19W compared to 21W claimed. Overall, the wattage corrections resulted in an insignificant increase in energy and peak demand savings and still had realization rates of 100 percent kW and kWh.

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for seven of the eight projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 96 percent was assessed for the program, as partial documentation was provided for one project. For a lighting project, the project documentation included LED qualifications, invoices, manufacturer specifications along with pre-and post-inspection notes and calculators which are significant efforts by the utility to verify equipment existing/new equipment conditions and quantities. However, the lighting savings was limited as it did not reflect the details of the project within the backup documentation captured. Since sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of Good.

9.2.2 Commercial Solutions Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
4.3%	587	587	100.0%	17.5%	3,303,543	3,303,543	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Commercial Solutions MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for three projects. All three projects had an adjustment of greater than five percent compared to the original claimed savings. SWEPCO accepted the evaluated results and matched the claimed savings to those of the evaluations for the three projects with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 990094. The energy efficiency project included lighting retrofits within the interior areas of two non-refrigerated warehouse facilities (C and D) at the site. During the desk review and on-site M&V visit, the EM&V team completed corrections to the baseline and post retrofit fixture types within areas of the site. The fixtures within warehouse C were found to be erroneously labeled F52sHS, and were corrected to be F46T12 types. This correction increased the baseline lighting wattage slightly for 10 fixtures from 168W per fixture to 170W per fixture. In addition, the post-retrofit fixtures that replaced the F46T12 fixtures were assumed to be 36W LED tubes and were verified on-site to be 108W LED fixtures. This adjustment increased the post lighting wattage significantly for the 10 fixtures. Overall, the corrections for warehouse C resulted in reduced savings. In warehouse D, the baseline fixture quantity for the lights claimed was adjusted from 89 to 79. The post-retrofit fixture code and quantity were corrected from 108W LED fixtures to 36W LED tubes, and from 33 to 79 quantities respectively, as verified on-site. Overall, the corrections for warehouse D resulted in reduced savings. The total lamp count verified at the site matched the supplied invoice. Overall, the corrections resulted in realization rates of 86 percent kW and kWh.

Project ID # 1042892. The energy efficiency project included the duct sealing measures at a small retail store. During the desk review and on-site M&V visit, the EM&V team verified the four-ton central air conditioning system was a split heat pump system as compared to a unitary split air conditioner. Also, the age of the heat pump was found to be 2006 compared to 2000 claimed. The HVAC system age and type corrections reduced savings. In addition, the predominant building type was changed from "office (small)" to “stand-alone retail”. This correction reduced energy savings slightly and increased demand savings as the deemed equivalent full load hours (EFLH) and coincidence factor (CF) assumptions for climate zone two were reduced from 1,203 to 1,100 hours per year and a CF of 0.92 to 0.95. Overall, these corrections resulted in realization rates of 100 percent kW and 94 percent kWh.

Project ID # 1056778. The energy efficiency project included lighting retrofits and addition of occupancy controls within the interior areas of a non-refrigerated warehouse facility. During the desk review, the EM&V team found the claimed savings included air conditioning in the warehouse, although the post-inspection noted that there was no air conditioning and gas heat in the space. This is

supported by a review of submitted pictures and the satellite image of the facility roof available on the internet. The correction of the air conditioning type to none eliminated the interactive effects for air conditioning that were claimed and resulted in realization rates of 91 percent kW and 95 percent kWh.

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for four of the four projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 92 percent was assessed for the program, as the documentation was provided for all projects, but was not used for assessing the project assumptions for one project that led to significant savings adjustments. For a lighting project, the project documentation included LED qualifications, invoices, manufacturer specifications along with pre-and post-inspection notes, calculators and photographic documentation of the existing and new lighting types which are significant efforts by the utility to verify equipment existing/new conditions and quantities. However, the lighting savings was limited as it did not reflect the details of the project within the backup documentation captured. Since sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of Good.

9.2.3 SCORE Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
2.9%	402	400	99.8%	10.7%	2,022,784	2,014,090	99.6%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 SCORE MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for two projects at the same participant site. One portion of the project had an adjustment of less than 5 percent and the other portion of the project had an adjustment of greater than five percent compared to the original claimed savings. SWEPCO accepted the evaluated results and matched the claimed savings to those of the evaluations for the one project with significant adjustments and therefore the final program realization rate is close to 100 percent. Further details of the EM&V findings are provided below.

Project ID # 1057052. The energy efficiency projects included the new construction installation of ground source heat pumps and lighting with some controls within the interior and exterior areas of an elementary school facility. During the desk review and on-site M&V visit, the EM&V team corrected the assumptions claimed by the HVAC portion of the project. The EM&V team found that 15 of the 105 ground source heat pumps installed had claimed capacities and efficiencies that did not match AHRI ratings for the equipment verified on-site. These corrections resulted in a decrease in energy savings and increase in demand savings for the HVAC portion of the project and realization rates of 103 percent kW and 84 percent kWh. In addition, during the on-site M&V visit, the EM&V team found minor corrections to the lighting portion of the project at the site. A portion of the exterior lighting was claimed

within the interior inventory and had assumed the deemed operating hours and coincidence factors for the education, no summer building type. These lights were confirmed controlled by the building energy management system (EMS) and not operated according to building hours. The corrections for the lighting portion of the project resulted in a small decrease in peak demand and energy savings and realization rates of nearly 99 percent kW and 98 percent kWh.

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for two of the four projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 84 percent was assessed for the program, as partial documentation was provided for two projects. Both projects included custom HVAC controls retrofits of the facility HVAC system for multiple buildings in each school district. The documentation lacked clarity on the measures that were installed for each building. Also, the savings assumptions in the M&V report were not clearly documented for the 40 percent claim of savings and did not appear to be sourced from the baseline regressions, but rather from a per square foot factor for all the buildings retrofit. The final savings for both projects will be trued up in PY2018 once enough post-installation billing data is available to complete final analysis. Also, while the initial savings estimates appeared to be reasonable and no adjustments to the savings were made, the lack of documentation about the measures greatly limited the EM&V team's ability to thoroughly review the assumptions and savings for the project. *According to the M&V reports, both projects do not appear to be referring to the TRM Volume 1 peak demand savings calculations and they will likely need to be updated to include these analysis approaches for final savings determinations*. Complete documentation enhances the accuracy and transparency of project savings along with ease of evaluation. Since sufficient documentation was provided for greater than 70 percent, but less than 90 percent of the sampled projects, the EM&V team assigned a program documentation score of Fair.

9.3 DETAILED FINDINGS—RESIDENTIAL (MEDIUM EVALUATION PRIORITY)

9.3.1 Residential Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
13.0%	1,768	1,768	100.0%	18.3%	3,448,346	3,448,346	100.0%	Good

Completed Desk Reviews*	On-Site M&V
8	4

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY17 evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team did not make an adjustment to any of the projects for this program. Overall, the EM&V team assessed ex-ante claimed energy and demand savings across the following two activities:

- For a sample of projects, desk reviews were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for eight projects, and resulted in desk review realization rates of 100 percent and 100 percent for demand and energy savings, respectively.

However, there were minor differences between ex-ante and ex post savings for LEDs due to rounding. All identified variations due to rounding were within 1 kWh and 0.001 kW.

On-site M&V was completed for four projects, and resulted in on-site realization rates of 100 percent and 100 percent for demand and energy savings, respectively.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and ceiling insulation. There was limited documentation for direct installs such as LEDs.

Because sufficient documentation was provided for most of the measures per project across all the projects, the EM&V team assigned a program documentation score of Good.

9.3.2 Hard-to-Reach Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
11.8%	1,610	1,610	100.0%	15.5%	2,933,009	2,933,009	100.0%	Good

Completed Desk Reviews*	On-Site M&V
6	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY17 evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team made an adjustment over five percent to the claimed savings for one project. Overall, the EM&V team assessed ex-ante claimed energy and demand savings based on the following two activities:

- For a sample of projects, desk reviews were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for six projects, and resulted in desk review realization rates of 95.3 percent and 91.9 percent for demand and energy savings, respectively. These overall desk review realization rates for the six projects were driven by the one project where an adjustment was made. For this one project, the energy savings realization rate was 46.4 percent and the demand savings

realization rate was 46.3 percent. For this one project, the EM&V team determined that the required documentation for ceiling insulation was missing, which led to the differences between ex-ante and ex post savings. More information about the documentation required is below.

- **Ceiling insulation, baseline restriction.** TRM contains an eligibility requirement for the ceiling insulation measure, the application of which led to a difference in reported and evaluated savings for one project. TRM V4.0 states for any reported pre-retrofit R-value that falls below R-5, all contractors are required to provide sufficient evidence including two pictures: 1) a picture showing the entire attic floor, and 2) a close-up picture of a ruler that shows the measurement of the depth of the insulation. In the absence of evidence demonstrating pre-retrofit ceiling insulation below R-5, the lowest level of pre-retrofit ceiling insulation that can be claimed is the R-5 to R-8 range.

Additionally, there were minor differences between ex-ante and ex post savings for LEDs due to rounding. All identified variations due to rounding were within 1 kWh and 0.01 kW.

On-site M&V was completed for three projects, and resulted in on-site realization rates of 109 percent and 106.3 percent for demand and energy savings, respectively. These overall on-site realization rates for the three projects were driven by the one project where the EM&V team's on-site testing resulted in a substantially higher reduction in air infiltration than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's blower door test results were quite a bit lower than the results found in the tracking data. For this one project, the energy savings realization rate was 145.5 percent and the demand savings realization rate was 150.6 percent.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and ceiling insulation. There was limited documentation for direct installs such as LEDs.

Because sufficient documentation was provided for most of the measures per project across all the projects, the EM&V team assigned a program documentation score of Good.

9.4 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

9.4.1 Load Management Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
57.8%	7,878	7,878	100.0%	0.2%	37,969	37,969	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the SWEPCO Load Management program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the meter level. Load management events occurred on the following dates and times:

- May 22, 2017 between 1:30 p.m. and 2:30 p.m. (scheduled)
- May 23, 2017 between 1:00 p.m. and 2:00 p.m. (scheduled)
- May 23, 2017 between 2:00 p.m. and 3:00 p.m. (scheduled)
- May 24, 2017 between 4:00 p.m. and 5:00 p.m. (scheduled)
- May 24, 2017 between 2:00 p.m. and 3:00 p.m. (scheduled)
- June 13, 2017 between 1:30 p.m. and 2:30 p.m. (scheduled)
- June 26, 2017 between 1:00 p.m. and 2:00 p.m. (scheduled)
- July 20, 2017 between 2:00 p.m. and 6:00 p.m. (unscheduled).

The EM&V team received the interval meter data as well as a summary spreadsheet that detailed the SWEPCO calculated event-level savings results for each event and meter. All participants participated in the unscheduled event on July 20, 2017, with the preceding unscheduled events used as test events for individual participants. The EM&V Team replicate all event-level savings for each participant using the TRM calculation methodology, with results matching that of SWEPCO's savings calculations.

Evaluated savings for the SWEPCO Load Management program are 7,878 kW and 37,969 kWh. The realization rate for both kW and kWh is 100.0 percent.

9.5 SUMMARY OF LOW PRIORITY EVALUATION PROGRAMS

Table 2-4 provides a summary of claimed savings for SWEPCO's low evaluation priority programs in PY2017, including programs' overall contribution to portfolio savings. Low priority programs' claimed savings were verified against the final PY2017 tracking data provided to the EM&V team for the EM&V database.

Table 9-4. PY2017 Claimed Savings (Low Evaluation Priority Programs)

Program	Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)
Open MTP	1.9%	256	256	100.0%	6.0%	1,129,190	1,129,190	100.0%
LED Retail Pilot (Res)	0.9%	125	125	100.0%	2.9%	541,151	541,151	100.0%
LED Retail Pilot (Com)	0.0%	7	7	100.0%	0.2%	28,482	28,482	100.0%

10.0 IMPACT EVALUATION RESULTS—TEXAS NEW MEXICO POWER COMPANY

This section presents the evaluated savings and cost-effectiveness results for TNMP's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

10.1 KEY FINDINGS

10.1.1 Evaluated Savings

TNMP's evaluated savings for PY2017 were 10,688 in demand (kW) and 20,766,819 in energy (kWh) savings. The overall kW and kWh portfolio realization rates are 100 percent. TNMP was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which also supported healthy realization rates.

Table 10-1shows the claimed and evaluated demand savings for TNMP's portfolio and broad customer sector/program categories.

Table 10-1. TNMP PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**10,688**	**10,688**	**100.0%**	**0.0%**
Commercial	18.2%	1,942	1,942	100.0%	0.0%
Residential	38.9%	4,158	4,158	100.0%	0.0%
Low Income	4.7%	505	505	100.0%	0.0%
Load Management	37.7%	4,030	4,030	100.0%	0.0%
Pilot	0.5%	52	52	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 10-2 shows the claimed and evaluated energy savings for TNMP's portfolio and broad customer sector/program categories for PY2017.

Table 10-2. TNMP PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**20,766,771**	**20,766,771**	**100.0%**	**0.0%**
Commercial	51.4%	10,683,871	10,683,871	100.0%	0.0%

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Residential	44.2%	9,173,640	9,173,640	100.0%	0.0%
Low Income	3.7%	772,850	772,850	100.0%	0.0%
Load Management	0.0%	4,030	4,030	100.0%	0.0%
Pilot	0.6%	132,380	132,380	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of Good, Fair, or Limited as discussed in Section 3. For the overall utility program documentation score, the score of "Good" was given if 90 percent or more of the evaluated savings estimates received a score of Good or Fair due to program documentation received as indicated in detailed program findings. A score of "Fair" was given if 70 percent–89 percent of the evaluated savings estimates received a score of Good or Fair. A score of "Limited" was given if less than 70 percent of savings received score of Good or Fair. In general, a score of "Good" indicates the utility has established processes to collect sufficient documentation to verify savings; a score of "Fair" also indicates established processes with some areas of improvements identified; and a score of "Limited" indicates program documentation improvements across more individual programs and/or high savings programs have been identified.

TNMP received a Good program documentation score for its commercial programs and HTR. For RSOP and low-income programs, TNMP received a Limited documentation score as the EM&V team was Limited in verifying key inputs and assumptions (e.g., pre- and post- equipment) for central heat pumps, ceiling insulation, and direct installs such as LEDs, and pipe insulation.

10.1.2 Cost-Effectiveness Results

TNMP's overall portfolio had a cost-effectiveness of 1.98, or 2.16 excluding low-income programs.

The more cost-effective programs were High Performance Homes MTP and Commercial Solutions MTP. The less cost-effective programs were Efficiency Connection MTP and CoolSaver Pilot MTP, neither of which passed cost-effectiveness. The CoolSaver Pilot MTP was in its first year of operation.

The lifetime cost of evaluated savings was $0.009 per kWh and $17.13 per kW.

Table 10-3. TNMP Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**2.0**	**2.0**	**1.7**
Total Portfolio excluding low-income programs	**2.2**	**2.2**	**1.9**
Commercial	**2.4**	**2.4**	**2.1**
Open for Small Business MTP	1.1	1.1	1.0
Commercial Solutions MTP	3.1	3.1	2.7
SCORE/CitySmart MTP	2.6	2.6	2.4
Residential	**2.2**	**2.2**	**1.8**
High-Performance Homes MTP	3.4	3.4	2.4
Residential SOP	2.1	2.1	1.8
Efficiency Connection MTP	0.7	0.7	0.7
Hard-to-Reach SOP	1.4	1.4	1.4
Low Income*	**2.0**	**2.0**	**2.0**
Low Income Weatherization*	2.0	2.0	2.0
Load Management	**1.5**	**1.5**	**1.5**
Load Management SOP	1.5	1.5	1.5
Pilot	**0.2**	**0.2**	**0.2**
CoolSaver Pilot MTP	0.2	0.2	0.2

**The Low-Income sector and Low-Income Weatherization program are evaluated using the savings-to-investment ratio.

10.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

10.2.1 Commercial Solutions Market Transformation Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
8.7%	927	927	100.0%	22.6%	4,689,694	4,689,694	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Commercial MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for two projects. Both projects had adjustments of greater than 5 percent compared to the original claimed savings. TNMP accepted the evaluated results and matched the claimed savings to those of the evaluations for the project with significant adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 991702. The energy efficiency project included lighting retrofits at a non-refrigerated warehouse. During the desk review and on-site M&V visit, the EM&V team corrected the space air-conditioning type for 200 post-retrofit lighting fixtures in the east side of the warehouse from "Air-Conditioned" to "None." During the on-site visit, the EM&V team verified that the space had the capability to be air conditioned, but the typical operation is without comfort cooling. This adjustment reduced savings slightly due to a reduction of the lighting upgrades interactive effects for these spaces and resulted in realization rates of 95 percent kW and 98 percent kWh.

Project ID # 991910. The energy efficiency project included the early retirement and replacement of multiple packaged rooftop HVAC units at a standalone retail store. During the desk review and on-site M&V visit, the EM&V team corrected the capacity of two of the baseline HVAC units from nominal to rated capacities verified: a 15-ton unit was adjusted from 180,000 to 189,000 Btu/hour, and a 12.5-ton unit was adjusted from 150,000 to 154,000 Btu/hour. Overall, the corrections resulted in an increase in savings, and realization rates of 107 percent kW and 106 percent kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for four of the four projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

10.2.2 SCORE/CitySmart MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
6.9%	737	737	100.0%	22.9%	4,759,679	4,759,679	100.0%	Good

Completed Desk Reviews*	On-Site M&V
6	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 SCORE/CitySmart MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for three projects. One project had adjustments of less than 5 percent and two projects had an adjustment greater than 5 percent compared to the original claimed savings. TNMP accepted the evaluated results and matched the claimed savings to those of

the evaluations for all projects with adjustments and therefore the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 991065. The energy efficiency project included the installation of an ENERGY STAR® roof at an office facility. During the desk review and on-site M&V visit, the EM&V team corrected the HVAC unit capacity from nominal to rated values (from 150 tons claimed to 139.8 tons) as confirmed with the units AHRI certificate. Overall, this adjustment resulted in realization rates of 93 percent kW and kWh.

Project ID # 1056072. The energy efficiency project included the custom M&V replacement of centrifugal blowers and motors with turbo blowers and motors with variable frequency drives (VFD) and dissolved oxygen (DO) controls at a waste water treatment plant. During the desk review, the EM&V team applied a common and consistent approach to calculate pre- and post-peak demands using the hourly average peak demand probability factors (PDPF) from the Texas TRM 4.0 Volume 1 Table 4-17. The claimed savings had used the top 20-hour PDPF method for the post demand, but did not use a similar probability weighting in the baseline case. Overall, the adjustments resulted in a slight increase in savings, and realization rates of 101 percent kW and kWh.

Project ID # 1057042. The energy efficiency project included a custom M&V retrofit of various HVAC control systems at a library and a large office campus to optimize the operation of the cooling and heating systems already in place. During the desk review, the EM&V team added an independent variable, Days, and was able to achieve lower standard errors for both pre- and post-utility regression models compared to the models used for claimed savings. The EM&V team's models also resulted in different balance points from the claimed regression models. Overall, the revised regression models resulted in an increase in savings, and in realization rates of 105 percent kW and kWh.

Document Score

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for six of the six projects that had desk reviews completed because sufficient documentation was provided for the sites. Since sufficient documentation was provided for 100 percent of the sampled projects, the program documentation for these estimates is Good.

10.3 DETAILED FINDINGS—RESIDENTIAL (MEDIUM EVALUATION PRIORITY)

10.3.1 Residential SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
26.2%	2,804	2,804	100.0%	25.4%	5,271,688	5,271,688	100.0%	Limited

Completed Desk Reviews*	On-Site M&V
10	5

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team made an adjustment of over five percent to the claimed energy and demand savings for one project. The realization rates were driven by adjustments to claimed energy and demand savings based on the following activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation

Desk reviews were completed for ten projects, and resulted in overall desk review realization rates of 99.6 percent and 99.0 percent for demand and energy savings, respectively. These overall desk review realization rates for the ten projects were driven by the one project where an adjustment was made at the measure-level as part of the desk review process based on the on-site M&V, and is described in the on-site M&V text below.

On-site M&V was completed for five projects, and resulted in overall on-site realization rates of 99.2 percent and 97.9 percent for demand and energy savings, respectively. These overall on-site realization rates for the five projects were driven by one project where the EM&V team's on-site testing resulted in a substantially lower reduction in duct leakage than what was documented by the program. Using a threshold of +/- 10%, the EM&V team's duct blaster test results were quite a bit higher than the results found in the tracking data. For this project, the energy savings realization rate was 88.0 percent, and the demand savings realization rate was 92.5 percent.

Additionally, the EM&V team identified minor differences between claimed and evaluated savings for LEDs due to rounding. All identified variations due to rounding were within 1 kWh and 0.001 kW.

The EM&V team was Limited in verifying key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, LEDs, and ceiling insulation for some projects.

Because sufficient documentation was provided for only some of the measures per project across some the projects, the EM&V team assigned a program documentation score of Limited.

10.3.2 Hard-to-Reach SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
4.1%	435	435	100.0%	4.1%	859,167	859,167	100.0%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team did not make an adjustment of over five percent to the claimed energy and demand savings for any of the projects. The realization rates were based on the following activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for four projects and resulted in overall desk review realization rates of 100.0 percent and 100.0 percent for demand and energy savings, respectively.

On-site M&V was completed for two projects and resulted in overall on-site realization rates of 100.0 percent and 100.0 percent for demand and energy savings, respectively.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for duct efficiency and ceiling insulation.

Because sufficient documentation was provided for all of the measures per project across all of the projects, the EM&V team assigned a program documentation score of Good.

10.4 DETAILED FINDINGS—LOW INCOME (HIGH/MEDIUM EVALUATION PRIORITY)

10.4.1 Low Income Weatherization

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
4.7%	505	505	100.0%	3.7%	772,850	772,850	100.0%	Limited

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 evaluation efforts focused on desk reviews and on-site M&V. The sampled number of completed desk reviews and on-site M&V projects for this program are listed in the table above.

The EM&V team made an adjustment of over 5 percent to the claimed savings for one project. Overall, the EM&V team assessed claimed energy and demand savings based on the following two activities:

- Desk reviews were completed for a sample of projects to check that measure data collected by contractors on forms aligned correctly with that in the tracking system
- On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for four projects, and resulted in overall desk review realization rates of 100.0 percent and 100.1 percent for demand and energy savings, respectively. These overall desk review realization rates for the four projects were driven by the one project where an adjustment was made. For this one project, the energy savings realization rate was 106.0 percent and the demand savings realization rate was 106.2 percent. The EM&V team identified a discrepancy in the wattage tracked compared to the wattage in the documentation, which resulted in increased savings.

On-site M&V was completed for two projects, and resulted in overall on-site realization rates of 100.0 percent and 100.0 percent for demand and energy savings, respectively.

The EM&V team was Limited in verifying key inputs and assumptions (e.g., pre- and post- equipment) for central heat pumps, ceiling insulation, and direct installs such as LEDs, and pipe insulation.

Because sufficient documentation was provided for only some of the measures per project across some the projects, the EM&V team assigned a program documentation score of Limited.

10.5 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

10.5.1 Load Management Standard Offer Program

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
37.7%	4,030	4,030	100.0%	0.0%	4,030	4,030	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the TNMP Commercial Load Management program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the Electric Service Identifier (ESI ID) level. A single load management event occurred on June 7, 2017 from 2pm to 3pm.

The EM&V team received the interval meter data as well as spreadsheets detailing the TNMP calculated savings results for the event and each ESI ID. The EM&V Team was able to calculate savings for each of the participating ESI IDs with the results matching those of the program. As such, no adjustments were made to the program savings.

Evaluated savings for the TNMP Commercial Load Management program are 4,030 kW and 4,030 kWh. The realization rate for both kW and kWh is 100.0 percent.

10.6 DETAILED FINDINGS—PILOTS (HIGH/MEDIUM EVALUATION PRIORITY)

10.6.1 CoolSaver Pilot MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
0.5%	52	52	100.0%	0.6%	132,380	132,380	100.0%	Unranked

Completed Desk Reviews*	On-Site M&V
Census Tracking Review	0

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 CoolSaver Pilot MT program evaluation efforts focused on a targeted engineering review for a census of tune-up measures reported by the program as listed above.

For PY2017 the EM&V team conducted a complete tracking system review for all four utilities and nine programs that reported tune-ups in 2017 including TNMP's residential CoolSaver Pilot MT program. 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. In PY2016, the efficiency loss factors, which are the major driver of the claimed savings for this measure, for the state-wide population of tune-ups were much lower than in previous years (PY2011–2015). In PY2017, the EM&V team examined the efficiency loss factors for both the commercial and residential sectors and found that they were similar to previous program years and the decline observed by the EM&V team in PY2016 did not continue. This alleviates the concern with the efficiency loss factors approaching the deemed values currently in the Texas TRM 4.0 and 5.0 versions. The EM&V team also examined the percentage of projects with full M&V, and found that the utility achieved over 10 percent M&V on their projects. This confirmed that a robust M&V sample was collected.

The EM&V team made no adjustments to any of the savings calculations for the projects reviewed. Therefore, evaluated savings were equal to the claimed savings, with realization rates for both kW and kWh equaling 100 percent.

Document Score

This program only received a tracking system review and the EM&V team did not obtain any project level documentation and is therefore not able to comment on the documentation sufficiency.

10.7 SUMMARY OF LOW PRIORITY EVALUATION PROGRAMS

Table 2-4 provides a summary of claimed savings for TNMP's low evaluation priority programs in PY2017, including programs' overall contribution to portfolio savings. Low priority programs' claimed savings were verified against the final PY2017 tracking data provided to the EM&V team for the EM&V database.

Table 10-4. PY2017 Claimed Savings (Low Evaluation Priority Programs)

Program	Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)
Open for Small Business MTP	2.6%	278	278	100.0%	5.9%	1,234,498	1,234,498	100.0%
High-Performance Homes MTP	8.5%	904	904	100.0%	14.3%	2,970,734	2,970,734	100.0%
Efficiency Connection MTP	0.1%	15	15	100.0%	0.3%	72,051	72,051	100.0%

11.0 IMPACT EVALUATION RESULTS—XCEL ENERGY SOUTHWESTERN PUBLIC SERVICE COMPANY

This section presents the evaluated savings and cost-effectiveness results for Xcel SPS's energy efficiency portfolio. The key findings are summarized first, followed by details for each program in the portfolio that had a high or medium evaluation priority. Finally, a list of the low evaluation priority for which claimed savings were verified through the EM&V database are included.

11.1 KEY FINDINGS

11.1.1 Evaluated Savings

Xcel SPS's evaluated savings for PY2017 were 7,748 in demand (kW) and 16,861,822 in energy (kWh) savings. The overall kW and kWh portfolio realization rates are 100 percent. Xcel SPS was responsive to all EM&V recommendations to adjust claimed savings based on EM&V results, which also supported healthy realization rates.

Table 11-1 shows the claimed and evaluated demand savings for Xcel SPS's portfolio and broad customer sector/program categories.

Table 11-1. Xcel SPS PY2017 Claimed and Evaluated Demand Savings

Level of Analysis	Percent Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**7,750**	**7,748**	**100.0%**	**0.2%**
Commercial	23.4%	1,811	1,809	99.9%	0.8%
Residential	30.5%	2,362	2,362	100.0%	0.0%
Low Income	3.3%	254	254	100.0%	0.0%
Load Management*	42.9%	3,323	3,323	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Table 11-2 shows the claimed and evaluated energy savings for Xcel SPS's portfolio and broad customer sector/program categories for PY2017.

Table 11-2. Xcel SPS PY2017 Claimed and Evaluated Energy Savings

Level of Analysis	Percent Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total Portfolio	**100.0%**	**16,870,850**	**16,861,821**	**99.9%**	**0.5%**
Commercial	55.5%	9,364,616	9,355,587	99.9%	0.7%
Residential	39.9%	6,727,511	6,727,511	100.0%	0.0%
Low Income	4.5%	765,432	765,432	100.0%	0.0%
Load Management*	0.1%	13,292	13,292	100.0%	0.0%

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

Program-level realization rates are discussed in the detailed findings sub-sections. However, it is important to note that these results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

In program-level realization rates, we have also included a program documentation score of Good, Fair, or Limited as discussed in Section 3. For the utility program documentation score, the score of Good was given if 90 percent or more of the evaluated savings estimates received a score of good or fair due to program documentation received as indicated in detailed program findings. A score of Fair was given if 70–89 percent of the evaluated savings estimates received a score of good or fair. A score of Limited was given if less than 70 percent of savings received score of good or fair. In general, a score of Good indicates the utility has established processes to collect sufficient documentation to verify savings; a score of Fair also indicates established processes with some areas of improvements identified; and a score of Limited indicates program documentation improvements across more individual programs and/or high savings programs have been identified.

Xcel SPS only received a good program documentation score for the Recommissioning MTP and Commercial Load Management program, with fair documentation scores for the CSOP and residential programs. While a fair documentation score indicates a reasonable level of documentation, it also indicates some room for improvement. For Residential, in particular, the EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and ceiling insulation for some projects but not all. In addition, there was limited documentation for direct installs such as LEDs across all three programs.

11.1.2 Cost-Effectiveness Results

Xcel SPS's overall portfolio had a cost-effectiveness of 2.48, or 2.68 excluding low-income programs.

The more cost-effective programs were Home Lighting MTP and Commercial SOP. The less cost-effective programs were Small Commercial MTP and Load Management SOP.

The lifetime cost of evaluated savings was $0.009 per kWh and $17.22 per kW.

Table 11-3. Xcel SPS Cost-Effectiveness Results

Level of Analysis	Claimed Savings Results	Evaluated Savings Results	Net Savings Results
Total Portfolio	**2.5**	**2.5**	**2.3**
Total Portfolio excluding low-income programs	**2.7**	**2.7**	**2.5**
Commercial	**2.6**	**2.6**	**2.3**
Commercial SOP	4.6	4.6	4.2
Recommissioning MTP	2.6	2.6	2.3
Small Commercial MTP	1.1	1.1	1.0
Home Lighting MTP	4.7	4.7	4.2
Residential	**3.0**	**3.0**	**2.7**
Residential SOP	2.4	2.4	2.1
Home Lighting MTP	7.3	7.3	6.6
Hard-to-Reach SOP	2.0	2.0	2.0
Low Income*	**2.6**	**2.6**	**2.6**
Low-Income Weatherization*	2.6	2.6	2.6
Load Management	**1.3**	**1.3**	**1.3**
Load Management SOP	1.3	1.3	1.3

* The Low-Income sector and Low Income Weatherization program are evaluated using the savings-to-investment ratio (SIR).

11.2 DETAILED FINDINGS—COMMERCIAL (HIGH/MEDIUM EVALUATION PRIORITY)

11.2.1 Recommissioning MTP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
11.9%	922	920	99.8%	29.7%	5,003,942	4,995,673	99.8%	Good

Completed Desk Reviews*	On-Site M&V
4	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 Retro-Commissioning MTP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for three projects. One project had an adjustment of less than five percent and two projects had an adjustment of greater than five percent compared to the original claimed savings. Xcel SPS accepted the evaluated results and matched the claimed savings to those of the evaluations for the two projects with significant adjustments and therefore the final program realization rate is nearly 100 percent. Further details of the EM&V findings are provided below.

Project ID # 1080980. The energy efficiency project included lighting retrofits within the interior and exterior areas of retail (non-mall/strip) facility. During the desk review, the EM&V team completed corrections to the post retrofit fixture types and wattages for some lighting at the site as model numbers were found to be inconsistent between those documented within the calculator compared to model numbers clearly identified on the material invoice and QPL listings provided. The interior high bay lights that were claimed as 50W per fixture were verified to be 75W per fixture. The exterior wall packs that were claimed as 55W per fixture were verified to be 70W per fixture. Overall, the corrections resulted in realization rates of 98 percent kW and kWh.

Project ID # 1080982. The energy efficiency project included interior lighting retrofits and the installation of multiple refrigeration system upgrades at a food manufacturing facility. During the desk review and on-site M&V visit, the EM&V team made adjustments to the assumptions and savings for the custom refrigeration portion of the project and did not adjust the lighting savings. The retrofits of the refrigeration system included the installation of condenser wet bulb temperature reset controls, suction pressure reset controls and the conversion of unused refrigerated silos into reverse osmosis (RO) water storage for a new on-site production operation. Adjustments to the refrigeration systems energy use were due to corrections in the hours of production that were reduced from 110 to 99 hours per week which reduced savings for production hours and increased savings during non-production hours. This decreased savings for the condenser reset controls and increased savings for the suction pressure reset controls, with the combined savings value increasing slightly. The demand savings were reduced due to the EM&V team utilizing the Texas TRM 4.0 Volume 1 peak demand savings calculations for non-weather dependent loads. This along with the hours of operation changes resulted in the reduction of the peak demand savings. These corrections reduced peak demand savings and increased energy savings for the custom refrigeration portion of the project and resulted in realization rates of 94 percent kW and 103 percent kWh. The lighting portion of the project resulted in realization rates of 100 percent kW and kWh.

Project ID # 1080987. The energy efficiency project included lighting retrofits within the interior areas of a retail (non-mall/strip) facility. During the desk review, the EM&V team completed corrections to the post retrofit fixture quantities and wattages for some of the lighting at the site. The quantities and wattages were found to be inconsistent between those documented within the calculator compared to quantities clearly identified on the material invoice and wattages on the QPL listings provided. Overall, the corrections resulted in realization rates of 92 percent kW and 91 percent kWh.

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for two of the four projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 92 percent was assessed for the program, as two lighting projects provided many key documents, but the information within the documents were not used for assessing the project assumptions and claiming savings and this led to savings adjustments. The project documentation included invoices, QPL qualifications, pre-and post-inspection notes and the project savings calculators which are significant efforts by the utility to verify equipment conditions and quantities. However, the lighting savings were limited for two projects as they did not reflect the correct details of the lighting types or quantities as described by the backup documentation captured. Complete documentation enhances the accuracy and transparency of project savings along with ease of evaluation. Since

sufficient documentation was provided for 90 percent or greater of the sampled projects, the EM&V team assigned a program documentation score of Good.

11.2.2 Commercial SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
8.1%	631	630	100.0%	18.9%	3,188,139	3,187,380	100.0%	Fair

Completed Desk Reviews*	On-Site M&V
8	4

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY2017 CSOP evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team adjusted the claimed savings for three projects. Two projects had an adjustment of less than five percent and one project had an adjustment of greater than five percent compared to the original claimed savings. Xcel accepted the evaluated results and matched the claimed savings to those of the evaluations for the one project with significant adjustments; therefore, the final program realization rate is 100 percent. Further details of the EM&V findings are provided below.

Project ID # 983853. The energy efficiency project included lighting retrofits within the interior and exterior areas of an office facility. During the desk review, the EM&V team completed corrections to the post retrofit fixture types and wattages that were installed within some areas of the site. The post-retrofit fixture code and wattage for lighting claimed as LED017-SCRW (17W per lamp) were found to be LED020-TUBE (20W per tube). Overall, the correction resulted in realization rates of 98 percent kW and kWh.

Project ID # 983859. The energy efficiency project included lighting retrofits within the interior and exterior areas of a courthouse. During the desk review, the EM&V team corrected the deemed building type selection for the interior lighting and corrected multiple LED product wattages. The building type was corrected from "office" to "public order/safety" to more appropriately match the predominant building type. As defined by the US EAI CBECS building survey, Public Order and Safety includes buildings such as police station; fire station; jail, reformatory, or penitentiary; courthouse or probation offices. The building type correction decreased demand and energy savings slightly across all lighting as the deemed assumptions for coincidence factor (CF) were decreased slightly from 0.77 to 0.75 and the operating hours were reduced from 3,737 to 3,472 hours per year. In addition, ENERGY STAR® qualification could not be verified for two lighting products (13W LED013-SCRW and 15W LED015-SCRW). Savings for these installations were removed from the project. DLC qualification verified that all reported 43W exterior lights were rated at 41W which increased savings slightly. ENERGY STAR® qualification verified that all reported 10W LED lamps were 9W which increased savings slightly. Overall, these corrections reduced savings and resulted in realization rates of 90 percent kW and 86 percent kWh.

Project ID # 1096777. The energy efficiency project included lighting retrofits within the interior and exterior areas of a religious facility. During the desk review and on-site M&V visit, the EM&V team corrected multiple LED product wattages and quantities based on the site verified lighting installed and using the DLC and ENERGY STAR® qualified products lists. Overall, these corrections resulted in a negligible increase to the project's savings and realization rates of 100 percent kW and kWh.

The EM&V team was able to verify key inputs and assumptions (e.g., equipment quantity, equipment capacity, QPL qualifications, AHRI certifications) for two of the eight projects that had desk reviews completed because sufficient documentation was provided for the sites.

A documentation score of 80 percent was assessed for the program, as partial documentation was provided for six lighting projects. Four of the lighting projects with partial documentation lacked information regarding the new LED lighting installed. The lighting calculators did not detail the manufacturers make or model number and the qualification type was not described. In addition, invoices, manufacturer's specification sheets, and QPL documentation were not provided. Without a site visit to capture the lighting model numbers, the QPL and wattage could not be verified from the documentation provided. The fifth lighting project with partial documentation was a project in which custom hours of operation were claimed, however, no details were provided to support the custom attribute. The sixth lighting project provided many key documents, but the information within the documents were not used for assessing the project assumptions and claiming savings and this led to significant savings adjustments. The project documentation included invoices, manufacturer specifications along with post-inspection notes and the project savings calculator which are significant efforts by the utility to verify equipment conditions and quantities. However, the lighting savings were limited as they did not reflect the correct details of the project lighting types or building type as described by the backup documentation captured. Complete documentation enhances the accuracy and transparency of project savings along with ease of evaluation. Since sufficient documentation was provided for greater than 70 percent, but less than 90 percent of the sampled projects, the EM&V team assigned a program documentation score of Fair.

11.3 DETAILED FINDINGS—RESIDENTIAL (MEDIUM EVALUATION PRIORITY)

11.3.1 Residential SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
12.1%	935	935	100.0%	13.9%	2,343,021	2,343,021	100.0%	Fair

Completed Desk Reviews*	On-Site M&V
6	3

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY17 evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team made an adjustment of over five percent to the claimed savings for one project. Overall, the EM&V team assessed ex-ante claimed energy and demand savings based on the following two activities:

For a sample of projects, desk reviews were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system

On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for six projects, and resulted in desk review realization rates of 103.5 percent and 103.2 percent for demand and energy savings, respectively.

There were minor differences between ex-ante and ex post savings for all measures due to rounding. All identified variations due to rounding were within 1 kWh and 0.01 kW.

On-site M&V was completed for three projects, and resulted in on-site realization rates of 105.0 percent and 105.1 percent for demand and energy savings, respectively. These overall on-site realization rates for the three projects were driven by the one project where the EM&V team's on-site testing resulted in a substantially higher reduction in air infiltration than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's blower door test results were quite a bit lower than the results found in the tracking data. For this one project, the energy savings realization rate was 117.8 percent and the demand savings realization rate was 117.3 percent.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration, duct efficiency, and ceiling insulation for some projects but not all. There was also limited documentation for direct installs such as LEDs.

Because sufficient documentation was provided for some of the measures per project across all the projects, the EM&V team assigned a program documentation score of Fair.

11.3.2 Hard-to-Reach SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
8.5%	659	659	100.0%	9.9%	1,665,792	1,665,792	100.0%	Fair

Completed Desk Reviews*	On-Site M&V
5	2

*Confidence intervals are not reported at the utility program level as these results should only be viewed qualitatively due to the small sample sizes.

The PY17 evaluation efforts focused on desk reviews and on-site M&V. The sample of completed desk reviews and on-site M&V projects for this program are listed above.

The EM&V team made an adjustment of over five percent to the claimed savings for three projects. Overall, the EM&V team assessed ex-ante claimed energy and demand savings based on the following two activities:

For a sample of projects, desk reviews were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system

On-site M&V was completed for a sample of projects to verify that measures remained installed and matched project documentation.

Desk reviews were completed for five projects, and resulted in desk review realization rates of 96.9 percent and 100.9 percent for demand and energy savings, respectively. These overall desk review realization rates for the five projects were mainly driven by one of the projects where an adjustment was made. For this one project, the energy savings realization rate was 54.1 percent and the demand savings realization rate was 55 percent. For this one project, the EM&V team determined that the required documentation for ceiling insulation was missing, which led to the differences between ex-ante and ex post savings. More information about the documentation required is below.

- **Ceiling insulation, baseline restriction.** TRM V4.0 contains an eligibility requirement for the ceiling insulation measure, the application of which led to a difference in reported and evaluated savings for one project. TRM V4.0 states for any reported pre-retrofit R-value that falls below R-5, all contractors are required to provide sufficient evidence including two pictures: (1) a picture showing the entire attic floor, and (2) a close-up picture of a ruler that shows the measurement of the depth of the insulation. In the absence of evidence demonstrating pre-retrofit ceiling insulation below R-5, the lowest level of pre-retrofit ceiling insulation that can be claimed is the R-5 to R-8 range.

Additionally, there were minor differences between ex-ante and ex post savings for all measures due to rounding. All identified variations due to rounding were within 1 kWh and 0.01 kW.

On-site M&V was completed for two projects, and resulted in on-site realization rates of 110 percent and 105.2 percent for demand and energy savings, respectively. These overall on-site realization rates for the two projects were driven by the one project where the EM&V team's on-site testing resulted in a substantially higher reduction in air infiltration than what was documented by the program. Using a threshold of +/- 10 percent, the EM&V team's blower door test results were quite a bit lower than the results found in the tracking data. For this one project, the energy savings realization rate was 107.7 percent and the demand savings realization rate was 115.6 percent.

The EM&V team was able to verify key inputs and assumptions (e.g., pre- and post- condition test results) for air infiltration and duct efficiency. There was limited documentation for ceiling insulation and direct installs, such as LEDs and low flow showerheads.

Because sufficient documentation was provided for some of the measures per project across all the projects, the EM&V team assigned a program documentation score of Fair.

11.4 DETAILED FINDINGS—LOW INCOME (HIGH/MEDIUM EVALUATION PRIORITY)

11.4.1 Low-Income Weatherization

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
3.3%	254	254	100.0%	4.5%	765,432	765,432	100.0%	Fair

Completed Desk Reviews	On-Site M&V
2	0

The PY17 evaluation efforts focused on desk reviews. The sample of completed desk reviews for this program are listed above.

The EM&V team made an adjustment of over five percent to the claimed savings for one project. Overall, the EM&V team assessed ex-ante claimed energy and demand savings based on desk reviews:

For a sample of projects, desk reviews were completed to check that measure data collected by contractors on forms aligned correctly with that in the tracking system.

Desk reviews were completed for two projects, and resulted in desk review realization rates of 37.3 percent and 58.2 percent for demand and energy savings, respectively. These overall desk review realization rates for the two projects were mainly driven by the one project where an adjustment was made. For this one project, the energy savings realization rate was 47.4 percent and the demand savings realization rate was 28.8 percent. For this one project, the EM&V team determined that the required documentation for ceiling insulation was missing, which led to the differences between ex-ante and ex post savings. More information about the documentation required is below.

- **Ceiling insulation, baseline restriction.** TRM V4.0 contains an eligibility requirement for the ceiling insulation measure, the application of which led to a difference in reported and evaluated savings for one project. TRM V4.0 states for any reported pre-retrofit R-value that falls below R-5, all contractors are required to provide sufficient evidence including two pictures: (1) a picture showing the entire attic floor, and (2) a close-up picture of a ruler that shows the measurement of the depth of the insulation. In the absence of evidence demonstrating pre-retrofit ceiling insulation below R-5, the lowest level of pre-retrofit ceiling insulation that can be claimed is the R-5 to R-8 range.

Additionally, there were minor differences between ex-ante and ex post savings for all measures due to rounding. All identified variations due to rounding were within 1 kWh and 0.01 kW.

The EM&V team was able to verify key inputs and assumptions for solar screens. There was limited documentation for ceiling insulation and LEDs.

Because sufficient documentation was provided for some of the measures per project across all the projects, the EM&V team assigned a program documentation score of Fair.

11.5 DETAILED FINDINGS—LOAD MANAGEMENT (HIGH/MEDIUM EVALUATION PRIORITY)

11.5.1 Load Management SOP

Program Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Program Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Program Documentation Score
42.9%	3,323	3,323	100.0%	0.1%	13,292	13,292	100.0%	Good

Completed Desk Reviews*	On-Site M&V
N/A	N/A

* The review for the load management program included a census review of equations and interval meter data to estimate the baseline usage and resulting level of load curtailment achieved for each event for all participants.

The EM&V team evaluated the Xcel SPS Load Management program by applying the TRM calculation methodology to interval meter data. The meter data was supplied in 15-minute increments at the meter level. A single unscheduled load management event occurred on August 22, 2017, from 3:00 p.m. to 7:00 p.m.

The EM&V team received the interval meter data as well as a spreadsheet that summarized the event-level savings for each participant. The EM&V team was able to calculate savings with the data that Xcel SPS provided, with the results matching for each participant and in total.

Evaluated savings for the Xcel SPS Load Management program are 3,323 kW and 13,292 kWh. The realization rate for both kW and kWh is 100.0 percent.

11.6 SUMMARY OF LOW PRIORITY EVALUATION PROGRAMS

Table 2-4 provides a summary of claimed savings for Xcel SPS's low evaluation priority programs in PY2017, including programs' overall contribution to portfolio savings. Low priority programs' claimed savings were verified against the final PY2017 tracking data provided to the EM&V team for the EM&V database.

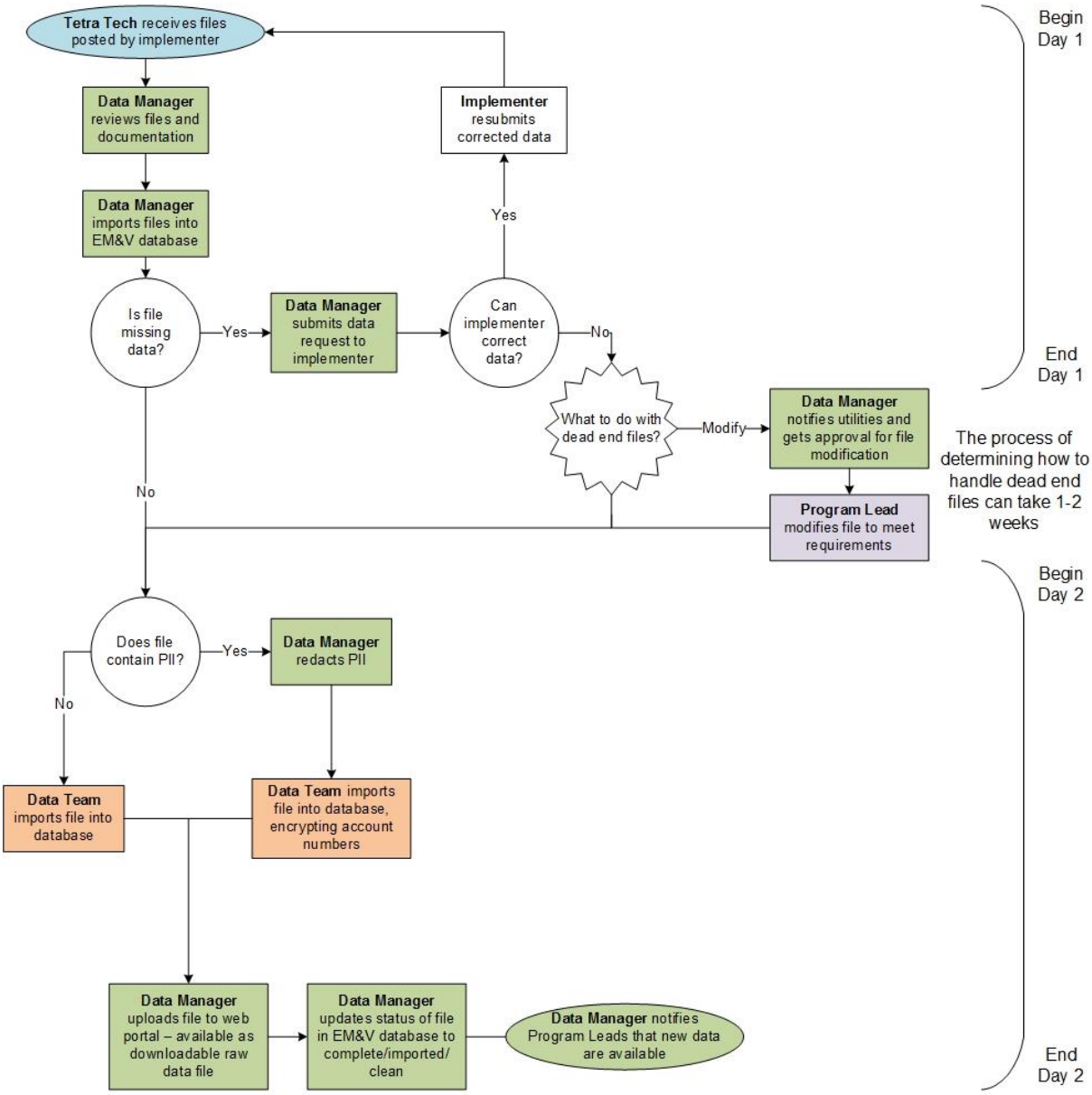
Table 11-4. PY2017 Claimed Savings (Low Evaluation Priority Programs)

Program	Contribution to Portfolio Savings (kW)	Claimed Demand Savings (kW)	Evaluated Demand Savings (kW)	Realization Rate (kW)	Contribution to Portfolio Savings (kWh)	Claimed Energy Savings (kWh)	Evaluated Energy Savings (kWh)	Realization Rate (kWh)
Small Commercial MTP	2.8%	219	219	100.0%	6.1%	1,029,446	1,029,446	100.0%
Home Lighting MTP (Com)	0.5%	40	40	100.0%	0.8%	143,089	143,089	100.0%
Home Lighting MTP (Res)	9.9%	768	768	100.0%	16.1%	2,718,698	2,718,698	100.0%

APPENDIX A: DATA MANAGEMENT PROCESS

The following figure details the data management process.

Figure A-1. Data Management Process



APPENDIX B: COST-EFFECTIVENESS CALCULATIONS

This appendix describes the calculations used for modeling cost-effectiveness. This approach provides the PUCT with a consistent methodology for evaluating cost-effectiveness across the utilities.

B.1 APPROACH

The approach to the EM&V team's benefit-cost testing is based on P.U.C. SUBST. R. 25.181, where costs and benefits are defined in section (d):

> *"The cost of a program includes the cost of incentives, measurement and verification, any shareholder bonus awarded to the utility, and actual or allocated research and development and administrative costs. The benefits of the program consist of the value of the demand reductions and energy savings, measured in accordance with the avoided costs prescribed in this subsection. The present value of the program benefits shall be calculated over the projected life of the measures installed or implemented under the program."*

This description is consistent with the PACT. Based on this definition, we collected the costs reported in the utilities' 2018 EEPRs, filed on April 1, 2018.[6] The program benefits must be calculated at a measure level in order to apply individual effective useful lives. Therefore, the savings were derived from the EM&V database, which is a comprehensive, centralized source of the utilities' program tracking data.

The present value of the benefits is calculated separately for energy and demand as follows:

$$PV = \frac{AC}{WACC - E}\left[1 - \left(\frac{1+E}{1+WACC}\right)^{n}\right]$$

Where:

AC is the avoided cost of the benefit (energy or demand)

The discount rate, *WACC*, is the utility's weighted average cost of capital

E is the escalation rate

n is the effective useful life of the measure.

This calculation was modified from the original evaluation plan in order to allow for including an escalation rate. The EM&V team has provided results for benefit-cost calculation using an escalation rate of 2 percent and without an escalation rate.

[6] PUCT filing number 44480.

The benefit-cost ratio is calculated as:

$$BC = \frac{PV_e + PV_d}{C}$$

Where:

PV_e is the present value of the avoided energy costs

PV_d is the present value of the avoided demand costs

C is the total program cost, including incentives, administrative, evaluation, measurement and verification, shareholder bonus, and research and development costs.

Some costs are reported by the utilities at the portfolio level, such as research and development and shareholder bonus costs. These costs are attributed to individual programs based on each program's incentive costs as a percentage of the portfolio. EM&V costs were previously distributed among utility programs by the EM&V team based on programs' share of energy savings and evaluation priority.

B.1.1 Savings-to-Investment Ratio

Targeted low-income energy efficiency programs are run by all unbundled transmission and distribution utilities. These programs are evaluated using the SIR rather than the PACT described above.

The SIR is significantly different in both the benefits and costs included. The benefits are comprised of the customer's avoided energy costs. This means that the retail electric rate is used rather than the utility's avoided cost, and there is no cost associated with avoided demand. Rather than the WACC, the SIR uses a societal discount rate of 3 percent. The only costs included are the incentives paid to the weatherization agencies.

The following table lists the average retail rates paid by customers. These rates are based on data collected by Frontier Associates through weatherization agencies.

Table B-1. Average Energy Cost by Utility

Utility	Average kWh Rate
AEP TCC	$0.1123
AEP TNC	$0.1123
CenterPoint	$0.1438
Oncor	$0.1150
Sharyland	$0.1403
TNMP	$0.1078
Xcel Energy	$0.1135

B.1.1 Net-to-Gross Ratios

The following NTG ratios were used to calculate cost-effectiveness based on net savings. The EM&V team determined the NTG ratios through primary research in the PY2013 and PY2014 scope.

Table B-2. Net-to-Gross Ratios

Program	kWh NTG	kW NTG
Commercial		
Commercial SOP	0.91	0.89
Recommissioning MTP	0.90	0.90
Small Commercial MTP	0.95	0.95
Home Lighting MTP	0.90	0.90
Residential		
Residential SOP	0.92	0.86
Home Lighting MTP	0.90	0.90
Hard-to-Reach SOP	1.00	1.00
Low Income		
Low-Income Weatherization	1.00	1.00
Load Management		
Load Management SOP	1.00	1.00

APPENDIX C: QA/QC PROTOCOLS

This appendix documents the QA/QC protocols established for the PUCT EM&V team for reporting claimed and evaluated impacts. Although quality control is a function of all evaluation stages (e.g., populating the EM&V database, sampling, analysis), this appendix focuses on the QA/QC processes within the reporting stage. A QA/QC team, which will be led by the Tetra Tech reporting lead, will be developed and accountable for ensuring all QA/QC protocols are being followed.

Below we summarize the specific activities that will be subject to QA/QC processes. Note that these QA/QC processes focus on accuracy of data; this section does not address methodological issues.

Accuracy of ex-ante program data. The EM&V team is housing data, analysis, and reporting functions within the EM&V database. Data will be provided by program implementers, read into the database in raw form, and organized for analysis. The database centrally stores the claimed (ex-ante) savings, which will be used for sampling and reporting of those claimed savings. Data will be provided to the EM&V team quarterly. The EM&V team will characterize the data received in terms of energy and demand savings and participants served and report the information within the detailed research plans. These detailed research plans will be delivered to the utilities for review and confirmation that the population data is accurate. Inaccurate population data may indicate missing data, errors in the data importation process, or misunderstanding of the data fields.

- Responsibility: program leads
- Accountability: QA/QC team
- Consulted: utility staff and implementation contractors and EM&V project manager.

Application of verification rates and net-to-gross ratios. The impacts will be generated in the EM&V database. The database will categorize measure-level information in the format it was provided to the EM&V team per the data acquisition process. Although projects may be sampled and verified at the measure level, the EM&V team will conduct impact evaluations to obtain and report verification and net-to-gross estimates at the utility and program type level, which will then be aggregated and reported at the program group level.

These impact estimates will be provided by the program leads and stored in two locations. First, the program leads will enter the impact results within an Excel tracking sheet stored on the SharePoint site. The Excel tracking sheet will include the following fields—program year, utility, program group, program type, measure group, program lead, verification rate, net-to-gross ratio, report source of verification rate, report source of net-to-gross ratio, and modification date. *Only one sheet will maintain current impact information.* Should data be updated throughout the process, the outdated records will be moved to a separate worksheet within that file. Doing so will ensure one sheet will maintain the correct rates, and that any modifications are documented including reason for modification.

Second, the EM&V database will include an interface where program leads will directly enter their impact results. These results will then be stored and applied against the claimed savings to calculate the evaluated gross and evaluated net results for the annual reporting.

By creating a two-stage impact reporting process, the EM&V team builds a point of verification of the data into the process. The evaluated and net savings results will be directly calculated out of the EM&V database using the rates supplied within the web interface. The EM&V team will then verify that the results are as expected using the values documented within the Excel impact reporting file. Should the results differ, the QA/QC team will be able to go refer to the original source to verify the results.

- Responsibility: program leads
- Accountability: QA/QC team
- Consulted: impact leads, EM&V data lead, and project manager.

Accuracy of reported savings. As documented within the report outline, program impacts will be aggregated and reported in various ways. At the most aggregate level, the data will be reported by program group overall and then by utility. At the most granular level, the data will be reported by program group for each utility. The annual report will therefore represent impacts in over 100 tables. It will be critical to spend considerable time conducting QA/QC against those reported values.

The EM&V database will calculate the full year claimed savings by utility, program type and program group. Although claimed savings will be documented in quarterly detailed research plans, adjustments made in claimed savings are likely to occur throughout the year. Therefore, it will be necessary to calculate the full program year claimed savings and verify our results against the utility claimed data, which will be reported to the commission. The EM&V team will request that the utilities provide their Draft claimed savings to verify against the reported claimed savings within the EM&V database. Any differences in the evaluation and utility claimed savings will be clearly documented within the report.

All results tables will be cross-referenced to ensure the results true-up and are consistent with each other. For example, the sum of all Residential MTPs evaluated net savings documented within the utility-specific sections should equal the Residential MTP results captured in Volume I. The QA/QC team will develop a checklist of tables to be crosschecked and against which sources, and will systematically go through this checklist throughout the report proofing process.

Although not a specific QA/QC function, the team's development of these reporting functions with the overarching goal of ensuring transparency will inherently allow for ad hoc QA/QC checks by the PUCT, utilities, implementation contractors, or other interested parties. For example, the EM&V database can export results and resulting calculations within easy-to-use Excel files. In addition, impact-related reports will tie back to results clearly for secondary review.

- Responsibility: utilities (for providing claimed savings) and program leads (for verifying claimed impacts provided)
- Accountability: QA/QC team (for final review and cross-checks of impact tables)
- Consulted: impact leads, EM&V data lead, utilities, and EM&V project manager.