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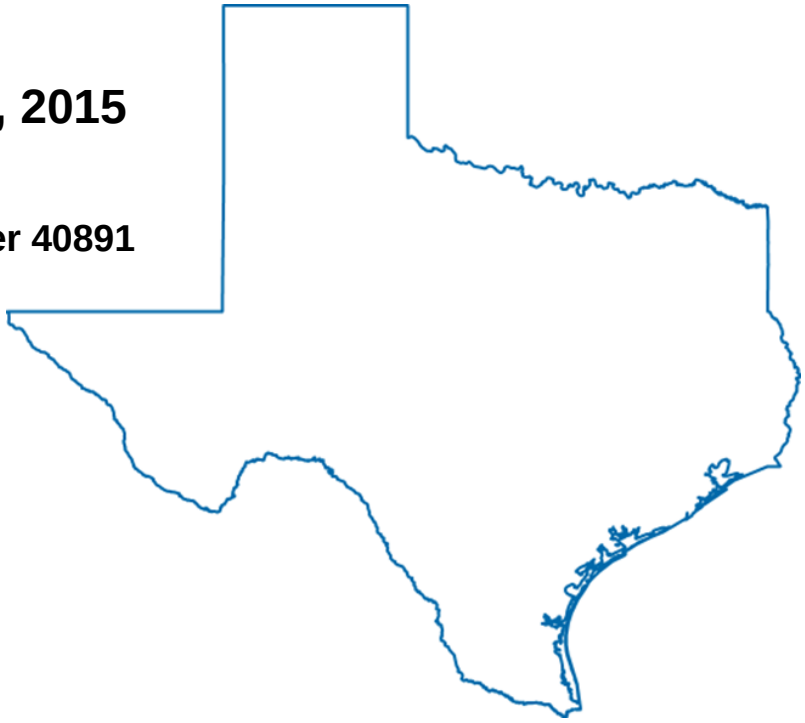
Public Utility Commission of Texas

Annual Statewide Portfolio Report for Program Year 2014—Volume I

October 16, 2015

Project Number 40891



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Public Utility Commission of Texas

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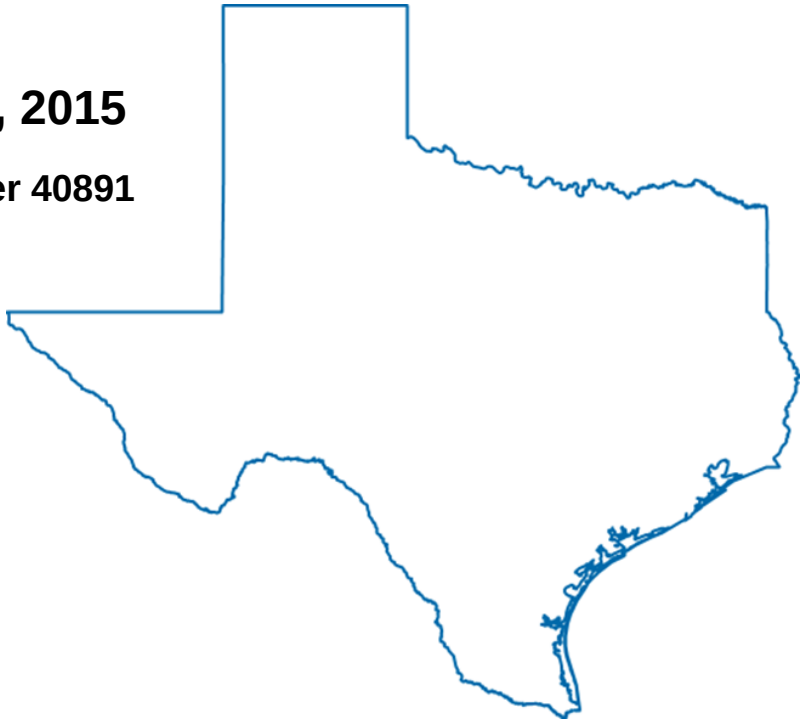

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Acknowledgements

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EM&V team primary report contributors include:

Firm	Contributor	Role
Tetra Tech	Lark Lee	Overall project manager and technical reviewer
	Jonathan Hoechst	Evaluation Planning and Reporting lead
	Dan Belknap	Cost-effectiveness testing and data lead

Firm	Contributor	Role
	Sue Hanson and Rich Hasselman	Residential market transformation programs
	Kim Baslock, Jeff Brooks and Chris King	Nonresidential market transformation programs
The Cadmus Group	Steve Cofer and Paul Youchak	Residential standard offer programs
	Scott Reeves and Natalie Bodington	Low-income/hard-to-reach programs
Itron	Bob Ramirez, Ben Cheah and Phani Pagadala	Commercial standard offer programs
	Dave Hanna and Molly Du	Load management programs
	Stephan Barsun	Solar PV programs

Please send any questions or comments on the report to Katie Rich (katie.rich@puc.gov.tx) and Lark Lee (lark.lee@tetratech.com).

Acronyms

AC	Air conditioner
AEP TCC	American Electric Power Texas Central Company
AEP TNC	American Electric Power Texas North Company
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
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)

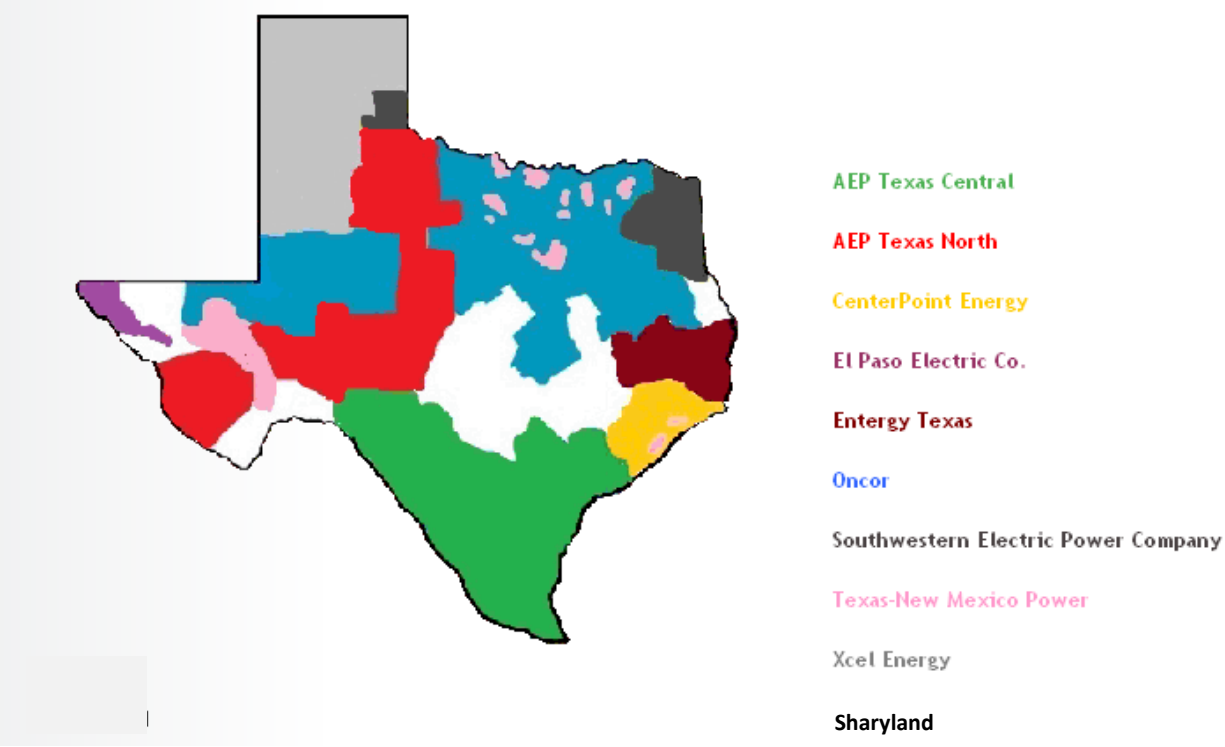
1. EXECUTIVE SUMMARY

The Public Utility Commission of Texas (PUCT) oversees the energy efficiency programs delivered by the state's ten investor-owned electric utilities: American Electric Power Texas Central Company (AEP TCC), American Electric Power Texas North Company (AEP TNC), CenterPoint Energy Houston Electric, LLC (CenterPoint), Entergy Texas, Inc. (Entergy), El Paso Electric Company (El Paso Electric), Oncor, Sharyland Utilities, L.P. (Sharyland), Southwestern Electric Power Company (SWEPCO), Southwestern Public Service Company (Xcel SPS), and Texas New Mexico Power Company (TNMP).

In program year 2014 (PY2014) the ten Texas electric utilities delivered statewide savings of 539,192,555 kWh and 392,643 kW at a lifetime evaluated savings cost of $0.012 per kWh and $20.29 per kW. Eight of the ten utilities exceeded their energy and demand savings goals for PY2014. One utility fell slightly short of just their demand goal and the other utility recently started offering energy efficiency programs and saw increased participation in PY2014.

The utilities' service territories are shown in Figure 1 below:

Figure 1-1. Territories of Regulated Electric Utilities in Texas

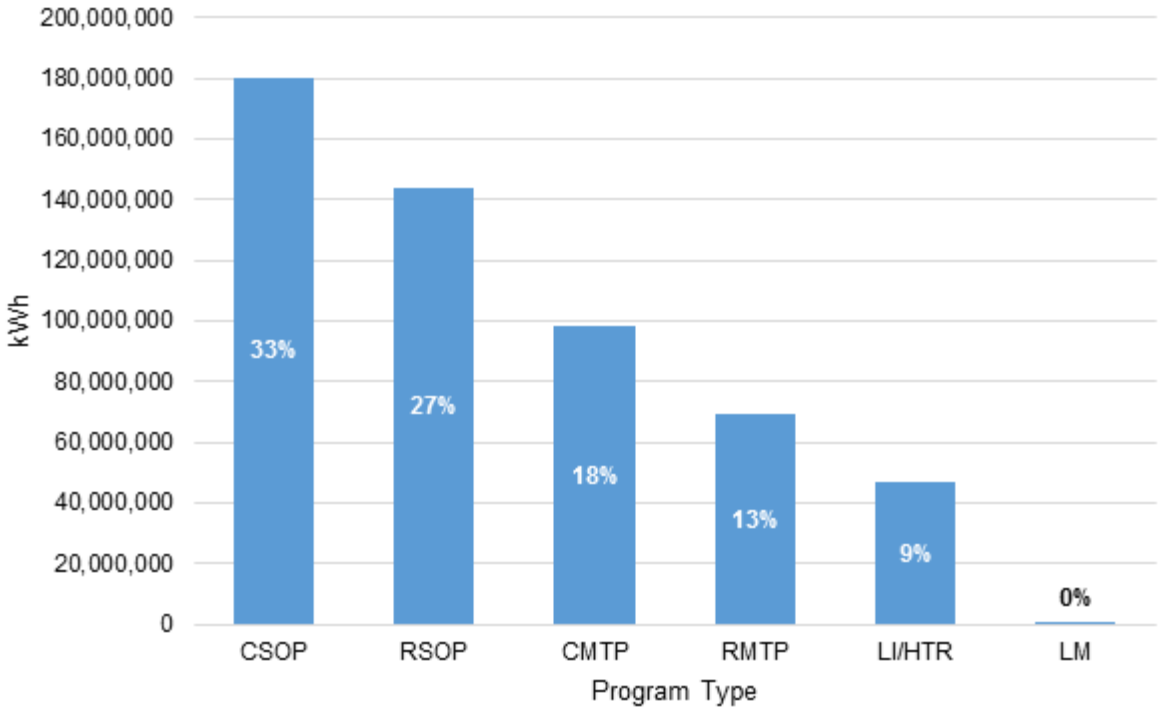


The Texas electric utilities' programs improve the energy efficiency of residential and commercial customers through Standard Offer Programs (SOPs) and Market Transformation Programs (MTPs). SOPs support an infrastructure of contractors ("energy efficiency service providers" (EESPs)) delivering equipment and services directly to customers. Over 100 unique EESPs participated in the commercial SOPs and over 200 unique EESPs participated across the residential SOPs. Implementation contractors selected by the utilities deliver MTPs that provide additional outreach, technical assistance and education to customers in harder-

to-reach markets (i.e., small business, health care, schools and local governments) and/or for select technologies (i.e., recommissioning, air conditioning tune-ups, pool pumps). All utilities provide energy efficiency offerings to low-income customers through hard-to-reach (HTR) programs that are delivered similarly to the residential SOPs and/or targeted low-income (LI) programs that coordinate with the existing federal weatherization program. Finally, nine of the ten utility portfolios also include load management programs, which are designed to reduce peak demand.

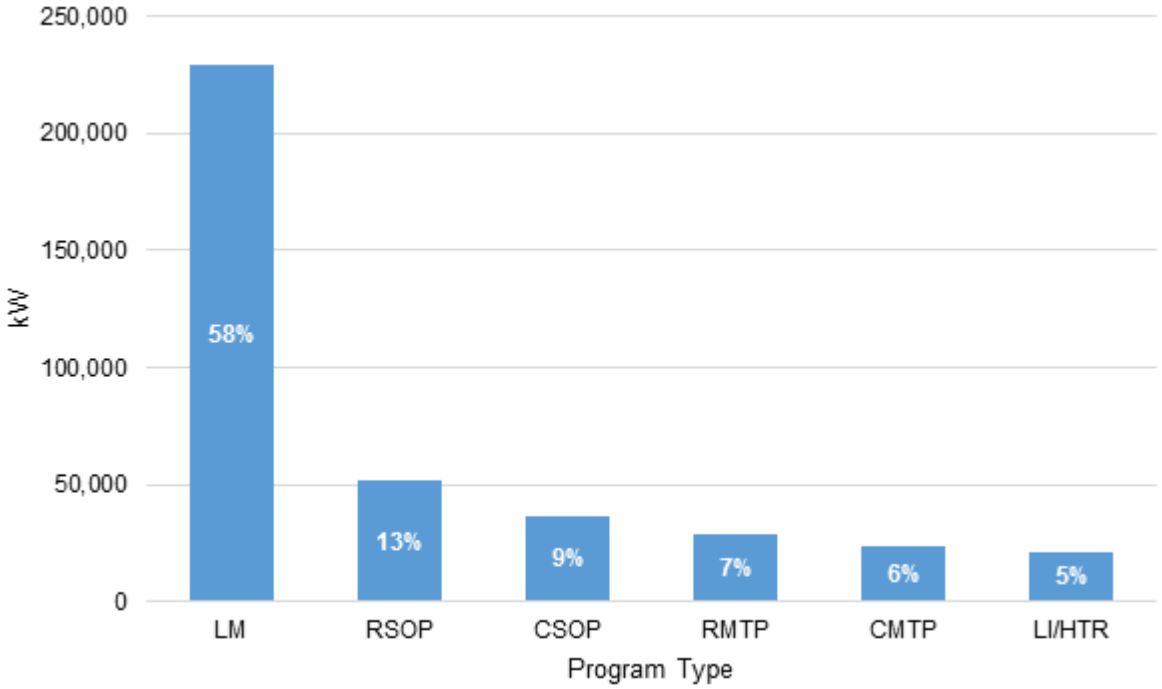
As shown in Figure 1-2 below, commercial SOPs account for one-third of statewide energy savings and residential SOPs account for about a quarter of statewide savings.

Figure 1-2. Evaluated Energy Savings by Program Type (PY2014)
(Percent of Total Statewide Savings Contained in Bar)



Load management programs account for well over half of the statewide demand savings (Figure 1-3).

Figure 1-3. Evaluated Demand Savings by Program Type (PY2014)
(Percent of Total Statewide Savings Contained in Bar)



1.1 EM&V OVERVIEW

In 2011, the Texas Legislature enacted SB 1125, which required the Public Utility Commission of Texas (PUCT) to develop an evaluation, measurement, and verification (EM&V) framework that promotes effective program design and consistent and streamlined reporting. The EM&V framework is embodied in 16 Tex. Admin. Code § 25.181 (TAC), relating to Energy Efficiency Goal (Project No. 39674).

The PUCT selected a third-party EM&V team through the Request for Proposals (RFP) 473-13-00105, Project No. 40891. This team is led by Tetra Tech and includes Texas A&M Center for Applied Technology, Texas Energy Engineering Services, Inc. (TEESI), The Cadmus Group, Itron, and Johnson Consulting Group (hereafter, "the EM&V team").

Independent EM&V was conducted for Texas electric utilities' PY2014 energy efficiency portfolios. The objectives of the EM&V effort are to:

- Document gross and net energy and demand impacts of utilities' individual energy efficiency and load management portfolios
- Determine program cost-effectiveness
- Provide feedback to the PUCT, utilities, and other stakeholders on program portfolio performance
- Prepare and maintain a statewide Technical Reference Manual (TRM).

This Statewide Annual Portfolio Report presents the PY2014 EM&V findings and recommendations looking across all ten electric utilities' portfolios. It addresses gross and net energy and demand impacts, program-cost effectiveness and provides feedback on program portfolio performance. In addition, it includes findings and recommendations related to measure savings to inform the maintenance of the TRM.

PY2014 is the third program year evaluated as part of the statewide EM&V effort. The EM&V team conducted program tracking system reviews across all utility programs and desk reviews and on-site M&V for sampled projects. Energy efficiency program evaluations routinely employ 90 percent confidence intervals with ±10 percent precision as the industry standard ("90/10"). The sampling process for evaluation activities was designed to achieve a minimum of 90/10 relative precision for evaluated savings estimates at the utility portfolio level. In addition, customer and market actor surveys were conducted for targeted areas of additional research identified from the prior year evaluation effort. The following EM&V activities were completed statewide:

- 1,349 desk reviews
- 493 on-site M&V
- 145 customer surveys
- Calculation of load management impacts using interval meter data.

The EM&V activities:

- Confirmed that the measures installed are consistent with those listed in the tracking system
- Verified that the savings estimates in the tracking system are consistent with the savings calculated in the deemed calculation tools or tables or measurement and verification (M&V) methods used to estimate project savings
- Reviewed savings assumptions and, when available, utility M&V reports gathered through the supplemental data request for sampled projects and EM&V team on-site M&V and customer survey results.

The evaluated savings are based on project-level realization rate calculations that are then weighted to represent program-level, sector-level, and 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 and primary data collected by the EM&V team. For example, baseline assumptions or hours of use may be corrected through the evaluation review and thus affect the realization rates.

A complementary component of the realization rate is the sufficiency of program documentation provided to verify claimed savings. This was used to determine an overall program documentation score for each program and the utility portfolio overall.

The EM&V team conducted cost-effectiveness testing using the program administrator cost test for PY2014 claimed and evaluated savings results. Low-income programs' cost-effectiveness results were also calculated using the Savings-to-Investment Ratio (SIR).

1.2 EVALUATED SAVINGS

Evaluated savings results are shown below across all utilities first at the portfolio level, followed by commercial sector, residential sector, load management, and pilot results. Overall, evaluated savings were close to claimed savings as reflected in the healthy realization rates that are close to one hundred percent.

A. Portfolio results

For PY2014, evaluated demand savings from all ten of the utilities' programs were 392,643 kW, somewhat less than the two prior program years (453,489 kW in PY2013 and 402,061 kW in PY2012, Figure 1-4).

Figure 1-4. Total Statewide Portfolio: Evaluated Demand Savings by Program Year

PY2014 evaluated energy savings of 539,192,555 kWh were slightly lower than PY2013 but slightly higher than PY2012. (577,023,515 kWh for PY2013 and 480,631,457 kWh for PY2012, Figure 1-5).

Figure 1-5. Total Statewide Portfolio: Evaluated Energy Savings by Program Year

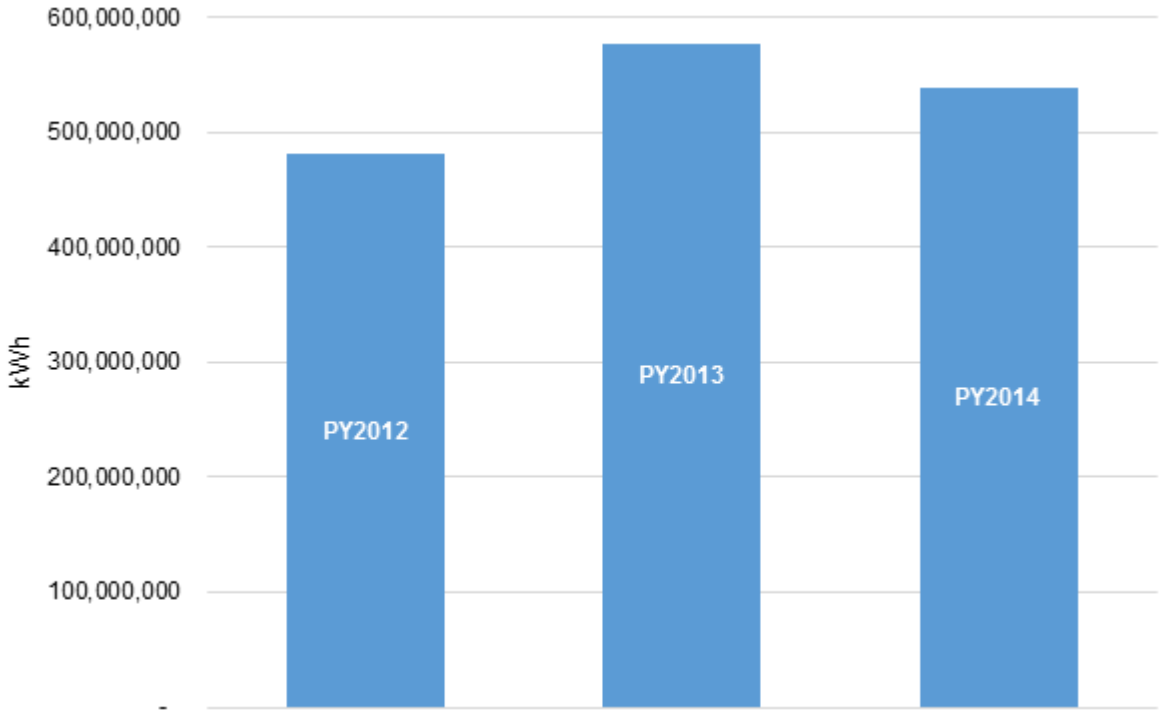


Table 1-1 shows the claimed and evaluated demand savings for each utility's portfolio for PY2014 and the precision levels around the evaluated savings estimates at a 90% confidence interval. Overall, evaluated savings are similar to claimed savings. Statewide, the demand savings realization rate is 100.6 percent and the energy savings realization rate is 99.8 percent. Utility portfolio realization rates for kW ranged from 84.0 to 103.7 percent.

In addition, the sufficiency of program documentation provided to the EM&V team to complete a third-party due diligence review of evaluated demand savings is indicated as good, fair, or limited. Eight of ten utilities received a "good" documentation score in PY2014 for kW. This is an improvement in project documentation compared to PY2012, when four of the utilities received a program documentation score of "good."

Table 1-1. Program Year 2014 Claimed and Evaluated Demand Savings—Total Portfolio

Utility	Percent Statewide Savings (kW)	2014 Claimed Demand Savings (kW)	2014 Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence	Program Documentation Score
AEP TCC	10.2%	39,805	40,065	100.7%	2.1%	Good
AEP TNC	2.1%	8,151	8,106	99.5%	2.9%	Good
CenterPoint	40.7%	159,094	159,193	100.1%	1.2%	Good
El Paso Electric	3.4%	13,389	13,181	98.4%	2.0%	Fair
Entergy	4.4%	17,180	17,819	103.7%	2.9%	Good

Utility	Percent Statewide Savings (kW)	2014 Claimed Demand Savings (kW)	2014 Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence	Program Documentation Score
Oncor	32.1%	125,275	127,141	101.5%	2.0%	Good
Sharyland	0.1%	379	318	84.0%	9.5%	Good
SWEPCO	3.2%	12,582	12,530	99.6%	2.5%	Good
TNMP	2.5%	9,602	9,145	95.2%	3.9%	Good
Xcel SPS	1.3%	5,019	5,144	102.5%	3.3%	Limited
Total	**100%**	**390,477**	**392,643**	**100.6%**	**0.8%**	**Good**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

Table 1-2 shows the claimed and evaluated energy savings for each utility's portfolio for PY2014 and the precision levels around the evaluated savings estimates at a 90% confidence interval. Overall, evaluated savings are similar to claimed savings with a statewide realization rate of 99.8 percent. Utility portfolio realization rates for kWh ranged from 61.2 to 103.4 percent.

Five utilities received the highest program documentation score of "good" for kWh savings. This is again a marked improvement from PY2012 when only one utility received a "good" program documentation score for kWh.

Table 1-2. Program Year 2014 Claimed and Evaluated Energy Savings—Total Portfolio

Utility	Percent Statewide Savings (kWh)	2014 Claimed Energy Savings (kWh)	2014 Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence	Program Documentation Score
AEP TCC	11.8%	63,587,033	63,775,136	100.3%	9.0%	Fair
AEP TNC	2.2%	11,867,206	11,486,248	96.8%	7.2%	Fair
CenterPoint	28.3%	153,170,389	150,942,241	98.5%	10.6%	Good
El Paso Electric	4.2%	22,117,836	20,485,734	92.6%	9.4%	Limited
Entergy	7.2%	39,213,564	40,533,021	103.4%	5.4%	Good
Oncor	37.3%	202,105,135	206,057,501	102.0%	9.4%	Good
Sharyland	0.3%	1,790,776	1,096,334	61.2%	9.9%	Good
SWEPCO	3.2%	17,486,363	17,350,971	99.2%	3.3%	Fair
TNMP	3.2%	17,118,627	15,438,546	90.2%	9.3%	Good
Xcel SPS	2.2%	11,900,129	12,026,823	101.1%	5.5%	Limited
Total	**100%**	**540,357,057**	**539,192,555**	**99.8%**	**4.8%**	**Good**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

Another contributor to the overall healthy realization rates was that the utilities responded to evaluation findings in their PY2014 claimed savings if the EM&V team recommended a correction in claimed savings. Below is a summary of utility program claimed savings adjustments based on evaluation results.

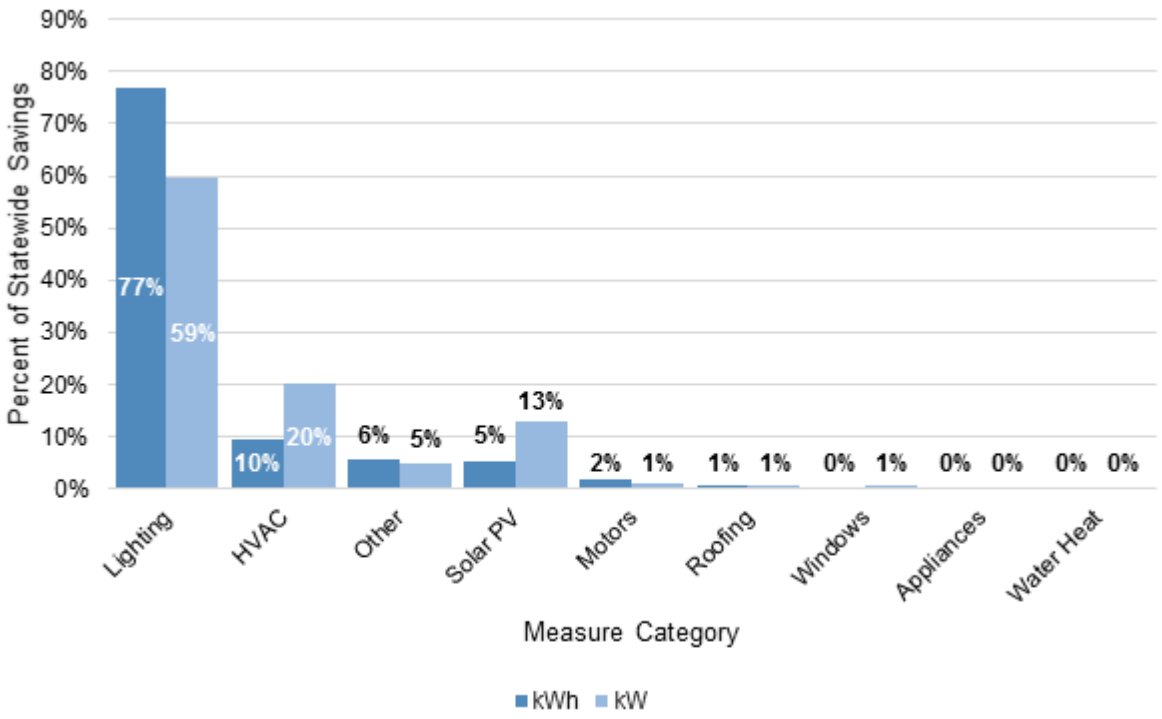
Table 1-3. Claimed Savings Adjustments by Program

Utility	Program	Initial Demand Claimed Savings (kW)	Evaluated Demand Savings (Adjustment)	Initial Energy Claimed Savings (kWh)	Evaluated Energy Savings (Adjustment)
AEP TCC	SCORE/CitySmart	1,692	1,580	5,524,683	4,856,196
CenterPoint	Pool Pumps	199	101	369,078	369,078
El Paso	Appliance Recycling	142	244	1,047,630	1,590,480
	Hard-to-Reach	808	723	1,110,419	1,075,487
	LivingWise	89	89	1,143,341	449,940
	Residential Solutions	406	322	577,776	524,974
Oncor	Home Energy Efficiency	30,833	30,794	81,903,388	81,868,628
	Hard-to-Reach	7,977	7,978	20,460,496	20,450,231
	Low Income	2,131	2,075	2,289,611	3,885,335
SWEPCO	Small Business	347	346	1,591,293	1,584,129
Xcel SPS	Commercial Standard Offer	1,534	1,534	5,161,680	5,068,854

B. Commercial sector results

Statewide PY2014 evaluated savings from commercial sector programs were 271,089,099 kWh (compared to 263,638,864 kWh for PY2013 and 254,241,172 kWh for PY2012) and 58,221 kW (compared to 58,512 kW for PY2013 and 56,114 kW for PY2012). The majority of commercial kW savings came from commercial SOPs (71 percent). Lighting and HVAC measures accounted for the majority of the kWh and kW savings (77 and 10 percent of kWh and 59 and 20 percent of kW, respectively), as shown in Figure 1-6.

Figure 1-6. Distribution of Statewide Evaluated Energy and Demand Savings by Measure Category—Commercial Programs PY2014



Statewide, realization rates were 99.6 percent for demand savings and 99.9 percent for energy savings. Figure 1-7 and Figure 1-8 show statewide evaluated demand and energy savings, respectively, for commercial programs from PY2012 through PY2014, which shows fairly constant kW savings coupled with a slight increase in kWh savings.

Figure 1-7. Total Statewide Evaluated Demand Savings by Program Year—Commercial Programs

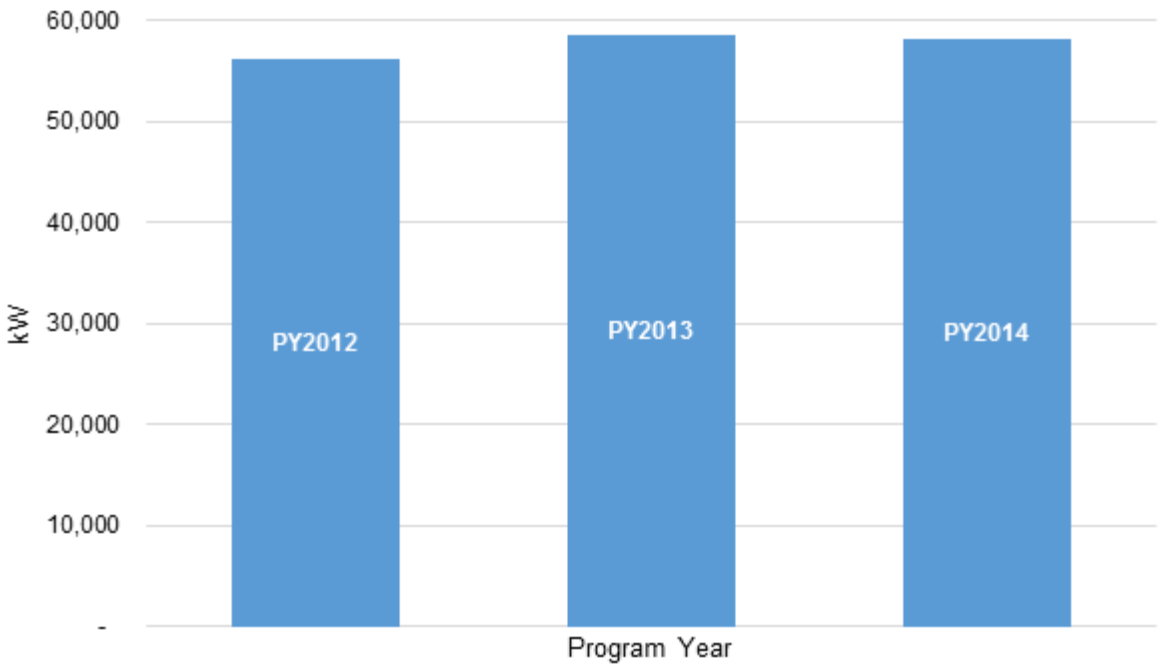
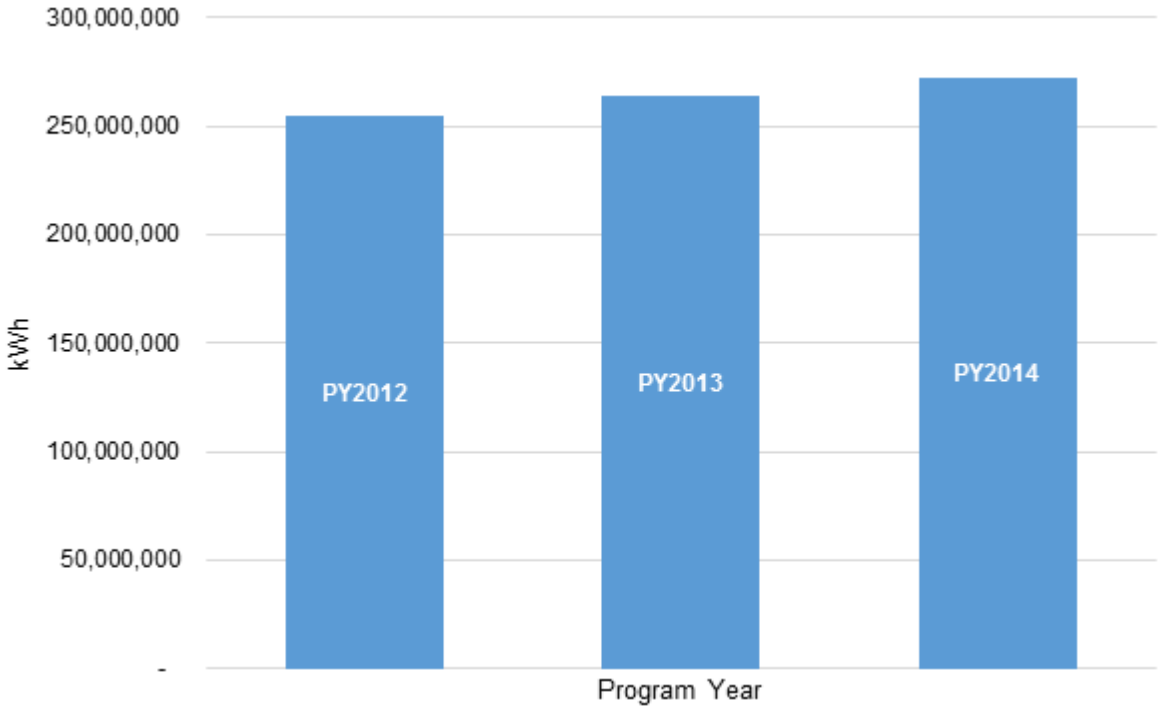


Figure 1-8. Total Statewide Evaluated Energy Savings by Program Year—Commercial Programs



Commercial evaluated savings primarily varied from claimed savings due to desk review and on-site M&V findings for issues such as different measure type and/or quantities found on-site from those used for claimed savings as well as different hours of operation and equipment efficiency levels. The adjustments, made at the project level, were typically minor and the utilities saw project-level savings both increase and decrease based on the desk and on-site M&V results.

Table 1-4 shows the claimed and evaluated demand savings for each utility's commercial energy efficiency portfolio for PY2014 and the precision levels around the evaluated savings estimates at a 90% confidence interval. Utility realization rates ranged from 96.2 to 104.0 percent for kW.

Table 1-4. Program Year 2014 Claimed and Evaluated Demand Savings—Commercial Sector

Utility	Percent Statewide Savings (kW)	2014 Claimed Demand Savings (kW)	2014 Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
AEP TCC	13.6%	7,972	7,881	98.9%	5.3%
AEP TNC	3.0%	1,770	1,758	99.3%	6.9%
CenterPoint	25.3%	14,819	14,572	98.3%	13.1%
El Paso Electric	5.9%	3,455	3,323	96.2%	7.0%
Entergy	6.7%	3,929	3,919	99.8%	2.5%

Utility	Percent Statewide Savings (kW)	2014 Claimed Demand Savings (kW)	2014 Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
Oncor	35.7%	20,865	21,027	100.8%	9.2%
Sharyland	0.0%	8	8	100.0%	0.0%
SWEPCO	3.5%	2,024	2,025	100.1%	15.1%
TNMP	2.9%	1,693	1,692	100.0%	0.0%
Xcel SPS	3.3%	1,938	2,016	104.0%	3.6%
Total	**100%**	**58,474**	**58,221**	**99.6%**	**4.8%**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

Table 1-5 shows the claimed and evaluated energy savings for each utility's commercial energy efficiency portfolio for PY2014. Utility realization rates ranged from 90.9 to 103.7 percent for kWh.

Table 1-5. Program Year 2014 Claimed and Evaluated Energy Savings—Commercial Sector

Utility	Percent Statewide Savings (kWh)	2014 Claimed Energy Savings (kWh)	2014 Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
AEP TCC	12.6%	34,247,176	33,733,633	98.5%	16.0%
AEP TNC	2.8%	7,673,647	7,512,149	97.9%	9.6%
CenterPoint	29.9%	81,074,344	81,400,100	100.4%	19.6%
El Paso Electric	6.6%	17,903,867	16,276,927	90.9%	11.8%
Entergy	6.5%	17,751,570	17,745,894	100.0%	1.1%
Oncor	32.4%	87,914,456	89,477,307	101.8%	21.2%
Sharyland	0.0%	27,545	27,545	100.0%	0.0%
SWEPCO	4.0%	10,945,467	10,921,324	99.8%	4.0%
TNMP	2.5%	6,676,694	6,672,766	99.9%	0.2%
Xcel SPS	2.6%	7,061,773	7,321,454	103.7%	3.5%
Total	**100%**	**271,276,540**	**271,089,099**	**99.9%**	**9.4%**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

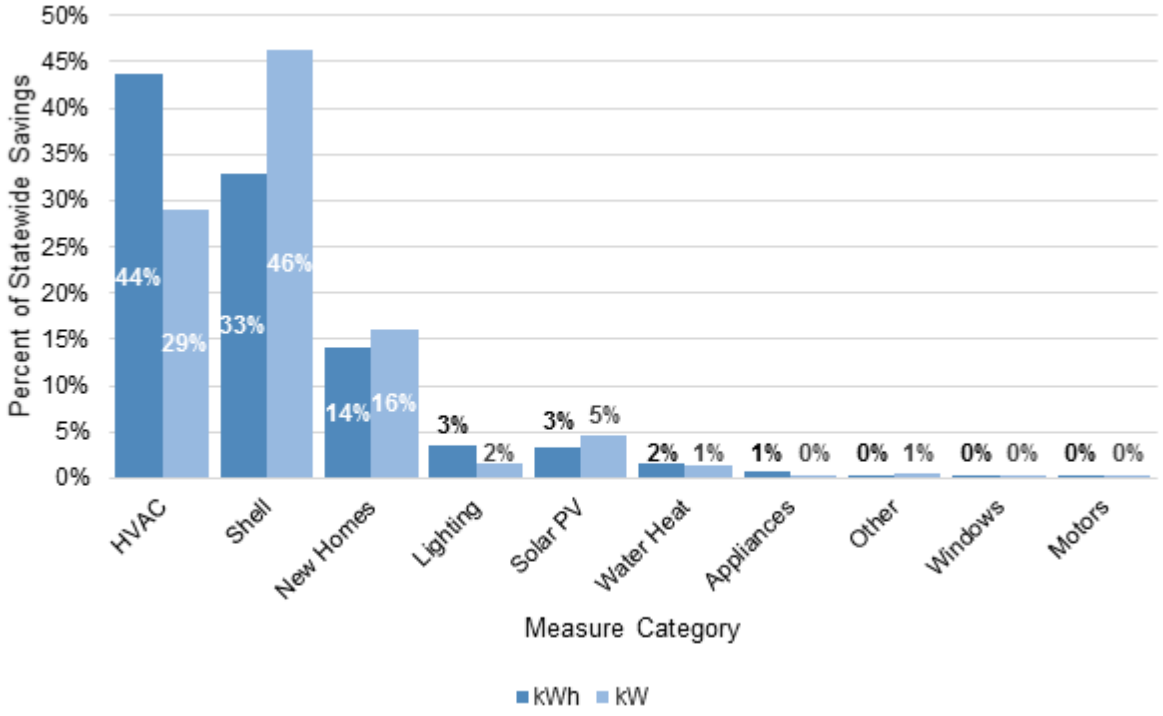
C. Residential sector results

The residential sector claimed energy savings are approximately 7.5 percent lower than those reported within the commercial sector (251,332,598 and 271,276,540 kWh, respectively). Both the residential and commercial sector had realization rates over 99 percent, with

residential savings achieving a realization rate of 99.6 percent, while commercial programs achieved a realization rate of 99.9 percent (250,307,253 and 271,089,099 kWh, respectively).

The majority of residential demand savings came from shell measures (46 percent), while the highest portion of energy savings came from HVAC measures (44 percent). Shell measures include duct sealing and air infiltration, which comprised a large percentage of the savings reported by utilities. Additional details on savings by measure category can be found in Figure 1-9.

Figure 1-9. Distribution of Statewide Evaluated Energy and Demand Savings by Measure Category—Residential Programs PY2014



While realization rates were high, the EM&V team made adjustments—oftentimes downward—to duct efficiency and air infiltration measures based on testing during on-site visits. Figure 1-10 and Figure 1-11 show statewide evaluated demand and energy savings, respectively, for residential programs between PY2012 through PY2014.

Figure 1-10. Total Statewide Evaluated Demand Savings by Program Year—Residential Programs

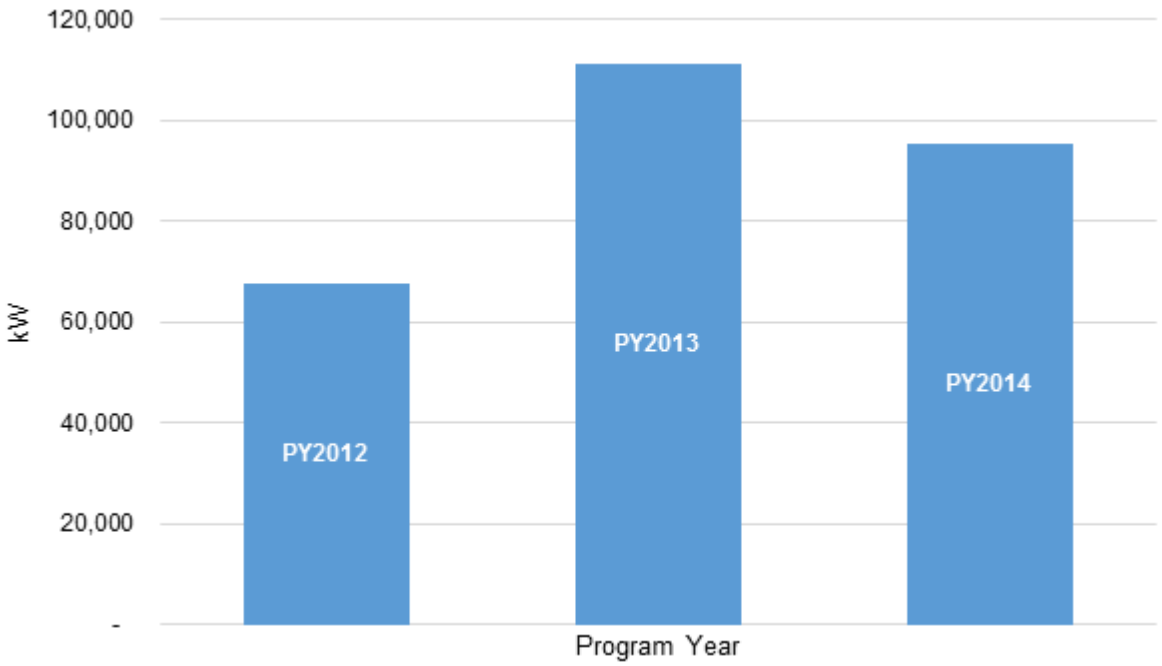


Figure 1-11. Total Statewide Evaluated Energy Savings by Program Year—Residential Programs

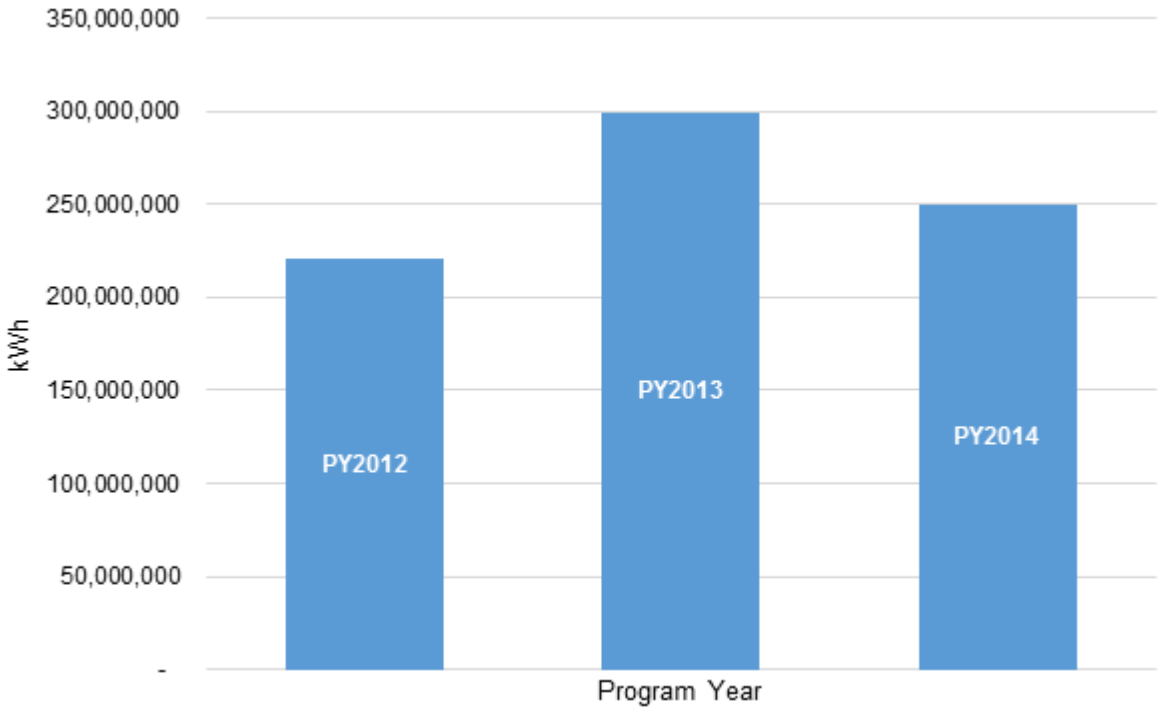


Table 1-6 shows the claimed and evaluated demand savings for each utility's residential energy efficiency portfolio for PY2014 and the precision levels around the evaluated savings estimates at a 90 percent confidence interval. There is one utility with a realization rate at or below 85 percent. There are two issues driving this realization rate. First, the utility had a higher proportion of projects where adjustments were made to air sealing and duct efficiency measures, as described above. But, second, the utility had smaller on-site sample sizes (fewer than 15), which increased the magnitude of adjustments on the overall results.

Table 1-6. Program Year 2014 Claimed and Evaluated Demand Savings—Residential Sector

Utility	Percent Statewide Savings (kW)	2014 Claimed Demand Savings (kW)	2014 Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
AEP TCC	8.9%	8,221	8,572	104.3%	8.4%
AEP TNC	1.3%	1,186	1,117	94.2%	18.2%
CenterPoint	23.5%	21,846	22,192	101.6%	0.4%
El Paso Electric	1.5%	1,378	1,302	94.5%	6.4%
Entergy	7.8%	7,227	7,882	109.1%	8.8%
Oncor	48.6%	45,165	46,869	103.8%	3.5%
Sharyland	0.4%	371	310	83.6%	9.8%
SWEPCO	2.4%	2,260	2,207	97.6%	4.1%
TNMP	4.2%	3,916	3,480	88.9%	10.2%
Xcel SPS	1.4%	1,291	1,339	103.7%	11.6%
Total	**100%**	**92,862**	**95,271**	**102.6%**	**1.9%**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

Table 1-7 shows the claimed and evaluated energy savings for each utility's residential energy efficiency portfolio for PY2014. While evaluated savings are similar to claimed savings, minor adjustments were made across all utilities' claimed savings. Two utilities had energy realization rates under 90 percent for the same reasons discussed above for demand savings.

Table 1-7. Program Year 2014 Claimed and Evaluated Energy Savings—Residential Sector

Utility	Percent Statewide Savings (kWh)	2014 Claimed Energy Savings (kWh)	2014 Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
AEP TCC	11.2%	28,182,450	28,888,018	102.5%	6.5%
AEP TNC	1.5%	3,850,310	3,578,644	92.9%	10.9%
CenterPoint	22.6%	56,736,102	54,182,199	95.5%	0.4%

Utility	Percent Statewide Savings (kWh)	2014 Claimed Energy Savings (kWh)	2014 Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
El Paso Electric	1.4%	3,638,590	3,633,428	99.9%	9.6%
Entergy	8.5%	21,450,338	22,775,471	106.2%	3.2%
Oncor	45.4%	114,000,136	116,389,651	102.1%	3.6%
Sharyland	0.7%	1,763,231	1,068,789	60.6%	10.2%
SWEPCO	2.6%	6,448,168	6,336,920	98.3%	5.8%
TNMP	4.2%	10,433,988	8,757,835	83.9%	16.5%
Xcel SPS	1.9%	4,829,285	4,696,298	97.2%	12.9%
Total	**100%**	**251,332,598**	**250,307,253**	**99.6%**	**2.1%**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

D. Load management results

Statewide PY2014 evaluated savings from load management programs were 229,351 (compared to 279,172 kW for PY2013 and 276,630 kW for PY2012) and 732,612 (compared to 950,570 kWh for PY2013 and 1,085,549 kWh for PY2012), as shown in Figure 1-12 and Figure 1-13, load management programs' savings decreased somewhat in PY2014.

Figure 1-12. Total Statewide Evaluated Demand Savings by Program Year—Load Management Programs

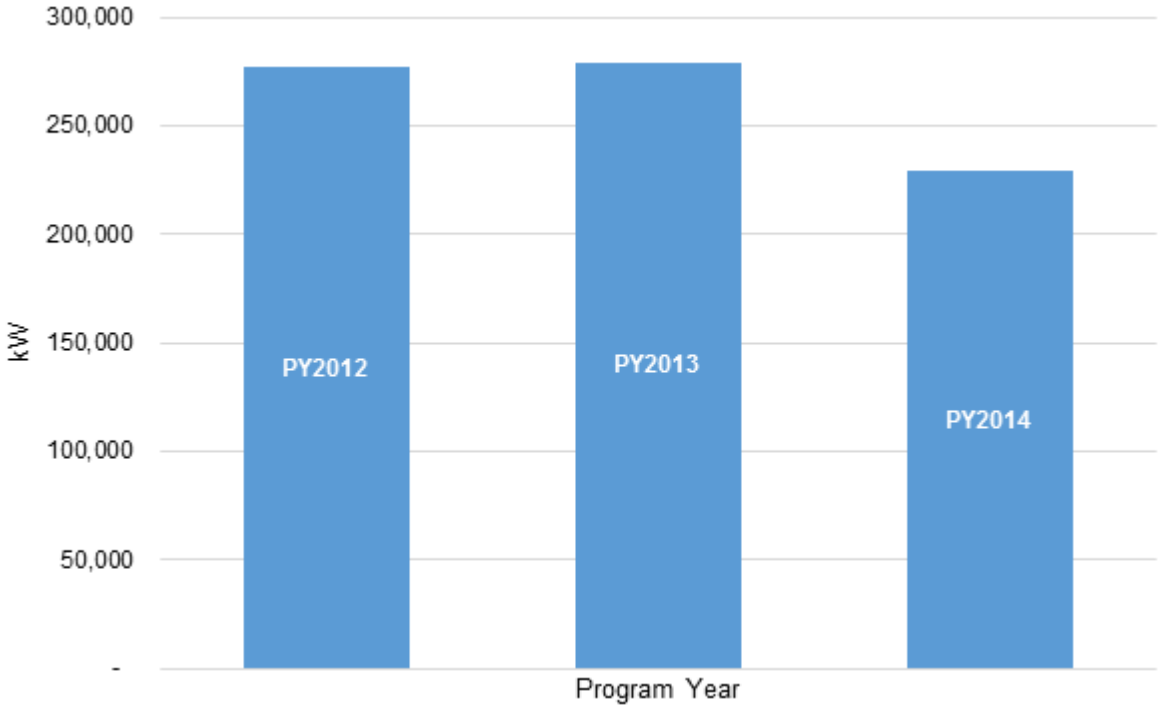


Figure 1-13. Total Statewide Evaluated Energy Savings by Program Year—Load Management Programs

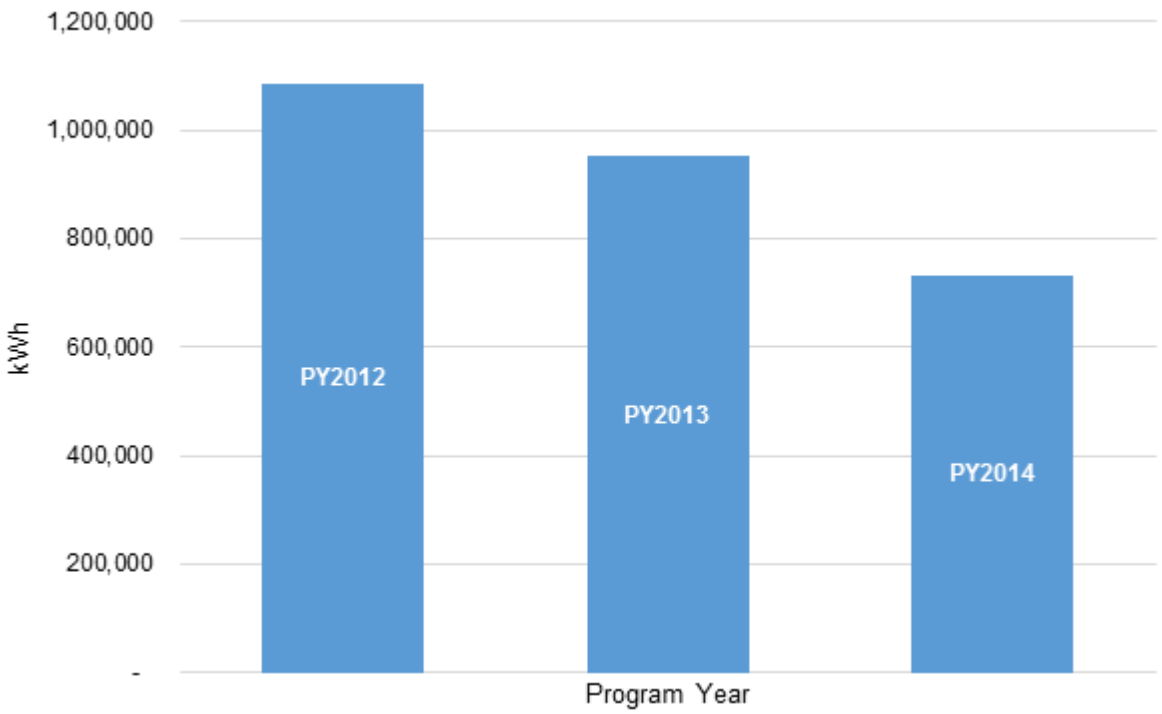


Table 1-8 shows the claimed and evaluated demand savings for each utility's load management portfolio for PY2014 and the precision levels around the evaluated savings estimates at a 90% confidence interval. Evaluated savings were the same as claimed savings across all utilities. Realization rates that differ slightly from 100 percent are due to rounding.

Table 1-8. Program Year 2014 Claimed and Evaluated Demand Savings—Load Management

Utility	Percent Statewide Savings (kW)	2014 Claimed Demand Savings (kW)	2014 Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
AEP TCC	10.2%	23,323	23,323	100.0%	0.0%
AEP TNC	2.2%	5,108	5,122	100.3%	0.0%
CenterPoint	49.4%	113,303	113,303	100.0%	0.0%
El Paso Electric	3.6%	8,281	8,281	100.0%	0.0%
Entergy	2.6%	6,024	6,018	99.9%	0.0%
Oncor	25.8%	59,245	59,245	100.0%	0.0%
SWEPCO	1.7%	8,297	8,297	100.0%	0.0%
TNMP	0.8%	3,993	3,973	99.5%	0.0%
Xcel SPS	10.2%	1,789	1,789	100.0%	0.0%
Total	**100.0%**	**229,363**	**229,351**	**100.0%**	**0.0%**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

Table 1-9 shows the claimed and evaluated energy savings for each utility's load management portfolio for PY2014, which again were the same as claimed savings with the exception of one utility, which had slightly lower evaluated kWh than claimed kWh.

Table 1-9. Program Year 2014 Claimed and Evaluated Energy Savings—Load Management

Utility	Percent Statewide Savings (kWh)	2014 Claimed Energy Savings (kWh)	2014 Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
AEP TCC	9.3%	68,036	68,036	100.0%	0.0%
AEP TNC	4.9%	35,597	35,501	99.7%	0.0%
CenterPoint	42.5%	311,583	311,583	100.0%	0.0%
El Paso Electric	1.7%	12,422	12,422	100.0%	0.0%
Entergy	1.6%	11,656	11,656	100.0%	0.0%
Oncor	26.0%	190,543	190,543	100.0%	0.0%
SWEPCO	1.1%	85,856	85,856	100.0%	0.0%
TNMP	1.2%	7,945	7,945	100.0%	0.0%
Xcel SPS	9.3%	9,071	9,071	100.0%	0.0%

Utility	Percent Statewide Savings (kWh)	2014 Claimed Energy Savings (kWh)	2014 Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
Total	**100.0%**	**732,708**	**732,612**	**100.0%**	**0.0%**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

E. Pilot results

Statewide PY2014 evaluated savings from pilot programs were 17,063,590 kWh (compared to 12,829,189 kWh for PY2013 and 4,710,045 kWh for PY2012) and 9,800 kW (compared to 4,674 kW for PY2013 and 1,710 kW for PY2012). While most utilities saw 100 percent realization rates, adjustments were made to two utilities' pilot programs based on the desk reviews. Figure 1-14 and Figure 1-15 show statewide evaluated demand and energy savings, respectively, for pilots programs from PY2012 through PY2014 where the amount of savings from pilots has increased.

Figure 1-14. Total Statewide Evaluated Demand Savings by Program Year—Pilot Programs

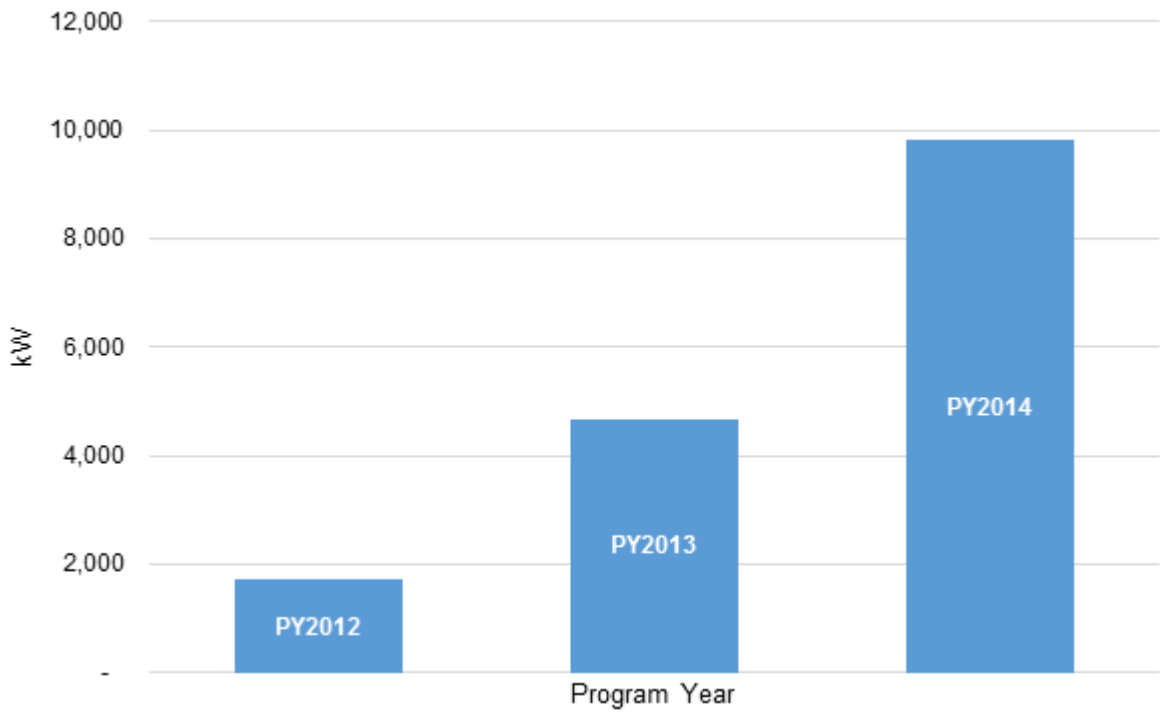


Figure 1-15. Total Statewide Evaluated Energy Savings by Program Year—Pilot Programs

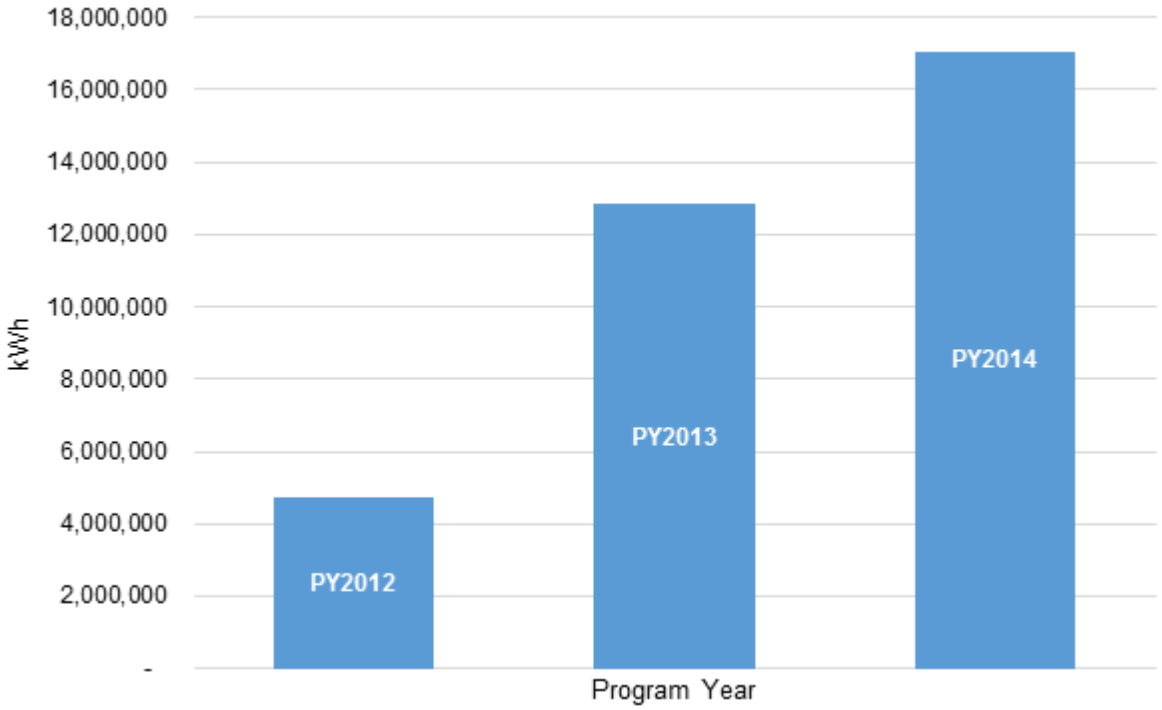


Table 1-10 shows the claimed and evaluated demand savings for each utility's set of pilot programs for PY2014 and the precision levels around the evaluated savings estimates at a 90 percent confidence interval.

Table 1-10. Program Year 2014 Claimed and Evaluated Demand Savings—Pilots

Utility	Percent Statewide Savings (kW)	2014 Claimed Demand Savings (kW)	2014 Evaluated Demand Savings (kW)	Realization Rate (kW)	Precision at 90% Confidence
AEP TCC	2.9%	289	289	100.0%	0.0%
AEP TNC	0.9%	86	109	126.0%	15.0%
CenterPoint	93.4%	9,223	9,126	98.9%	2.5%
El Paso Electric	2.8%	275	275	100.0%	0.0%
SWEPCO	0.0%	1	1	100.0%	0.0%
Total	**100.0%**	**9,874**	**9,800**	**99.2%**	**2.4%**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

Table 1-11 shows the claimed and evaluated energy savings for each utility's pilot portfolio for PY2014.

Table 1-11. Program Year 2014 Claimed and Evaluated Energy Savings—Pilots

Utility	Percent Statewide Savings (kWh)	2014 Claimed Energy Savings (kWh)	2014 Evaluated Energy Savings (kWh)	Realization Rate (kWh)	Precision at 90% Confidence
AEP TCC	6.4%	1,089,371	1,085,449	99.6%	0.5%
AEP TNC	1.8%	307,653	359,954	117.0%	9.3%
CenterPoint	88.4%	15,048,359	15,048,359	100.0%	3.6%
El Paso Electric	3.3%	562,958	562,958	100.0%	0.0%
SWEPCO	0.0%	6,871	6,871	100.0%	0.0%
Total	**100.0%**	**17,015,212**	**17,063,590**	**100.3%**	**3.2%**

*Results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

1.3 COST-EFFECTIVENESS RESULTS

The EM&V team calculated PY2014 cost-effectiveness based on claimed savings, evaluated savings, and evaluated net savings[1] using the Program Administrator Cost Test (PACT). Overall cost-effectiveness of Texas energy efficiency programs based on evaluated savings was 2.13 including low-income programs and 2.35 excluding low-income programs from the analysis. The cost-effectiveness for claimed savings were almost identical to evaluated savings results, reflecting the realization rates very close to 100 percent. The claimed savings cost-effectiveness ratios were 2.12 including low-income programs and 2.34 excluding low-income programs. Finally, the cost-effectiveness when calculated using net savings is 1.80 including low-income programs and 1.98 excluding low-income programs. Cost-effectiveness ratios are lower than 2013 results because the avoided cost of energy decreased from $0.104 to $0.046.

Cost-effectiveness results are shown below across all utilities first at the portfolio level, followed by commercial sector, residential sector, low-income programs, load management, and pilot programs.

A. Portfolio results

Table 1-12 below summarizes the cost-effectiveness of each utility's energy efficiency portfolio both with and without low-income programs. The cost-effectiveness of the utilities' portfolios ranged from 1.42 to 2.83 based on evaluated savings results and from 1.18 to 2.37 based on evaluated net savings results. Cost-effectiveness increases somewhat across all of the utility portfolios that include low-income programs when these programs are excluded

[1] Evaluated net savings are determined by applying the EM&V team's recommended net-to-gross factor to evaluated savings. The net-to-gross factor measures program attribution including free-riders and spillover as defined in 16 TAC § 25.181 (c).

from the analysis.[2] Cost-effectiveness without low-income programs ranged from 1.54 to 3.11 based on evaluated savings and from 1.27 to 2.62 based on evaluated net savings.

Table 1-12. Program Year 2014 Cost-effectiveness Results—Total Portfolio

Utility	Claimed Savings Results	Evaluated Savings Results	Evaluated Net Savings Results	Claimed Savings Results w/o low-income	Evaluated Savings Results w/o low-income	Evaluated Net Savings Results w/o low-income
AEP TCC	2.19	2.20	1.87	2.37	2.39	2.01
AEP TNC	2.12	2.06	1.78	2.30	2.24	1.93
CenterPoint	2.14	2.12	1.76	2.46	2.44	2.00
El Paso Electric	2.32	2.17	1.91	2.32	2.17	1.91
Entergy	2.72	2.83	2.37	2.72	2.83	2.37
Oncor	1.99	2.03	1.73	2.20	2.25	1.91
Sharyland	2.10	1.42	1.18	2.26	1.54	1.27
SWEPCO	2.29	2.27	1.97	2.29	2.27	1.97
TNMP	1.90	1.72	1.46	2.07	1.87	1.58
Xcel SPS	2.72	2.78	2.35	3.05	3.11	2.62

*Evaluated savings results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

Table 1-13 below summarizes the cost of lifetime kWh and kW for each utility. The cost per kWh ranges from $0.009 to $0.018, and the cost per kW ranges from $15.53 to $31.99. These costs provide an alternate way of describing the cost-effectiveness of a portfolio of programs. Those portfolios with a higher cost-effectiveness ratio will have a lower cost to acquire savings and vice versa.

Table 1-13. Program Year 2014 Cost-effectiveness Results—Cost of Lifetime Savings

Utility	kWh	kW
AEP TCC	$0.012	$21.43
AEP TNC	$0.013	$23.67
CenterPoint	$0.012	$21.89
El Paso Electric	$0.013	$22.61
Entergy	$0.009	$15.53
Oncor	$0.011	$19.82

[2] Non-ERCOT utilities are not required to offer low-income programs. Cost-effectiveness results shown with and without low-income programs do not vary for these utilities except for Xcel Energy, which elects to offer a low-income program.

Utility	kWh	kW
Sharyland[3]	$0.018	$31.99
SWEPCO	$0.011	$20.12
TNMP	$0.012	$21.34
Xcel SPS	$0.009	$15.72

B. Commercial sector results

Table 1-14 below summarizes the cost-effectiveness of each utility's commercial energy efficiency portfolio.

Commercial sector programs were the most cost-effective programs with an overall cost-effectiveness of 2.46 statewide based on evaluated savings and 2.10 based on net savings. With the exception of Sharyland,[4] utilities' results ranged from 1.91 to 3.92 based on evaluated savings and 1.70 to 3.24 based on evaluated net savings. There is variation in the utilities' results in the commercial sector because of the diversity of program designs offered by the utilities.

Table 1-14. Program Year 2014 Cost-effectiveness Results—Commercial Sector

Utility	Claimed Savings Results	Evaluated Savings Results	Evaluated Net Savings Results
AEP TCC	2.57	2.52	2.16
AEP TNC	2.34	2.30	1.98
CenterPoint	2.65	2.65	2.21
El Paso Electric	3.35	3.07	2.67
Entergy	3.04	3.03	2.66
Oncor	2.13	2.16	1.86
Sharyland	0.33	0.33	0.28
SWEPCO	2.50	2.50	2.12
TNMP	1.91	1.91	1.70
Xcel SPS	3.77	3.92	3.24

*Evaluated savings results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

Table 1-16 below summarizes the cost of lifetime kWh and kW for each utility's commercial sector programs. The cost per kWh ranges from $0.007 to $0.068, and the cost per kW ranges from $11.46 to $109.10. These costs provide an alternate way of describing the cost-

[3] Sharyland had low levels of participation from the commercial sector, which resulted in higher costs for lifetime savings.
[4] Ibid.

effectiveness of a portfolio of commercial programs. Those portfolios with a higher cost-effectiveness ratio will have a lower cost to acquire savings and vice versa.

Table 1-16. Program Year 2014 Cost-effectiveness Results—Cost of Lifetime Commercial Sector Savings

Utility	kWh	kW
AEP TCC	$0.011	$18.06
AEP TNC	$0.012	$21.22
CenterPoint	$0.010	$17.27
El Paso Electric	$0.010	$16.77
Entergy	$0.009	$15.58
Oncor	$0.011	$17.37
Sharyland	$0.068	$109.10
SWEPCO	$0.010	$18.07
TNMP	$0.013	$21.93
Xcel SPS	$0.007	$11.46

C. Residential sector results

Table 1-17 below summarizes the cost-effectiveness of each utility's energy residential efficiency portfolio.

Residential sector programs' cost-effectiveness statewide is 2.44 based on evaluated savings and 1.99 based on evaluated net savings. The residential sector had the widest variability between utilities, with evaluated savings results ranging from 1.36 to 2.80 and net savings results ranging from 1.18 to 2.26. As with the commercial sector, this is in part due to the differences in the types of programs offered by different utilities.

Table 1-17. Program Year 2014 Cost-effectiveness Results—Residential Sector

Utility	Claimed Savings Results	Evaluated Savings Results	Evaluated Net Savings Results
AEP TCC	2.27	2.35	1.92
AEP TNC	2.19	2.08	1.74
CenterPoint	2.86	2.80	2.13
El Paso Electric	1.40	1.36	1.18
Entergy	2.61	2.80	2.26
Oncor	2.33	2.39	2.00
Sharyland	2.88	1.93	1.60
SWEPCO	2.18	2.14	1.86
TNMP	2.24	1.91	1.54
Xcel SPS	2.61	2.60	2.24

*Evaluated savings results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

Table 1-18 below summarizes the cost of lifetime kWh and kW for each utility's residential sector programs. The cost per kWh ranges from $0.008 to $0.020, and the cost per kW ranges from $13.36 to $30.42. These costs provide an alternate way of describing the cost-effectiveness of a portfolio of residential programs. Those portfolios with a higher cost-effectiveness ratio will have a lower cost to acquire savings and vice versa.

Table 1-18. Program Year 2014 Cost-effectiveness Results—Cost of Lifetime Residential Sector Savings

Utility	kWh	kW
AEP TCC	$0.011	$19.35
AEP TNC	$0.012	$20.67
CenterPoint	$0.008	$13.36
El Paso Electric	$0.020	$30.42
Entergy	$0.009	$14.85
Oncor	$0.009	$16.30
Sharyland	$0.014	$23.73
SWEPCO	$0.011	$18.78
TNMP	$0.010	$17.13
Xcel SPS	$0.009	$15.28

D. Low-income results

Table 1-19 below summarizes the cost-effectiveness of each utility's low-income energy efficiency portfolio.[5]

As expected due to the higher program costs associated with serving this residential sector, low-income programs had a statewide cost-effectiveness ratio of 1.22.[6] There are no separately reported net evaluated savings for low-income programs since all savings are assumed to be attributable to the program due to the substantial affordability barriers this sector faces to make energy efficiency improvements.

Table 1-19. Program Year 2014 Cost-effectiveness Results—Low-income Sector

Utility	Claimed Savings Results	Evaluated Savings Results
AEP TCC	1.51	1.51
AEP TNC	1.81	1.83
CenterPoint	1.32	1.31
El Paso Electric	N/A	N/A
Entergy	N/A	N/A
Oncor	1.05	1.01
Sharyland	1.90	1.16
SWEPCO	N/A	N/A
TNMP	1.70	1.68
Xcel SPS	1.59	1.52

*Evaluated savings results should only be viewed qualitatively due to the small sample sizes at the utility-program level.

E. Load management results

Table 1-20 below summarizes the cost-effectiveness of each utility's load management energy efficiency portfolio.

Load management programs had the lowest cost-effectiveness of non-low-income or pilot programs at 1.60 based on evaluated savings. However, load management programs serve a different purpose in the utilities' energy efficiency portfolio as they are a supply-side resource to be used when peak demand reduction is needed due to capacity constraints. There is some variation in the utilities' evaluated savings results, ranging from 1.02 to 2.86. There are no separately reported net evaluated savings for load management programs since the

[5] Non-ERCOT utilities are not required to offer low-income programs. These cases are indicated in the table with "N/A."

[6] Unlike other programs that apply the program administrator cost test (PACT), the low-income sector programs are evaluated using the savings-to-investment ratio (SIR). This test excludes administrative and other overhead costs and directly compares the cost of installing the measure with estimated customer energy bill reductions.

programs require participation in a curtailment event that would not happen without the program.

Table 1-20. Program Year 2014 Cost-effectiveness Results—Load Management Sector

Utility	Claimed Savings Results	Evaluated Savings Results
AEP TCC	1.72	1.72
AEP TNC	2.86	2.86
CenterPoint	1.78	1.78
El Paso Electric	1.02	1.02
Entergy	1.48	1.48
Oncor	1.40	1.40
Sharyland	N/A	N/A
SWEPCO	1.64	1.64
TNMP	1.20	1.19
Xcel SPS	1.02	1.02

F. Pilot results

Table 1-21 below summarizes the cost-effectiveness of each utility's pilot energy efficiency portfolio.

The pilot programs' statewide cost-effectiveness is 1.29 based on evaluated savings and 1.13 based on net evaluated savings. As discussed with PUCT staff, pilots are not required to pass the cost-effectiveness test PACT their first year of implementation to recognize program start-up costs, but are expected to pass during the second year. Allowing time to pass cost-effectiveness is industry standard, as pilot programs serve an important function in energy efficiency portfolios by exploring the feasibility of programs designed to increase market penetration of new technologies, reach underserved customer segments, and/or explore new distribution channels. With that said, all utilities passed cost-effectiveness based on evaluated savings. Sharyland's cost-effectiveness of 0 reflects some start-up costs incurred with no savings in PY2014.

Table 1-21. Program Year 2014 Cost-effectiveness Results—Pilot Sector

Utility	Claimed Savings Results	Evaluated Savings Results	Evaluated Net Savings Results
AEP TCC	N/A	N/A	N/A
AEP TNC	N/A	N/A	N/A
CenterPoint	1.27	1.27	1.11
El Paso Electric	1.58	1.58	1.50
Entergy	N/A	N/A	N/A

Utility	Claimed Savings Results	Evaluated Savings Results	Evaluated Net Savings Results
Oncor	N/A	N/A	N/A
Sharyland	0.00	0.00	0.00
SWEPCO	N/A	N/A	N/A
TNMP	N/A	N/A	N/A
Xcel SPS	N/A	N/A	N/A

1.4 KEY FINDINGS AND RECOMMENDATIONS

Overall, the PY2014 EM&V research shows the utilities are running cost-effective portfolios based on both gross and net savings. The healthy realization rates across the portfolios indicate accuracy of claimed savings across the majority of programs, which in some instances was further improved by utilities agreeing to revise claimed savings based on EM&V findings. Additional net-to-gross research conducted for PY2014 continued to find relatively high net savings (or attribution) for programs.

Various successes of the programs are documented in this report so utilities can continue to build on effective practices to meet savings goals. The EM&V team benchmarked the programs using the National Action Plan for Energy Efficiency (NAPEE) chapter on energy efficiency program best practices. The EM&V team identified 18 best practices as most applicable and appropriate to support the effective delivery of the programs in Texas. There is evidence of all 18 of these best practices being employed in Texas and most of the best practices are well-established, including: offering programs for all customer classes; leveraging national programs like ENERGY star; considering building codes and appliance standards in program planning; creating a roadmap of key program components, milestones and reduction goals; changing measures over time to adapt to changing markets and new technologies; piloting new program concepts; coordinating with other utilities; keeping participation simple; investing in education, training and outreach; and maintaining tracking systems.

In addition, as outlined in PURA (§ 39.905(f)), the ERCOT utility-sponsored low income programs are to coordinate with the federal weatherization program. The evaluation research found that the ERCOT utilities are effectively utilizing the existing federal weatherization program's agency infrastructure in Texas to deliver the low income programs. The agencies report high satisfaction with the utility low income programs and feel they are serving a good cross-section of low-income customers that are in need of the program services. The evaluation findings also demonstrated the low-income population is served cost-effectively through the utilities' hard-to-reach programs.

While numerous program successes have been achieved, the EM&V research found some improvement opportunities. The EM&V team identified recommendations to improve reporting of program administrative and research and development (R&D) costs; transparency of sub-programs; engagement of retail electric providers (REPs); and accuracy of savings estimates. These recommendations are summarized below. The EM&V team will discuss these

recommendations from the PY2014 evaluation with all ten of the utilities to agree on "action plans" to respond to recommendations.

1.4.1 Program administrative/R&D costs

16 TAC § 25.181 limits utilities to spending 15 percent of their budget on administration, and 10 percent of the previous year's budget on research and development (R&D). Combined, administrative and R&D costs cannot exceed 20 percent of a utility's annual spending. Utilities' administrative costs in PY2014 ranged from 2 percent to 15 percent. All but one of the utilities reported R&D costs, ranging from 1 to 4 percent of their PY2013 budgets. While two utilities exceeded the administrative cost cap, one utility had a good cause exception approved by the PUCT as they have recently started offering energy efficiency programs.

In general, the administrative cost cap appears to be sufficient to operate programs. The sufficiency of the administrative cost cap is likely furthered by market transformation programs' implementation contractor costs captured in the incentive costs for these programs as opposed to the administrative costs. However, scale does appear to be an issue: the smaller utilities have a bigger challenge due to the base cost to run a program regardless of participation size. The utilities typically meet their savings goals with the current administrative cost cap based on recent years' results, but most indicated that if goals increased significantly, additional administrative funding may be needed to reach goals. One utility also expressed concern that responding to EM&V requests and recommendations also increased administrative costs.

While 16 TAC § 25.181 provides general guidelines on types of administrative costs, there is variation amongst the utilities in what costs are counted in program administration budgets and R&D budgets. In addition, while the types of R&D costs are described in EEPRs, the types of administrative costs typically are not. Conferences and staff development are also not clearly defined in the rule. The evaluation team believes industry conferences and membership and energy efficiency staff development costs that pertain to energy efficiency programs that a utility offers, or is considering offering, would be appropriately reported under R&D rather than administrative. These costs do not directly relate to delivering programs but are important to provide utilities with insight into the wider energy efficiency industry and research that other organizations are conducting and keep Texas programs evolving and integrating best practices. However, marketing and other educational activities to utility internal staff who are not part of the energy efficiency department should be reported in the administrative cost budget.

Recommendation: Increase the consistency and transparency of program administrative and research & development (R&D) cost reporting in annual Energy Efficiency Plan and Reports (EEPRs).

Action Plan: Utilities will provide a brief description of the types of costs incurred under the administrative category in their EEPRs starting in 2016 similar to the description already included for R&D. Industry conferences and memberships and energy efficiency staff development costs may be reported under R&D rather than administrative costs; however, marketing and other educational activities to utility internal staff who are not part of the energy efficiency department should be reported in the administrative cost budget.

1.4.2 Transparency of sub-programs

The EM&V team applauds the growth of market transformation initiatives in the utilities' portfolios as the utilities seek to better serve certain customer segments and/or integrate new technologies into their portfolios. At the same time, it is important to have transparency in distinct program components (or "sub-programs") in order to best assess how cost-effectively sub-programs can achieve their stated goals as well as how sub-programs are designed and delivered.

In PY2014 nine market transformation programs across four utilities offered distinct program components to different sectors and participant types while claimed savings and program costs were reported at a broader level. In some cases, these sub-programs are implemented by different program implementers than the primary program (or component contributing the majority of savings). In addition, they often offer different levels of rebates and technical assistance. The primary concern is the inability to calculate, and therefore properly assess, sub-program cost-effectiveness. In addition, there is increased difficulty in conducting third-party EM&V of programs.

Recommendation: Distinct program components in terms of design and/or delivery, such as programs targeting a specific segment or promoting a specific technology/practice, should have individual reporting and documentation requirements if they are combined into one umbrella program.

Action Plan: Utilities will provide separate cost information by sub-program starting in PY2016. Program manuals will be developed for each sub-program. The quality and content of both tracking data systems and supporting project documentation will be maintained at the sub-program level.

1.4.3 Engagement of retail electric providers (REPs)

16 TAC § 25.181 provides guidance regarding unbundled electric utilities' engagement of REPs in energy efficiency programs: *Each utility in an area in which customer choice is offered shall conduct outreach and information programs and otherwise use its best efforts to encourage and facilitate the involvement of retail electric providers as energy efficiency service companies in the delivery of energy efficiency and demand response programs*. ((16 TAC § 25.181 (t))

In PY2014 CenterPoint offered the only program specifically designed to engage REPs. The EM&V team conducted a targeted process evaluation of CenterPoint's program in order to provide information that may be helpful to the Commission and utilities when considering program efforts to engage REPs.

In general, the process evaluation found that the REP program is being implemented effectively from the perspective of both participating REPs and contractors. Both REPs and contractors gave the program implementer high satisfaction ratings overall and reported high satisfaction with various aspects of the program. From a participating REP perspective, the only challenge with the initial engagement process was confusion regarding the marketing and branding of the program to customers, but this was a start-up issue that was resolved.

Most participating REPs are offering the program services free to their customers as either a loyalty bonus for existing customers or as an acquisition incentive for new customers. Most participating REPs want to be able to help their customers become more energy efficient and provide customers an opportunity to lower their utility bills. The two REPs that the EM&V team spoke with who do not participate in the program mentioned concerns about the scalability and longevity of the program. In addition, they had concerns regarding brand recognition and wanting to maintain the direct relationship with their customers. Finally they also reported challenges with competing activities that they already offer to their customers.

The process evaluation results indicate it is most likely feasible to offer similar services working with REPs to customers beyond CenterPoint's service territory. However, at the same time, the results also indicate that while participating in an energy efficiency program may be attractive to some REPs, other REPs may not be interested in participating in a program.

Recommendation: ERCOT utilities should consider the feasibility of a REP program for their service territory.

Action Plan: ERCOT utilities will gauge the interest of REPs in their service territory in participating in energy efficiency program offerings.

1.4.4 Claimed savings estimates

Based on findings from the impact evaluations conducted across the ten utilities the EM&V team provides the following recommendations for improving savings estimates across sectors and for the residential and commercial sectors specifically.

1.5 CROSS SECTOR

1.5.1 Recommendation: Deemed savings calculations in tracking systems and savings tools should be updated to the applicable TRM version with the exception of carryover projects.

For a couple of measures across some utilities, the EM&V team's residential tracking system review found that residential savings were calculated based on prior approved deemed savings as opposed to the applicable TRM, which was TRM 1.0 for PY2014. Likewise for commercial programs, there were some instances where outdated savings calculators were used. Projects should calculate savings based on the program year TRM in which the savings are claimed. However, an exception to this is "carryover" projects where savings were determined and incentives awarded based on the prior program year TRM and savings calculators, but the project itself was not completed until the next program year.

Action Plan: Utilities will check for compliance with this recommendation in their QA/QC of claimed savings. The utilities will provide a list of carryover projects from the prior program year to the EM&V team.

1.5.2 Recommendation: Utilities may want to consider increased QA/QC of program documentation with inputs into deemed savings calculations.

Both the residential and nonresidential desk reviews found some discrepancies between program documentation and tracking system or savings calculator inputs across different measures. While these had a minor impact on realization rates, there may be opportunity to improve QA/QC review of inputs. Examples of discrepancies found between program documentation and savings inputs included pre- or post-treatment air infiltration values (i.e., CFM), HVAC unit tonnage or efficiency level, heating type, square footage and pre-treatment R-values.

Action Plan: Utilities may choose to supplement their QA/QC with checks of program documentation against tracking system inputs.

1.5.3 Recommendation: Measures with claimed savings need to have Commission approved deemed savings values or supported by M&V consistent with the IPMVP.

In a few instances, the EM&V team encountered measures with claimed savings that neither had a Commission approved deemed savings value or utilized M&V to calculate savings. Under the current regulatory framework, the basis of savings in M&V protocols in accordance with the IPMVP or Commission approved values: Commission-approved deemed energy and peak demand savings may be used in lieu of the energy efficiency service provider's measurement and verification (16 TAC § 25.181 (p) (2)). The Commission has included in the EM&V contractor's scope technical assistance if a utility desires to pursue Commission-approved deemed savings as well as review of M&V plans.

Action Plan: Utilities will have a M&V Plan for any measures implemented that do not have Commission approved deemed savings values.

1.5.4 Recommendation: LEDs should meet TRM certification requirements or have a M&V Plan in place.

In the PY2013 Statewide Portfolio Report it was noted that the EM&V team found that several LED lighting fixtures and lamps were not meeting the qualification requirements specified in the TRM. The new LED fixtures and lamps installed as part of the commercial energy efficiency programs should verify certification to confirm the eligibility of the LED fixtures and lamps. The qualification requirements are in keeping with national industry practice that protect customers from inferior products and help ensure the energy savings. The action plan to respond to this recommendation (#1a) was that utilities will require certification for all LEDs with a certification category with the Design Light Consortium (DLC) or ENERGY STAR as specified in the TRM. At the utilities' request, LED Lighting Facts®, a program of the U.S. Department of Energy, is also being considered for inclusion in TRM 3.1.The action plan further notes that in cases where a certification category does not address a certain LED usage (i.e., outdoor signage), utilities should inform the EM&V team and discuss a M&V plan and supporting savings information for these LED applications. Utilities are expected to be in full compliance in PY2015 with the certification requirement or M&V Plan as agreed upon in the PY2013 action plan.

Action Plan: Utilities will require LED certification or have a M&V Plan for any measures that do not have a certification category. Projects with a small percent of non-qualifying LEDs will follow the EM&V team's guidance memo on this topic finalized in July 2015. Since this recommendation was also made in PY2013, utilities should respond to this in PY2015.

1.5.5 Recommendation: Utilities need to develop deemed savings value for Commission approval for tune-ups or claim savings using an M&V approach.

Results of the PY2014 AC tune-up evaluation across residential and commercial sectors continue to support Recommendation #2a from PY2013, that tune-up measure savings methodologies should be based upon a deemed value, or rather a deemed efficiency loss factor and deemed calculation methodologies. With the increased number of AC tune-ups that can now be integrated into the dataset, the values should be sufficiently stable and robust over the next 2-3 years that the field M&V measurements that are currently occurring could be suspended. Not having to take M&V measurements for a number of years would streamline program implementation. However, field M&V measurements must continue if the program does not have Commission approved deemed values. This recommendation is further supported by the fact that other similar programs in the same region (in particular, Arkansas) have deemed savings for tune-ups that include refrigerant charge adjustments.

Action Plan: Utilities will develop deemed savings value for AC tune-ups. If a modeled approach is used for claimed savings, the model will be calibrated with the prior year's M&V data.

1.6 RESIDENTIAL

1.6.1 Recommendation: Infiltration reduction measure savings should not be claimed where infiltration levels remain within 10% of the initial cap post-retrofit or beyond final ventilation levels specified for health and safety reasons.

The TRM contains several eligibility requirements for the infiltration reduction measure. The EM&V team did find two primary instances where there is room to improve the claiming of infiltration measure savings in accordance with the TRM as follows:

- The TRM applies a cap to the pre-treatment infiltration against which contractors can claim savings.[7] For homes where the initial leakage exceeds 4.0 CFM_{50} per square foot, this cap is to be treated as the starting leakage. The TRM also requires that contractors reduce air leakage by at least 10% through implementation of this measure. This requirement should be measured relative to the initial leakage cap where applied.
- In addition, for health and safety reasons, final ventilation levels are specified within the TRM. Savings should not be claimed for reducing leakage below the health and

[7] The deemed savings awarded for this measure are not considered to vary linearly with leakage above the level of the cap, and since few homes have such high initial leakage the cap also serves to prevent data entry errors.

safety levels specified in the TRM. In a few cases, the EM&V team found that post-treatment infiltration levels fell below the minimum final ventilation. In these cases, the minimum ventilation limit should be applied. **Action Plan:** Utilities will check for compliance with this recommendation in their QA/QC site inspections.

1.6.2 Recommendation: Insulation savings should not be claimed for insulation installed in an unconditioned space.

There were a few instances where the EM&V team on-site inspections found insulation savings that were claimed for unconditioned spaces such as a garage.

Action Plan: Utilities will check for compliance with this recommendation in their QA/QC.

1.6.3 Recommendation: The installed heating system type should be used to calculate shell measure savings.

The on-site M&V found several cases where the incorrect heating system was recorded across utility programs for claimed savings. The most common error was that electric resistance heat was chosen to calculate savings instead of the heat pump found on-site. In some cases, it appears that the EESP may have recorded the wrong heating system type. In other cases, this was because the program replaced electric resistance heat with a heat pump. However, even if the program replaced electric resistance heat with a heat pump, savings for shell measures should use the newly installed heating system to calculate savings.

Action Plan: Utilities will check for compliance with this recommendation in their QA/QC.

1.6.4 Recommendation: Low flow showerhead savings may be claimed at the measure level.

In several cases, the EM&V team found multiple low-flow showerheads were installed in a household when only one showerhead was claimed per household. This is a conservative approach; however, the TRM does not restrict low flow showerhead savings per household. Savings may be claimed at the measure level for each installed unit.

Action Plan: Utilities will claim low flow showerhead savings for each installed measure.

1.6.5 Recommendation: Utilities may want to consider educating EESPs that major renovations or equipment changes planned in the next year by the household could negatively affect measure savings.

In a couple of instances on-site M&V findings regarding major household changes (a remodel or new heating system installed after program participation) decreased program realization rates. Given that the EM&V on-sites occur within 12 months after project completion, near-term changes such as these can affect first year savings.

Action Plan: Utilities will educate EESPs that planned major renovation or equipment changes could affect measure savings.

1.6.6 Recommendation: Assess TRM values for duct sealing, air infiltration and ceiling insulation measures to see if they are reasonable or if any updates are needed.

Duct sealing, air infiltration, and ceiling insulation measures account for a preponderance of savings for residential, hard-to-reach, and low-income programs in Texas. In PY2014, these three measures alone accounted for 94% of energy savings and 90% demand savings in these three residential programs. During its site inspection activities in PY2013 and PY2014, the EM&V team observed notable variation in air and duct leakage rates relative to the reported values, with these site visit findings significantly influencing realization rates. Given the large proportion of program savings derived from these measures, the PY2015 EM&V scope will include a robust approach to assess the impacts of these and other program measures through a billing analysis.

Action Plan: The EM&V team will perform a billing analysis during its PY2015 evaluation to assess the energy and demand impacts for the RSOP and HTR programs. These values will provide a point of comparison for TRM estimates of savings associated with weatherization measures. ERCOT utilities will provide the necessary data to support the billing analysis as identified in the PY2015 EM&V Plan.

1.7 COMMERCIAL

1.7.1 Recommendation: Sufficient justification for the use of the custom values is needed when used in lieu of Commission approved values.

In the course of the PY2014 evaluation, the EM&V team encountered some projects where savings were calculated with custom analysis instead of the Commission approved deemed savings calculations. Because of insufficient documentation provided to the EM&V team to support the use of the custom analysis, evaluated savings were calculated based on the deemed savings calculations, which decreased realization rates for these projects.

Action Plan: Utilities will require EESPs or implementation contractors to provide supporting documentation of custom values.

1.7.2 Recommendation: Review correct selection of building type and capture decision-making process of why a building type was selected when a judgment call is needed.

The EM&V team made several adjustments across projects based on the building type selected for the calculation. In many of these instances the more accurate building type was apparent through a desk review and did not require the on-site M&V while in other cases on-site M&V was important in determining the correct building type. While in some cases these changes in building types by the EM&V team had a positive effect on savings and sometimes a negative, for the accuracy of the savings, building type should be assigned as close as possible. Because judgment calls may be needed in determining building types, the EM&V is further recommending a field to track why the building type was selected. Furthermore, it is important that building type is assigned at the facility-level instead of by business type. For example, an energy efficiency project completed for a university of a warehouse should select “warehouse” as the building type as opposed to “education.”

Action Plan: Utilities will educate EESPs on selection of building type at the facility as opposed to business type level as well as documenting the reasons for selecting a business type when a judgment call is needed. Utilities will continue to check building type as part of their QA/QC processes.

1.7.3 Recommendation: Utilities may want to consider EESP education that savings could be affected if small business participants are not planning to remain in the participating facility for the next 12 months.

In a couple of instances on-site M&V findings for the Small Business Program found that the participating business had already moved and business changes affected first year savings. While unplanned changes are unavoidable, especially in the small business sector, there may be opportunity to increase persistence of at least first year savings if participants have at least one year of planned occupancy at the participating facility.

Action Plan: The utilities will consider EESP education regarding the importance of consistent participant first year occupancy of a treated facility.

1.8 CONCLUSION

The EM&V team continues to find that utilities generally have well-established program design and delivery processes, supported by developed program tracking systems, program documentation, and savings tools.

One of the previously referenced NAPEE best practices is coordinated design and implementation with EM&V. Texas presented a unique situation in the energy efficiency industry. In most jurisdictions, EM&V is rolled out concurrently or soon after program implementation as dictated by regulatory requirements. In Texas, EM&V requirements were not included in energy efficiency legislation or subsequent Commission rule-making until after the programs had been in operation for a decade. Therefore EM&V was a new aspect introduced within an already established program design and delivery infrastructure. Despite the challenges inherent in this situation, the utilities have demonstrated a commitment to coordinating program design and implementation with the EM&V effort.

In the first evaluation year (PY2012), the utilities, Commission, and EM&V team established a process to document recommendations and utilities' responses (referred to as "action plans"). Utilities use these action plans to respond to program design and implementation recommendations within the next program year's implementation consistent with 16 TAC § 25.181(q)(9). For example, a recommendation made based on PY2012 evaluation research, which was completed in calendar year 2013, are expected to be fully implemented in PY2014. The action plan process was further refined in PY2013 to also include vetting of the action plans with the EEIP.

The objective of the EM&V recommendations is to facilitate more accurate, transparent, and consistent savings calculations and program reporting across the Texas energy efficiency programs as well as provide feedback that can lead to improved program design and delivery. The EM&V team recognizes there may be a trade-off between these objectives and program administration cost and program participation barriers. Several of the recommendations require utility process changes as well as have administrative cost implications.

In PY2014, utilities fully responded to recommendations identified from the PY2012 EM&V effort[8] as follows:

- Utilities verify annual claimed savings reported in Energy Efficiency Plans and Reports with tracking system and/or implementation contractors and the EM&V team.
- In general, the program tracking systems have improved organization and transparency such as consistently including unique identifiers across all programs and measure savings information such as commercial measure type and residential measure savings inputs.
- Utilities are consistently defining participant numbers by unique identifiers such as ESIID or meter number.
- Program manuals or similar implementation materials are available across all programs that detail critical elements such as program goals and metrics, delivery methods (including any program marketing channels), participation requirements for both customers and EESPs, sample application form(s), required software or savings calculators, payment processing, data tracking and reporting, and how energy savings are calculated.
- Project-level documentation supporting savings calculations has improved including capturing key inputs into deemed savings projects such as type of fixtures, equipment efficiency and quantities through customer procurement documents (equipment invoices or purchase orders that describe the equipment quantities and specifications (i.e., make and model)) equipment cut sheets, and photos of pre- and post-equipment nameplates as well as utility M&V reports.
- A number of opportunities to improve savings estimates were incorporated into the annual TRM update and applicable program savings tools. In addition, consistency in savings approaches have also been included in the TRM. Key examples include calculating peak demand reductions and the baseline methodology used for load management programs.

The PUCT and EM&V team will discuss PY2014 recommendations with utilities to develop action plans for the reasonable roll-out of recommendations in PY2016.

[8] As PY2012 was the first year of the statewide EM&V, it was a limited effort based on program tracking and documentation review and therefore had a more limited set of recommendations.

2. INTRODUCTION

This document presents the third-party evaluation, measurement, and verification (EM&V) results for the Texas electric investor-owned utilities' energy efficiency portfolios implemented in Program Year 2014 (PY2014).

For PY2014, the team conducted program tracking system reviews across all utility programs and desk reviews, customer and market actor surveys, and on-site M&V for sampled projects. The reviews provided an independent assessment of claimed savings and the accuracy of the program data. Documentation reviewed were tracking data, project files, energy savings calculations (including a review of input assumptions and algorithms to verify claimed program savings), and utilities' existing M&V information.

The PY2014 EM&V plans[9] are based on the prioritization for the EM&V effort[10] presented and distributed for comment to the EEIP and approved by PUCT staff. To briefly summarize, the EM&V team identified 24 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 (Request for Proposals 473-13-00105, Project No. 40891, Scope of Work Task 1B (n)):

- 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 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.

2.1 EVALUATION METHODOLOGY

PY2014 is the third program year evaluated as part of the statewide EM&V effort. The EM&V team conducted program tracking system reviews across all utility programs and desk reviews, customer and market actor surveys and on-site M&V for sampled projects. Energy efficiency program evaluations routinely employ 90 percent confidence intervals with ±10 percent precision as the industry standard ("90/10"). The sampling process for evaluation activities was designed to achieve a minimum of 90/10 relative precision for evaluated savings estimates at the utility portfolio level. The sampling process was not designed to

[9] *Public Utility Commission of Texas Evaluation, Measurement, and Verification (EM&V) Plans for Texas Utilities' Energy Efficiency and Load Management Portfolios—Program Year 2014*, July 27, 2014.

[10] *EM&V Prioritization for Program Year 2014* to Katie Rich and Therese Harris, PUCT, from Lark Lee, EM&V project manager, May 19, 2014.

achieve the same level of relative precision at the program level; **thus, the evaluated savings set forth in this report should only be viewed qualitatively on account of small sample sizes at the program level.** The following EM&V activities were completed statewide:

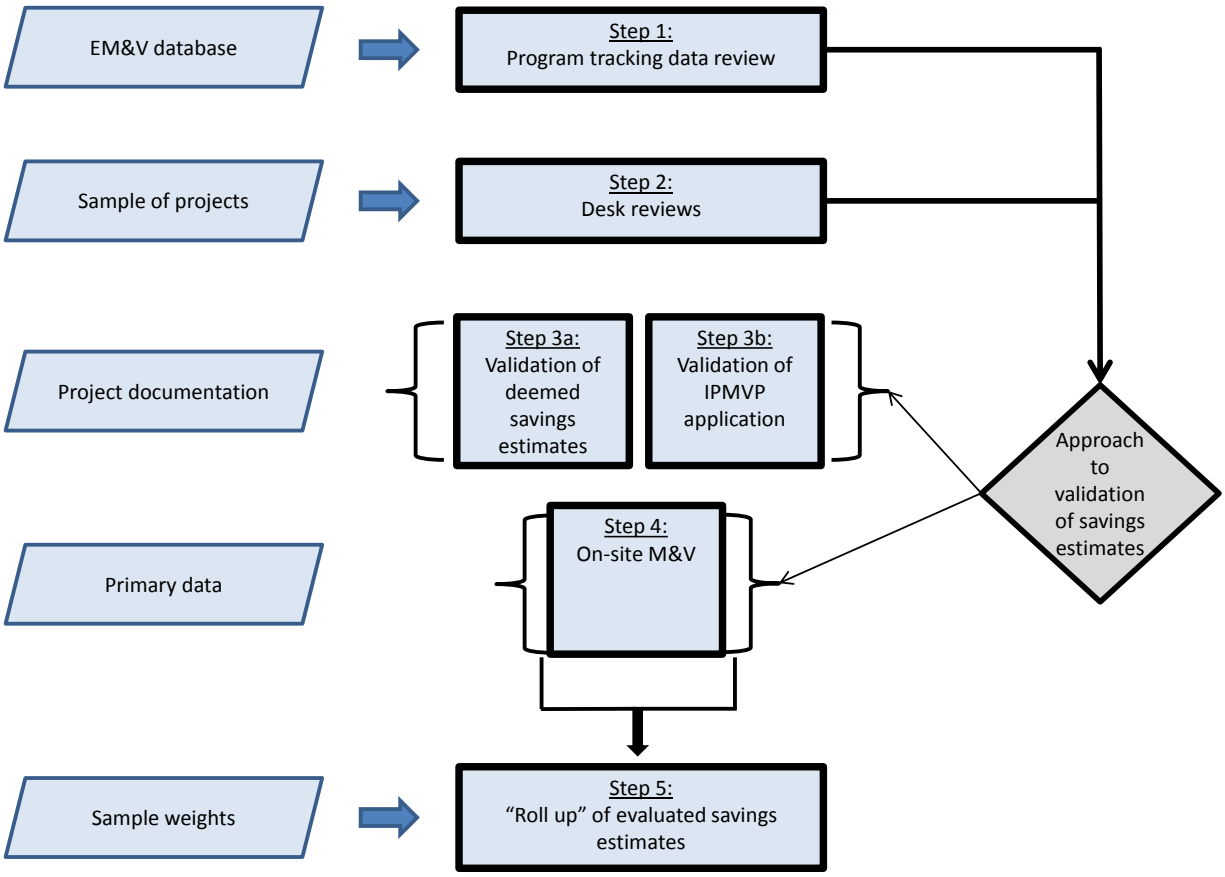
- Residential tracking system review
- 1,349 desk reviews
- 493 on-site M&V
- 145 customer surveys
- Calculation of all load management impacts using interval meter data.

The EM&V activities:

- Confirmed that the measures installed are consistent with those listed in the tracking system
- Verified that the savings estimates in the tracking system are consistent with the savings calculated in the deemed calculation tools or tables or measurement and verification (M&V) methods used to estimate project savings
- Reviewed savings assumptions and, when available, utility M&V reports gathered through the supplemental data request for sampled projects and EM&V team on-site M&V and customer survey results.

The evaluated savings are based on project-level realization rate calculations that are then weighted to represent program-level, sector-level, and 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 and primary data collected by the EM&V team. For example, baseline assumptions or hours of use may be corrected through the evaluation review and thus affect the realization rates. A flow chart of the realization rate calculations is below.

Figure 2-1. Realization Rate Flowchart



A complementary component of the realization rate is the sufficiency of program documentation provided to estimate evaluated savings. This was used to determine an overall program documentation score for each utility.

The EM&V team conducted cost-effectiveness testing using the program administrator cost test for PY2014 claimed and evaluated results. Low-income programs were also calculated using the Savings-to-Investment Ratio (SIR).

2.2 REPORT ORGANIZATION

Section 3 includes three statewide process assessments: a best practices assessment of the programs, characterization of the programs' administrative cost performance and transparency of the cost-effectiveness of different programs. Section 4 details program-specific results for the Small Business program, Retail Electric Provider (REP) program, the Appliance Recycling Program, low-income programs, and the CoolSaver Program which had additional evaluation research beyond the impact evaluations in PY2014. Section 5 provides key findings and recommendations on opportunities for savings improvements from the impact evaluations (Request for Proposals 473-13-00105, Project No. 40891, Scope of Work Task 5). A separate volume (Volume II) details the EM&V results for each utility's portfolio.

3. STATEWIDE PROCESS ASSESSMENTS

This section documents the EM&V team's process assessments of energy efficiency program best practices, administrative cost cap performance, and transparency of sub-programs.

3.1 BEST PRACTICES IN PROGRAM DESIGN AND DELIVERY

Below we summarize the EM&V team's assessment of the current progress of the Texas electric utilities in meeting industry-leading structures, tactics or processes ("best practices") in the design and delivery of energy efficiency programs.

A best practice is defined as a business practice that, when compared to other business practices that are used to address a similar business process, produces superior results. While best practices are documented strategies and tactics employed by successful organizations and programs, rarely is an organization or program "best-in-class" in every area. The focus of this assessment is on best practices that exist within and across the utilities' portfolios.

The EM&V team conducted interviews with program managers in April–May 2014 for 89 different utility programs. In addition, high-level PY2013 results meetings were held in July–August 2014 with each of the utilities to discuss the PY2013 evaluation recommendations and utility responses to the recommendations (similar results meetings were held the year prior for the PY2012 results and recommendations). Based on information gathered in these interviews and meetings with the utilities as well as other evaluation activities, this memo summarizes how best practices are currently incorporated into the Texas programs.

3.1.1 Evidence of best practices

The EM&V team referred to and benchmarked the Texas programs using the National Action Plan for Energy Efficiency (NAPEE) chapter on energy efficiency program best practices (Chapter 6). The team specifically identified 18 best practices as most applicable and appropriate to support the effective delivery of the Texas programs. These are[11]:

- Offer programs for all customer classes
- Develop an understanding of the market
- Start with demonstrated program models—build infrastructure for the future
- Leverage national programs like ENERGY STAR
- Use cost-effectiveness tests that are consistent with longer-term planning
- Consider building codes and appliance standards in program planning
- Create a roadmap of key program components, milestones and reduction goals
- Plan to incorporate new technologies

[11] Source: Modified from NAPEE Best Practices (2007), Chapter 6, and pp. 6-7, 6-10, 6-11.

- Change measures over time to adapt to changing markets and new technologies
- Pilot test new program concepts
- Coordinate with other utilities and third-party program administrators
- Keep participation simple
- Invest in education, training and outreach
- Develop program tracking system
- Leverage customer contact-cross-reference of programs
- Evolve to more comprehensive programs
- Align goals with funding
- Keep funding consistent.

There is evidence of all 18 of these best practices being employed in the Texas programs and most of the best practices are well-established. For some best practices, the EM&V team did identify opportunities for improvement to further support the best practice. Next, we summarize the progress for each of the best practices.

3.1.2 Best practices characterization

A. Offer programs to all customer classes

The current energy efficiency program portfolio serves all customers and rate classes included in the programs (transmission-level industrial customers are not included in the programs and distribution-level industrial customers may choose to opt-out of the programs). The Texas utilities have developed comprehensive programs to serve the range of customer classes from low income to large commercial customers.

The current programs are also addressing needs of specific customer segments including schools, municipalities, food service and health care, as well as hard-to-reach and low-income residential customers. Small business was one segment not specifically served within many utilities' programs in PY2012; however, this program offering became more prevalent beginning in PY2013 and continued to be so in PY2014.

One identified challenge to this best practice is possible disparity in the program participation process. Seasoned energy efficiency service providers (EESPs) and large customers who participate directly in commercial SOP programs know how to reserve funds and effectively participate in programs. Conversely, less sophisticated customers and EESPs may not be as informed on the participation process. To address this, some utilities are implementing specific funding "set-asides" for certain customer types (i.e., small schools) and have caps for the amount of funds one single EESP can receive annually. In addition, some utilities are conducting considerable outreach to smaller, local EESPs to encourage their participation. Some utilities are also leveraging market transformation program offerings to target less sophisticated EESPs and customers and assist them in participating in energy efficiency.

3. Statewide Process Assessments…

Another identified challenge in serving customers equitably is reaching those located in rural areas. Several utilities have higher incentives in their SOPs for projects completed in underserved counties. In addition, one utility started offering a market transformation program in PY2014 specifically serving small business customers in more rural areas of its territory.

B. Develop an understanding of the market

Given their experience offering energy efficiency programs in Texas, the utilities and program implementers have developed an understanding of the market. This market knowledge has benefited several technologies such as lighting and HVAC as well how to serve different customer sectors in both the residential and commercial markets as discussed above.

While utility portfolios remain fairly constant from year to year with a core set of programs, their portfolios do change annually as programs are added or discontinued based on program participation rates and market response. For example, one utility decided to discontinue some of its market transformation programs targeting certain commercial segments in PY2014 and instead is including those customers in the Commercial Standard Offer Program (CSOP). This utility reported making this decision as they felt this market segment was sufficiently transformed to support this change. At the same time, new market transformation programs including the previously mentioned small business programs and others such as AC tune-ups and Recommissioning have recently been introduced to utility portfolios to address specific market barriers in Texas.

The utilities have been implementing a number of activities to "keep a finger on the market." These have included baseline surveys, annual surveys of their EESPs and informal check-ins with EESPs to understand the market in their territory and what challenges they are encountering with customers. In the PY2013 results meetings, the utilities agreed to continue periodic qualitative or quantitative research with their EESPs to continue to monitor market conditions. In addition, they will conduct baseline/market assessment studies when net-to-gross research indicates the need to re-assess the market the program(s) is serving. It is important to note however that this is *at a minimum* when a market assessment study should be conducted as agreed between the utilities and the EM&V team. Periodic market assessment studies can provide the most up to-date and current information for programs to effectively serve and push the market and this may be an area for improvement in this best practice as while baseline studies are done, they have historically been fairly infrequent.

C. Start with demonstrated program models—build infrastructure for the future

The evaluation research indicates there is a strong infrastructure across the utilities, implementation contractors and EESPs in place to continue to deliver energy efficiency programs effectively and successfully in the future.

Programs began in 1999 as part of deregulation of the ERCOT retail market in Texas. At that time, a core group of programs were built on common templates. These programs have evolved over time as utilities respond to the needs of their specific territories. For example, utilities have employed different strategies to manage participation, which in some cases involves increasing program participation and in other cases decreasing program participation. Modifications have included changing the requirements for EESPs and incentive strategies as well as the measures that are offered.

Not only is there an infrastructure built upon core program designs, the evaluation also found that the programs have built an infrastructure of contractors as noted in the PY2013 Annual Portfolio Report. The PY2013 tracking system review reflects a considerable network of EESPs. Across the ten utility SOPs, the PY2013 tracking data showed that over 100 unique EESPs participated in the commercial SOPs and over 200 unique EESPs participated across the residential SOPs. In addition, approximately 2,300 commercial customers participated directly in the utility SOPs statewide.

D. Leverage national programs like ENERGY STAR

The Texas utilities are leveraging resources from national programs and initiatives including ENERGY STAR, the Department of Energy (DOE) and the Consortium for Energy Efficiency's Design Lights Consortium (DLC). These national programs are leveraged in a variety of ways such as including national certification requirements in the Texas TRM (i.e., DLC certification for commercial LEDs) as well as ENERGY STAR criteria and applying funding available from DOE for the low-income programs.

However, the utilities have also tried and determined that some national programs are not appropriate in Texas. For example, one large utility offered the Home Performance with ENERGY STAR program for a couple of years, but was not able to achieve cost-effectiveness for this program in Texas with electric-only savings. Consequently, it was discontinued. Some utilities are also assessing if the newest version of ENERGY STAR's New Homes Program is appropriate for Texas' new construction market.

Texas, along with Oklahoma, also has a new regional organization, South-central Partnership for Energy Efficiency as a Resource (SPEER), which may also be a source to leverage programs. At this time, the utilities are planning on coordinating with SPEER on a code compliance study and education effort starting in 2015, which is primarily funded through a DOE grant.

E. Use cost-effectiveness tests that are consistent with longer-term planning

Texas bases cost-effectiveness on the program administrator cost test (PACT) using avoided costs provided by the Commission annually. The rules governing cost-effectiveness testing are laid out in 16 TAC § 25.181. Utilities are appropriately using the PACT based on the evaluation's independent review of these results.

The cost-effectiveness testing includes a discount rate. 16 TAC § 25.181 also allows the use of an escalator for avoided costs in determining a utility performance bonus. It is industry practice to forecast avoided costs out more than one year. In addition, Texas utilities have been working on improved effective useful life (EUL) estimates for individual measures. Originally a 10-year EUL across all measures was assumed across all measures, which did not as accurately reflect the different time periods over which measure benefits are realized. Utilities are also now tracking measures at the EUL level, which was not previously done for commercial programs.

F. Consider building codes and appliance standards in program planning

Starting with PY2013, Texas has a statewide Technical Reference Manual (TRM). The TRM is an effective way to make sure programs incorporate new building and appliance standards.

The TRM is updated annually. Since many of these codes are continually changing, the TRM incorporates the newest standards with each update.

In addition, there is utility interest in codes and standard programs, which are allowed under 16 TAC § 25.181. This includes understanding current enforcement policies and program strategies that could increase enforcement and realize energy savings. In addition, utilities expressed interest in program strategies that would encourage the adoption of higher codes and standards than the current statewide code that could also realize energy savings.

G. Create a roadmap of key program components, milestones and reduction goals

Texas has a well-established annual regulatory reporting requirement, the Energy Efficiency Plan and Report (EEPR), that meets this best practice at the overall utility portfolio level. The EEPRs report on the last year program year's requirements and the plans for both the program year in progress and the next program year. The EEPRs describe each program and how it contributes to the utility's overall portfolio goals.

Another aspect of this best practice is program documentation that details each individual utility program. When the statewide evaluation began with PY2012, the EM&V team found diversity in available program documentation. Some utilities and programs had detailed program manuals available on their websites for most programs while others did not. A recommendation from the PY2012 evaluation was for utilities to develop a program manual for each program, which the utilities will have completed by the end of PY2014.

In addition, there are specific requirements for market transformation programs to document program components, milestones and goals. Looking specifically at market transformation program documentation, the EM&V team found how well the specifics in 16 TAC § 25.181 are addressed in program manuals varied. Therefore an additional recommendation from the PY2013 evaluation is for utilities to address the market transformation documentation requirements in program manuals, which the utilities agreed to complete in 2015. The market transformation documentation requirements include clearly identifying program goals, market barriers the program is designed to overcome, key intervention strategies for overcoming those barriers, projected savings and program implementation milestones.

In summary, while there are clear and well-established regulatory reporting requirements for utility portfolios, individual program documentation varied at the beginning of the EM&V effort. While this variation still exists, the utilities' receptiveness and response to the evaluation recommendations to improve program documentation across all programs should facilitate further implementation of this best practice going forward.

H. Plan to incorporate new technologies

The utilities regularly review and assess new technologies for their portfolio. As examples, in PY2014 utilities are considering a number of new technologies such as ductless heat pumps for multifamily buildings, pool pumps and geothermal heat pumps. They are putting in place pilot studies that could support the development of deemed savings for these technologies. For the next TRM update (3.0), the utilities will be developing deemed savings for residential LEDs (nonresidential LEDs are already in the current TRM) and a M&V protocol to determine savings for solar shingles.

In addition, one utility sponsored a petition in 2014 for Pump Off Controllers, which was approved and will be incorporated in the next TRM update. Another utility sponsored a petition in 2013 for residential demand response technologies which had not previously been employed in Texas. In addition, utilities appear to have an increased willingness to consider custom M&V projects. In 2012 and 2013, the vast majority of savings were from deemed measures; however, the utilities have been increasingly engaging the EM&V team in 2014 on new types of projects and appropriate M&V plans to measure claimed savings.

I. Change measures over time to adapt to changing markets and new technologies

While part of this best practice is addressed through offering new technologies as discussed above, the other component of this best practice is adapting to changing markets and baselines by discontinuing measures or offerings where markets have transformed. The Texas utilities have already been doing this to some extent through monitoring markets and discontinuing certain offerings as they ascertain the market has transformed. In addition, as discussed under the previous best practice, "Develop an understanding of the market," the utilities agreed to use net-to-gross research conducted by the EM&V team to indicate when a baseline study is needed to understand and respond to changing markets.

J. Pilot test new program concepts

16 TAC § 25.181 allows utilities to pilot new program concepts without passing cost-effectiveness the first year. This is in keeping with standard industry practice given the first year start-up costs make it difficult to be cost-effective the first year. The Commission does expect pilot programs to pass cost-effectiveness the second year.

Recently piloted program concepts have included offerings targeting: specific customer segments such as small business and multi-family; new technologies such as pool pumps and AC tune-ups; and new delivery concepts such as working with Retail Electric Providers (REPs) to deliver energy efficiency offerings to customers. Utilities also have new pilots in the planning stage for PY2015 such as a Data Center Program.

In general, one of the larger utilities tends to pilot the most new program concepts. However, smaller utilities reported they often watch what the larger utilities are piloting to see if the new concept has potential for their service territory. That being said, many of the smaller utilities have unique market and territory issues. In response, these utilities do consider innovative program delivery mechanisms that are unique to the needs of their service territory.

However, the EM&V team is unaware of clear criteria or consistent delineation of when a "pilot" program transitions to a full program in a utility's portfolio. While the transition is clearly articulated in utilities' EEPRs, the drivers of this transition are often not. Documenting, and if possible systematizing, this guideline is an area for improvement in this best practice. This has been discussed with the PUCT and the EM&V team will be assessing and making recommendations on "pilot" program status as part of the PY2015 EM&V.

K. Coordinate with other utilities and third-party program administrators

This best practice is being realized in Texas through two primary established venues for coordination. The Commission holds Energy Efficiency Implementation Project (EEIP) meetings at least annually. The meetings include regulators, the utilities, implementation

contractors and other interested stakeholders. In addition, the utilities coordinate with one another through the organization, Electric Utility Marketing Managers of Texas (EUMMOT). EUMMOT also maintains texasefficiency.com, which is a one-stop website that hosts links to all of the utility programs, regulatory filings and other pertinent program documents such as the TRM and EM&V reports.

Even with these established coordination means, discussions with utilities identified the need for program manager best practices meetings. It was discussed that annual utility best practices meetings had taken place in the past amongst the utilities, but these had not happened recently. The utilities agreed in the PY2013 results meetings to hold program manager best practices meetings for the residential and load management programs. These are program areas the EM&V team had identified as having evolved differently across the territories and therefore could benefit from sharing of best practices across the utilities.

L. Keep participation simple

An inherent challenge in the energy efficiency industry is the correct balance in keeping participation simple enough that contractors and customers want to participate in programs, but with sufficient requirements that both a certain level of quality assurance is maintained as well as a sufficient level of confidence in the resulting savings. The utilities have put considerable effort into striking this balance while employing this best practice. Utilities reported assessing their application process to streamline it while meeting program needs. Several of the utilities have also recently rolled out electronic applications, and other utilities are in the process of, or considering electric applications in the future.

In addition, some market transformation programs are delivered by the same implementation contractor across different utility territories. It was reported that in these cases, there is an effort underway to make consistent application forms across the utilities to minimize EESP and customer confusion.

Historically, the utilities have also kept participation simple by developing deemed savings estimates for select measures and savings tools for EESPs to use to calculate savings (and incentive levels). While this is a good practice and is continuing to improve through the TRM, deemed savings are not applicable for all measures or situations. The utilities are working with the EM&V team to also include systematic M&V protocols in future versions of the TRM. The TRM will also provide guidance on when an M&V approach is more appropriate.

The EM&V team's benchmarking of utilities' quality assurance (QA) M&V found that while residential M&V requirements are in-line with industry standard practice, commercial M&V requirements of conducting pre- and post- inspections for almost all projects are more stringent than QA practices employed in other jurisdictions. Some utilities are considering revising their commercial QA practices to a sampling approach, while others feel their current QA practices are important for customer satisfaction and to increase confidence in the savings and therefore are not planning any changes.

M. Invest in education, training, and outreach

The EM&V team's PY2013 research with customers and market actors indicated that the Texas utilities have been effective in providing education, training and outreach to EESPs and customers. The utilities provide annual education and training for participating EESPs as part

of the "kick-off" of SOPs each program year. In-depth technical assistance is provided to customers and EESPs through the market transformation programs. In fact, the influence of the education and training received through the programs was a large contributor to the overall healthy net-to-gross ratios found across most of the programs. Customers clearly recognized the influence the technical assistance had on their decision to install the equipment they did, which is in part a result of the education and training utilities and their contractors are providing to their EESPs.

N. Develop program tracking system

The utilities and their implementation contractors developed and (for the most part) accurately populate their comprehensive program tracking systems. As a result, the EM&V team was able to develop one statewide program tracking system across all of the utilities' portfolios. At the same time, the EM&V team identified some improvements in the program tracking systems, such as the need for measure-level information, which was conveyed to the utilities in the PY2012 recommendations. All of the utilities have responded or are in the process of responding to EM&V team program tracking system recommendations, further solidifying this best practice in Texas.

O. Coordinate design and implementation with EM&V

Texas presented a unique situation in the energy efficiency industry. In most jurisdictions, EM&V is rolled out concurrently or soon after program implementation as dictated by regulatory requirements. In Texas, EM&V requirements were not included in energy efficiency legislation or subsequent Commission rule-making until after the programs had been in operation for a decade. Therefore EM&V was a new aspect introduced within an already established program design and delivery infrastructure. Despite the challenges inherent in this situation, the utilities demonstrated a commitment to coordinating program design and implementation with the EM&V effort.

In the first evaluation year (PY2012), the utilities, Commission, and EM&V team established a process to document recommendations and key findings and utilities' response to the issues (referred to as "action plans"). Utilities use these action plans to respond to program design and implementation recommendations within the next program year's implementation. For example, a recommendation made based on PY2012 evaluation efforts, which were completed in 2013, are expected to be implemented in PY2014. The action plan process was further refined in PY2013 and also included vetting of the action plans with the EEIP.

Utilities have also increasingly engaged the EM&V team regarding technical guidance on new program concepts or technologies as well as the review of M&V for custom projects. In large part due to the receptivity of multiple parties to collaborate effectively and realize value from the EM&V effort, this best practice is now in place in Texas.

i. Leverage customer contact-cross program participation

Historically the utilities did not market directly to customers although information on all utility programs is available on each utility's websites or through the previously referred to "one-stop shop" of texasefficiency.com. The inability to do direct marketing could lead to less customer awareness of the various programs they can leverage to realize energy efficiency benefits.

However, a change in 2011 legislation now allows vertically integrated utilities outside of ERCOT to conduct direct marketing to customers (PURA § 39.905(h)).

Given the program design of the SOPs where EESPs ("trade allies") are the primary vehicle of program awareness and delivery, this also may result in less cross program participation as EESPs do not have an incentive to refer "their" customers to other programs delivered by other EESPs. This is a common challenge for trade-ally driven programs in the energy efficiency industry. An additional change in the 2011 legislation does allow utilities operating in an area open to competition (ERCOT) to provide rebates or incentive funds directly to customers in rural areas, upon meeting certain demonstration requirements, to facilitate the success of programs (PURA 39.905(i)). No utility has availed itself of this option to-date.

ii. Evolve to more comprehensive programs.

As in most areas around the US, the majority of Texas commercial savings are resulting from lighting measures. The trade ally driven nature of the commercial SOP may be a challenge to more comprehensive treatment of facilities as EESPs often specialize in one area such as mechanical or lighting systems, but often not both. In addition, the commercial SOP is not conducive to overall comprehensive treatment of facilities during new construction given individual measures are incentivized instead of overall more efficient building design. However, there is more comprehensive treatment of commercial facilities in some of the market transformation programs that offer overall building audits, benchmarking and other technical assistance that identify energy efficiency improvements throughout the facilities.

Residential SOP savings have reflected a more diversified measure mix comprised of various shell and HVAC measures as well as CFL offerings for hard-to-reach customers (LEDs will be added across all residential customers). Several of the utilities also have residential new construction programs which focus on multiple efficiency improvements. However, a systematic challenge in Texas for more comprehensive residential programs is the electric-only goals. Comprehensive residential retrofit programs such as Home Performance with Energy STAR are often only able to pass cost-effectiveness when both electric and natural gas savings are claimed.

Some of the utilities are promoting more comprehensive offerings across SOPs through tiered incentive structures, which may also assist this best practice.

P. Align goals with funding

Utilities establish an energy efficiency cost recovery factor (EECRF) that allows them to recover the reasonable costs of providing cost-effective programs to meet, at a minimum, goals that are calculated in accordance with 16 TAC § 25.181. Utilities do need to deliver programs to rate classes proportionately to how they pay in, although there is flexibility to collapse commercial rate classes.

16 TAC § 25.181 also establishes an "administrative cost cap" for the utilities—the cost of administration cannot exceed 15 percent of a utility's total program costs although a utility can file a good cause exception with the Commission. While performance against the administrative cost caps varies by utility, in general utilities reported costs are increasing due to increased administrative requirements as well as increasing baselines. Some additional requirements include the EM&V effort, processing opt-out customers, and tracking rate

classes. The other concern is with rising baselines. As performance standards and codes increase much of the "low-hanging fruit" is gone and utilities feel they will have to spend more money to reach goals. The administrative cost cap may be an area for improvement in this best practice as it is unclear how the administrative cost cap will affect the utilities' ability to meet goals in the future, especially as goals and baselines rise. The Commission has asked the EM&V team to assess utilities' performance against the administrative cost cap and EECRF overall cost cap as part of the PY2014 EM&V scope to provide some additional insight into this issue.

Q. Keep funding consistent

Several programs across utilities fully subscribe out during the program year therefore consistent funding is not available for the programs throughout the program year. This in an issue in energy efficiency programs across the country. Given the majority of utilities are exceeding goals this is primarily a concern from a customer and EESP satisfaction point of view. Utilities have tried to "smooth" participation out across the program year through EESP and customer incentive caps and they also make a concerted effort to keep EESPs informed of program funding.

3.1.3 Summary

Overall the Texas programs are delivered consistently with industry best practices. Several of the areas for improvement identified are inherent in the energy efficiency industry or are part of the regulatory framework of the programs. The utilities have been receptive in action plans to improvements that can help solidify some best practices and improve others to support transparent programs that cost-effectively meet goals.

3.2 ADMINSTRATIVE COST PERFORMANCE

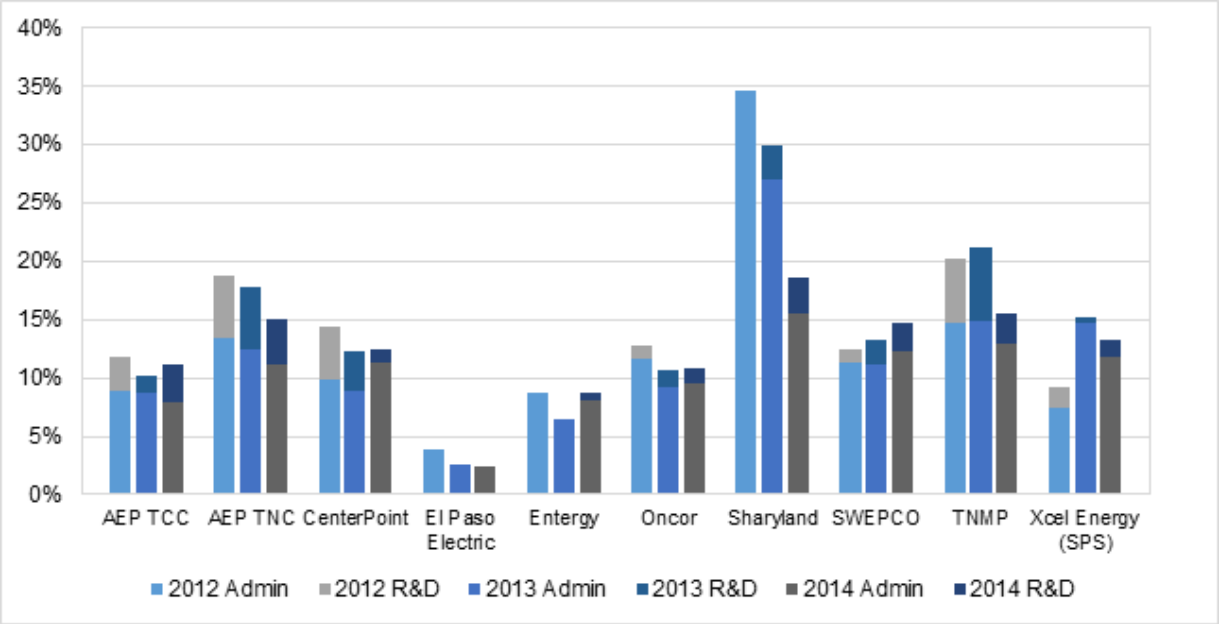
As part of the Program Year 2014 evaluation, we reviewed the administrative cost cap ("cap") that was established in 16 TAC § 25.181 ("the rule"). The rule limits utilities to spending 15 percent of their budget on administration, and 10 percent of the previous year's budget on research and development (R&D). Combined, administrative and R&D costs cannot exceed 20 percent of a utility's annual spending. Utilities have the option to request an exception to this portion of the rule. During process interviews with utilities as part of the PY2013 EM&V effort, utilities voiced concern about increasing program demands with set administrative cost caps. In response, the PUCT supported the EM&V team assessing the administrative cost cap as part of the PY2014 EM&V effort. The EM&V team's assessment included analysis of the utilities' spending in comparison with the cap as well as a brief process interview with the utilities regarding the cap.

3.2.1 Key findings

Utilities' administrative costs in PY2014 ranged from 2 percent to 15 percent of their portfolio budgets based on their 2015 Energy Efficiency Plan and Reports (EEPRs), and may increase as utilities incur Energy Efficiency Cost Recovery Factor (EECRF) costs. All but one of the utilities reported R&D costs, ranging from 1 to 4 percent of their PY2013 budgets. Most of the utilities attributed all of their administrative costs to individual programs, although three utilities also reported portfolio-level costs. While two utilities exceeded the administrative cost cap, one utility had a good cause exception approved by the PUCT as they recently began

programs. Figure 3-1 shows the utilities' administrative and R&D spending for program years 2012–2014[12].

Figure 3-1. Utility Administrative and R&D Spending, Program Years 2012–2014



The rule describes numerous activities that can be reported under the administrative cost category, including outreach to service providers and vendors, marketing self-delivered programs, program planning and reporting and EECRF proceedings. Utilities generally reported their costs to include program staff labor and expenses for program management, utilities' QA inspections, contractors aside from implementation (such as database providers or other consulting), and EM&V support. Some utilities also mentioned contractor outreach and training, and some non-ERCOT utilities include marketing to customers and/or internal marketing of the programs. Utility staff regulatory support came up as being included for some utilities and excluded for others. It was further discussed that market transformation programs' (MTPs) implementation contractor costs are not included in the administrative cost cap as those are covered in the incentive payments for MTPs.

Conferences and staff development are an area that is not clearly defined in the rule. One utility mentioned limiting travel to trade shows and events as a result of feeling constrained by the administrative cost cap. Another utility discussed conference activities and other professional industry membership in the R&D section of their EEPR.

Most utilities reported the cost cap to be sufficient to operate programs as they have been running during the last several years. Several utilities pointed out that scale is an issue: the smaller utilities have a bigger challenge because there is a base cost to run a program regardless of participation size. The utilities typically meet their savings goals based on recent years' results, but some indicated that if goals increased significantly, additional administrative funding may be needed to reach goals. Two utilities specifically mentioned customer awareness as a barrier that would need to be addressed for scaling up programs

[12] Note that Sharyland was rolling out energy efficiency programs for the first time in this timeframe.

that would require administrative spending. A couple of utilities also mentioned they would do increased QA/QC if additional administrative dollars were available.

3.2.2 Recommendations

The evaluation team offers the following recommendations regarding administrative and R&D costs.

Recommendation #1: Consistency and Transparency. The evaluation team's primary recommendation is to improve consistency and transparency in the categories that utilities report under administrative costs. We suggest that utilities provide a brief description of the types of costs incurred under the administrative category in their EEPRs, as they do for research and development. We recognize that there is additional burden from requiring too much detail in reporting, so we do not suggest that the utilities be required to report the amounts associated with these categories. The commission could provide additional guidance to the utilities on the inclusion or exclusion of utility staff labor for program staff and regulatory support.

Recommendation #2: Conferences and staff development. These categories are not as clearly defined in the rule. The evaluation team believes industry conferences and membership and energy efficiency staff development costs would be appropriately reported under R&D rather than administrative. These costs do not directly relate to delivering programs but are important to provide utilities with insight into the wider energy efficiency industry and research that other organizations are conducting and keep Texas programs evolving and integrating best practices. However, marketing and other educational activities to utility internal staff who are not part of the energy efficiency department should be reported in the administrative cost budget.

3.3 SUB-PROGRAM TRANSPARENCY

The EM&V team applauds the growth of market transformation initiatives in the utilities' portfolios as the utilities seek to better serve certain customer segments and/or integrate new technologies into their portfolios. At the same time, it is important to have transparency in distinct program components (or "sub-programs") in order to best assess how cost-effectively sub-programs can achieve their stated goals as well as how sub-programs are designed and delivered.

In PY2014 nine market transformation programs across four utilities offered distinct program components to different sectors and participant types while claimed savings and program costs were reported at a broader level. In some cases, these sub-programs are implemented by different program implementers than the primary program (or component contributing the majority of savings). In addition, they often offer different levels of rebates and technical assistance. In other cases, some of these sub-programs were launched as Pilots, which proves challenging in reviewing Pilots separately as utilities are allowed to pilot new program concepts without passing cost-effectiveness the first year.

Combining distinct program components together has added challenges to clear and transparent reporting and effective third-party EM&V. The primary concern is the inability to

calculate, and therefore properly assess, sub-program cost-effectiveness. Low-income[13] versus market classes are required to be reported separately. In these instances, the EM&V team was able to identify such breakdowns; however, as they cross multiple sub-programs we were unable to clearly evaluate each sub-program's cost-effectiveness.

In addition, there is increased difficulty in conducting third-party EM&V of programs with multiple components for the following reasons:

- Multiple implementation contractors may be delivering different components
- Some programs lack program manuals describing the specifics of the sub-programs
- There are differences in tracking data system content and quality
- There are differences in supplemental data and documentation collected by implementers at the project level
- Confirming program savings with reported savings in EEPRs is challenging when program-level savings are achieved across distinct components .

3.3.1 Key findings and recommendations

The EM&V team's overarching recommendation is that distinct program components in terms of design and/or delivery, such as programs targeting a specific segment or promoting a specific technology or practice, should have individual reporting and documentation requirements if they are combined into one umbrella program. We provide more specific recommendations to implement this overarching objective.

A. Recommendation: Provide separate cost information by sub-program

When multiple programs' costs are rolled up together without budget reporting for each sub-program, cost-effectiveness can only be completed at the overall program level. This has implications for the more established programs. If new/pilot program budgets are included with other programs and not reported separately, cost-effectiveness can be reduced. Implementation of new/pilot programs typically require additional costs for program start-up costs such as for marketing materials, training for EESPs, incentives, outreach to potential participants, and on-site project verification. Conversely it can be difficult to assess how cost-effective a new program strategy can be in Texas if it is absorbed into a more mature, established program or an array of programs.

B. Recommendation: Program manuals should be developed for each distinct program component.

The PY2012 EM&V discussed the importance of program manuals and recommended a program manual is developed for each program. The utilities fully responded to this recommendation. We expand this recommendation as part of the PY2014 EM&V effort to

[13] Unlike other programs that apply the program administrator cost test (PACT), the low-income sector programs are evaluated using the savings-to-investment ratio (SIR). This test excludes administrative and other overhead costs and directly compares the cost of installing the measure with estimated customer energy bill reductions.

recommend that program manuals, or other documentation of program design and delivery, should be developed for each distinct program component. This is of particular importance for these sub-programs where clear delineation of each sub-programs goals and metrics in addition to participation paths and requirements are necessary. For instance, some sub-programs have very different market actors, quality assurance/ quality control (QA/QC) requirements, eligible measures, and incentive levels. Having this information clearly described for each sub-program assists in the transparency of these distinct differences and that those variances are communicated well to a range of stakeholders.

C. Recommendation: The quality and content of both tracking data systems and supporting project documentation should be maintained at the program component level.

When sub-programs are implemented by different parties, whether internal or external to the utility, the EM&V team found variation in the level of detail of the data tracked. This limits the transparency of the tracking system data and makes it difficult to conduct efficient sampling and stratification across the broader program. The differences in tracking system contact and quality also makes program checks across the tracking system difficult. Without clear documentation of which programs contain subprograms and what the data sources are, the EM&V team encountered difficulty validating tracking data against utility-reported results.

The amount and type of project level documentation varies by end-use and measure type. When different sub-programs have very distinct measures, the project level information and documentation needs should be clearly established to support key savings inputs and assumptions for that program component.

4. PROGRAM-SPECIFIC RESULTS

This section presents results for the following programs that had additional research beyond impact evaluations in PY2014:

- Retail Electric Provider (REP) program
- The Low-income program
- The Small Business program
- The Appliance Recycling program
- The CoolSaver Program.

4.1 THE RETAIL ELECTRIC PROVIDER PROGRAM

This section summarizes the key findings and recommendations from the PY2014 evaluation of the Retail Electric Provider (REP) program

4.1.1 Background

16 TAC § 25.181 provides guidance regarding unbundled electric utilities' engagement of REPs in energy efficiency programs:

Each utility in an area in which customer choice is offered shall conduct outreach and information programs and otherwise use its best efforts to encourage and facilitate the involvement of retail electric providers as energy efficiency service companies in the delivery of energy efficiency and demand response programs. ((16 TAC § 25.181 (t))

As of PY2014, CenterPoint Energy (CenterPoint) offers the only program specifically designed to engage REPs. The EM&V team conducted a targeted process evaluation of CenterPoint's program in order to provide information that may be helpful to the Commission and utilities when considering program efforts to engage REPs.

4.1.2 Retail Electric Provider program overview

Starting in PY2012, CenterPoint introduced the concept of a "cafeteria program" to the REPs in an effort to engage them more in the company's energy efficiency portfolio through a pilot market transformation program (MTP). The pilot concept offered an open-ended menu of measures for REPs to then select measures and offerings for their customers. In 2012, two REPs participated in a residential demand response offering. In 2013, this increased to nine participating REPs.

CenterPoint designated the REP MTP a full program instead of a pilot program starting in PY2014. CenterPoint selected a program implementer for the 2014 program to recruit and support REP and contractor participants to help the program achieve its goals. 12 REPs are participating in the program. REPs were able to choose from the following menu of offerings:

- **CoolSaver A/C Tune-ups.** The initial measure, and core to the program, that is available to REPs is the CoolSaver A/C tune-up. CoolSaver utilizes specially trained

air conditioning contractors to perform comprehensive A/C tune-ups for residential and small commercial customers in CenterPoint's service territory, including providing participating contractors training on best practices and discounting field tools. In 2014, the program transitioned from a full test-in/test-out approach to a modeled savings approach in order to decrease the time required to perform a tune-up.

- **CoolSaver A/C Install.** Beginning in 2014, a limited number of REPs marketed incentives for eligible customers to replace their existing air conditioners and/or heat pumps with new high efficiency units. A/C replacements were recommended to customers that enrolled for a tune-up, but whose equipment needed replacement at the time of the tune-up. Incentives were paid to the A/C contractor for the installation of a minimum 16 SEER A/C unit.
- **Residential Energy Efficiency and Demand Response.** In addition to the CoolSaver program, REPs or other third party entities may also propose their own services or programs. Each service provider in the program is limited to a maximum of 20% of the program incentive budget, similar to rules in other CenterPoint energy efficiency programs. Currently, several third party entities have proposed methodologies to implement a residential demand response program utilizing Wi-Fi enabled programmable communicating thermostats (PCTs). Demand and energy savings must be measured and verified utilizing an appropriate baseline.
- **LED Electronic Marketplace.** Available measures were increased in 2014, adding an LED Electronic Marketplace to the menu of energy saving methods. In 2014, two REPs agreed to try the program. These REPs offer LED light bulbs online to eligible customers.

Per the program's implementation plan, 5,600 residential A/C tune-ups and 1,250 commercial A/C tune-ups were forecasted to be completed in 2014. Based on program implementer records at the end of PY2014, 4,732 residential A/C tune-ups and 1,961 commercial A/C tune-ups had been completed and invoiced.

4.1.3 Process evaluation objectives and approach

The EM&V team conducted a series of in-depth interviews:

- **Program design and delivery staff.** Interviews were completed with the utility program manager and implementation contractor staff responsible for delivering the program. The purpose of these interviews was to understand the program operations and any issues of concern in the program's implementation.
- **Participating REPs.** Interviews were completed with five participating REPs. The purpose of the participating REP interviews was to:
  - Learn about reasons for REP participation and how they heard about the program.
  - Determine if outreach to customers and contractors is sufficient to move them to participate.
  - Gauge REP perspective on program participation barriers (both for customers and contractors).

- Gauge their customers' satisfaction with the program.
- Assess program equipment offerings and rebate levels.
- Determine REP satisfaction with various aspects of the program, as well as overall.

- **Non-participating REPs.** Interviews were completed with two non-participating REPs. REPs that serve a large percent of customers were selected for these interviews. The purpose of the non-participant REP interviews was to:
  - Learn about reasons for why REPs may choose not to participate in this program.
  - Gauge REP perspective on program participation barriers (both for customers and contractors).
  - Assess program equipment offerings and rebate levels.
- **Contractors.** Interviews were completed with 12 participating CoolSaver contractors. The purpose of these interviews was to:
  - Determine contractor business and customer base.
  - Assess contractor involvement, program training, and communication.
  - Gauge contractor interactions with customers and the factors driving customer decision-making processes, including barriers to participation.
  - Solicit contractors' thoughts on program improvement.

4.1.4 Results summary

In general, the process evaluation found that the REP program is being implemented effectively from the perspective of both participating REPs and contractors, particularly the CoolSaver program component which was the primary focus of the process evaluation. Both REPs and contractors gave the program implementer high satisfaction ratings overall and reported high satisfaction with various aspects of the program. From a participating REP perspective, the only challenge with the initial engagement process was confusion regarding the marketing and branding of the program to customers, but this was a start-up issue that was resolved.

Most REPs are offering the tune-ups free to their customers as either a loyalty bonus for existing customers or as an acquisition incentive for new customers. Because the REPs have a limited number of tune-ups allocated to them, they are selective in how the tune-ups are marketed and disbursed. Additionally, many of the REPs cross utility service territories, and since the tune-ups can only be offered to CenterPoint customers, this also limits marketing efforts.

The two REPs that the EM&V team spoke with who do not participate in the program mentioned concerns about the scalability and longevity of the program. In addition, they had concerns regarding brand recognition and wanting to maintain the direct relationship with their customers. Finally they also reported challenges with competing activities that they already offer to their customers such as pre-paid meters.

Contractors reported they are participating in the program primarily to increase their business opportunities and gain more customers. Almost all contractors said the market in Texas is

ripe for tune-ups—contractors used words like "*spectacular*," "*big*," and "*very busy*." Contractors generally said they think customers have become more educated about why they should have their A/C systems maintained, so it is easier to get customers to participate now. A few contractors mentioned the weather conditions in Texas as a reason why the tune-up market is robust—"*it's so hot, people do not want to do without*."

4.1.5 Key findings

Next, the process evaluation key findings are summarized, largely as they are related to the A/C tune-up component of the REP program, in the following key areas:

- How participants became involved and reasons for participation
- Program marketing, communications, and participation barriers
- Assessment of program equipment offerings and rebate levels
- Program satisfaction.

A. How participants became involved and reasons for participation

i. Retail electric providers

All of the REPs that were interviewed said they have been participating in the program for the past couple of years, and that the process for participation works well. Comments from participating REPs included:

> *"Almost too good to be true. Very impressed."*
>
> *"There shouldn't be a reason a REP would not want to participate."*

For a couple of the REPs, including the two non-participating ones, one of the main hurdles for participation was branding. That is, working with program implementer to be sure the REP corporate communications protocols were being followed and program materials were properly represented. Additionally, because of the seamless nature of the CoolSaver program from the REP perspective, REPs wanted to be sure communication channels to their customers were appropriately documented.

Participating REPs decided to engage with the CoolSaver component of the REP Pilot program for a variety of reasons, as reflected in Table 4-1. As depicted, most REPs want to be able to help their customers become more energy efficient and provide customers an opportunity to lower their utility bills. For many, the simple and seamless nature of the implementation made their participation a "*no brainer*."

Table 4-1. Reasons for REP Program Participation

Reason	Number
Want to provide some kind of "loyalty" bonus	3
Good offer to REP customers/ help our customers become more energy efficient	2
Initially thought it was a requirement to participate	1

NOTE: Respondents could provide more than one answer.

When discussing reasons for not participating with the two non-participating REPs, a number of reasons were described, including:

- *Scalability/longevity*. Non-participating REPs were concerned about the longevity of program funding. Given the annual planning cycle of the energy efficiency programs, they had concerns that the program would not have consistency. Similarly, one of the non-participating REPs mentioned concern about the "*first come, first serve model*"– specifically that energy service companies (ESCOs) tend to get involved fast in the program and then it is fully subscribed.
- *Suitability.* One of the non-participating REPs noted that energy efficiency program implementation is "*better suited*" for the regulated utilities rather than the competitive REP market. This REP said that "*utilities are in a better place to promote energy efficiency programs due to the nature of the Texas market*."
- *Brand image*. One of the non-participating REPs mentioned that brand recognition and image is very important to them. Both non-participating REPs said they want to have the direct relationship with their customers and they want to control their customer's experience. The non-participating REPs felt the current REP program design does not allow the REP to have the direct customer relationship.
- *Priorities*. One of the non-participating REPs mentioned priorities; they recently spent a fair amount of money to build a specialized energy offering and thus did not have budget left to participate in the REP program.
- *Staffing*. Both non-participant REPs mentioned some challenges with staff turnover. When decision makers move, the learning process has to start over.

ii. Contractors

Most of the interviewed CoolSaver contractors have been providing A/C services in Texas for 20 years or more. A couple of the contractors are newer to the field, having been in the business three or four years. Contractors report having installed a minimal number of A/C units for residential clients that were 16 SEER or higher over the past 12 months, indicating the equipment incentive is pushing the market.

The majority of contractors have only been participating in the CoolSaver program for one year or less; only one contractor we talked to had been participating over one year. Contractors are a primary source of how the interviewees learned about the program (mentioned by four contractors). Other sources of program awareness included A/C manufacturers (1), Air Conditioning Contractors of America (1), and another branch of their company (1).

Contractors decided to participate in the program for various reasons. As reflected in Table 4-2, just under half of the contractors decided to participate in the program to increase their business opportunities and gain more customers.

Table 4-2. Reasons for Contractor Program Participation

Reason	Number
Increase business opportunities/gain customers	5
Like the training provided/good way to conduct tune-ups	4
Customer retention	2

NOTE: Respondents could provide more than one answer

When asked why they think customers choose to participate in the program, most contractors said because the service is free. In a few cases, contractors believe the customer understood the benefits of having their A/C system tuned up and/or they are looking for a utility bill savings (and understood they were getting a very good deal for the service).

None of the contractors we spoke with participate in other utility energy efficiency programs, though a couple of them were in interested in learning what other opportunities may exist. This is also an interesting finding as the program appears to be reaching new contractors in Texas and helping build that infrastructure.

B. Program marketing and customer participation barriers

i. Retail electric providers

For the CoolSaver component of the program, there are two levels of marketing and outreach—one is to contractors and the other is to end-use customers. The program implementer is responsible for recruiting and training contractors; the REPs do not engage at this level at all. However, the REPs are responsible for marketing the tune-ups to end use customers. In this realm, REPs largely rely on email communication. One REP tried marketing the tune-ups through their call center, but mentioned that was “tricky” because if a customer was interested in participating then the call center representative had to direct the customer to a different phone number (as all sign-ups are handled by the program implementer).

Because REPs cover service territories in addition to CenterPoint’s, all mentioned they have to be sure to only offer the tune-up service to those that are in CenterPoint’s service territory. For this reason, many of the REPs leverage the tune-up service as a customer “bonus”—either as a customer retention bonus or as a customer acquisition “thank you.” One REP is more selective, and offers the tune-ups to their highly valued customers. Another REP mentioned they use the tune-up service, at least in part, for customer escalation issues.

Another key component to the REP marketing strategy is the number of tune-ups they are allocated each year. If the allocation is on the smaller side, REPs mentioned that to do any kind of marketing campaign or “push” of information is not feasible. They do not want to run the risk of over-subscription that would then lead to customer dissatisfaction with them. In a couple of cases, where it looked as though goals may not get met, REPs did directly market via email to select customers.

REPs mentioned that from their perspective, there are few barriers for customers to participate in the CoolSaver program. One REP mentioned there were some issues with contractors related to waiting periods in the first year they participated, but that it was "*much better this year*." Other theories for why customers may not participate in the CoolSaver component of the program are outlined in Table 4-3, below.

Table 4-3. Customer Participation Barriers (REP Perspective)

Barrier	Number
"Free" offering/too good to be true	3
Time commitment for the tune-up itself	1
Having a stranger in the home	1
Just finding the time for the contractor to conduct the tune-up	1

NOTE: Respondents could provide more than one answer.

ii. Contractors

When asked about program marketing and outreach activities, a small number of contractors said they actually were not really sure how the program has been marketed. Two contractors seemed pretty well-versed in how the program was marketed. One contractor expressed concerns about offering tune-ups when the equipment was not in good enough condition.

The EM&V team asked participating contractors questions about the CoolSaver program's A/C tune-up requirements and their practices. Almost all contractors said the CoolSaver program's A/C tune-up requirements are more involved than their standard tune-up offering. Representative contractor comments included:

> *"We don't do as many tests."*
>
> *"It is definitely enhanced. A standard tune-up for one of our techs may take about an hour. CoolSaver program tune-ups take more like an hour and a half. There is a lot more testing and lot more information taken. We would charge $69–89 for a regular tune-up, they were providing a $150 per system. The program tune-up is advantageous to us and to our customer."*
>
> *"CoolSaver is way, way more involved. It is a very detailed tune-up, but it's good. One is getting a lot of data, but I understand why they need that. Takes a lot of time to do that. A normal A/C tune-up is really just checking it out and the homeowner paying for different things."*
>
> *"It's what a tune-up should be but the problem is there are companies out there advertising A/C inspections for $49, and we all know they aren't going to do nothing for that. They are just sending out the truck, looking for something more to sell."*
>
> *"The CoolSaver is more detailed. Our standard, pretty much the industry standard, doesn't ever include cleaning the equipment. You won't hardly find a company that goes out and does what the CoolSaver program does. Cleans the evaporator coils, condenser coils and boiler wheel. Those are the requirements on the CoolSaver program for us to clean. If we charge a customer $79, to do a spring cooler checkup, we don't clean anything, there's an extra charge for that."*

About half of the contractors said there are situations where they perform tune-ups that meet the CoolSaver program standard but they either charge the customer their tune-up rate or do not submit the project through the program for an incentive due to the paperwork. Related contractor comments included:

> *"Yeah, there are times that we do that, majority of ours we do not submit. A majority of them came from [REP program implementer]. We did submit, we just didn't submit any of our own. But none of our customers were looking for rebate. We could have brought tens of thousands of people into the program if we wanted to, but we never did. Kind of felt like it was double dipping in the program and no clear direction we could do this, so we never did it. Just did those that they referred to us."*
>
> *"Yes, that did happen. Actually, with the few we did, we didn't really do a high percent of calls as we were inundated as the summer started coming on; unusually busy year. I can't recall doing anything beyond the check-ups."*
>
> *"Yes, there were times. Sometimes. Customers did not want the service (beyond cleaning) and it needs to be replaced. Would have been impossible to get correct readings. The equipment was not functioning properly. Some couldn't afford it and some didn't want to do it. It wasn't broke so they didn't want to fix."*

All contractors said they believe their customers are receiving good value from this service:

> *"Absolutely. I think the whole process is great. Most companies do not go to that extent to do that kind of work. Most companies have never been trained that way. They kick the tires and run and take advantage of customers. The program is good, the customers we are getting is not."*
>
> *"Absolutely. I believe in the tune-up program in general and any time we can do a tune up, it benefits the customer."*
>
> *"Absolutely. I'm not even sure if the customer had to pay anything for the tune-up."*

C. Assessment of program equipment offerings and rebate levels

i. Retail electric providers

Participating REPs were asked if they noticed any program design changes since they started participating. One REP mentioned that they noticed a number of improvements between the first year they participated and the second year they participated. For example, the REP started receiving more information from the program implementer about the CoolSaver process, number of completes, the status of contractors, etc.

When probed for this question about program design changes related to additional offerings, all of the REPs mentioned that they recall having discussions about some of the new offerings (e.g., the LED Online Marketplace and residential demand response), and two of the REPs said they are participating in the LED Online Marketplace, but in a "*soft launch*" capacity, with no risk. One of the REPs participating in the LED Online Marketplace mentioned it is going well so far, but that they had to update their website to address the service territory challenge—the product offering is only available to their CenterPoint customers, and initially all of their customers could see the offering on the website. Two REPs

mentioned they would like more information about the residential demand response component.

All of the REPs said that equipment/ service incentives are set appropriately. Though one REP did mention that given some of the skepticism around the free tune-up service, it might interesting to see what happens if customers were charged $20 for the service. Other REP comments included:

> *"Free is still the way to go."*
>
> *"Keeping it simple is key."*

ii. Contractors

Most contractors said the A/C tune-up and equipment incentives could be more. Only one contractor said they think the incentives were appropriate. Contractors said that because of the extensive requirements, the amount of incentive received to conduct the tune-up is break-even at best. In some cases, contractors are only training their best technicians to conduct the CoolSaver program tune-ups, to be sure they are done in an acceptable amount of time. Contractors said they continue to do the program tune-ups to gain customers for future work (e.g., A/C replacement) even though they are not profitable for them.

D. Satisfaction

i. Retail electric providers

REPs were asked to gauge the level of customer satisfaction with the various aspects of the program (participation process, program application, measure performance, instant discount on service provided, etc.). However, due to the fact that the customer receives an instant discount on the cost of the tune-up service, and that the incentive is paid directly to contractors for completing tune-ups, none of the REPs had a good sense of customer satisfaction. Many of the REPs mentioned that the only feedback they receive is when a customer calls to complain, which happens infrequently. One REP mentioned that they have confidence the program managers are doing a good job and the program is delivering a valuable service to their customers. Two REPs mentioned they have received no customer complaints.

The EM&V team asked participating REPs to rate their overall experience with the REP program on a scale of 1 to 10, where 1 is "unacceptable" and 10 is "outstanding." As reflected below, the program received high ratings from all REPs.

Table 4-4. Overall Program Experience Rating (REPs)

Rating Level	Number
Outstanding (10)	1
9	3
8	1

Additionally, using the same 1 to 10 scale, four of the five REPs rated the level of communication with program implementation staff as 10; one rated their level of communication with program implementation staff as 9.

ii. Contractors

The EM&V team asked participating contractors to rate their overall experience with the CoolSaver program on a scale of 1 to 10, where 1 is "unacceptable" and 10 is "outstanding." As reflected below, the program received high ratings from all REPs, with an average rating was 8.1.

Table 4-5. Overall Program Experience Rating (Contractors)

Rating Level	Number
Outstanding (10)	4
9	2
8	1
1–7	5

Additionally, the EM&V team asked participating contractors to rate various aspects of the CoolSaver program, using a 1 to 10 scale, where 1 is "not at all satisfied" and 10 is "very satisfied." Results are presented in Table 4-6, below, and ranked from the highest average satisfaction rating to the lowest.

Table 4-6. Satisfaction Ratings

Program Aspect	Average Rating	Number Answering
The level of communication with program staff	9.3	12
Contractor training	9.1	11
Timeliness of rebate payment to contractors	8.7	12
Marketing and outreach to contractors	8.3	8
Marketing and outreach to customers	8.0	9

As reflected in the high average rating, all contractors provided positive comments when asked about their interactions with program staff. Contractor comments included:

> *"Those guys were here doing a massive amount of training, very involved, spectacular group of people."*

"They were very easy to work with. We got overwhelmed, but anytime we had to talk with them, they were very helpful and understanding."

"They were very involved. We had at least three times that CoolSaver personnel actually attended our team meetings and explained things, and I spent a lot of time on the phone in webinars with the staff as far as data entry. They were extremely helpful."

"They are really helpful. The ones that are in charge of it and the ones that work with us. I think they do a real good job."

4.1.6 Conclusion

In summary, the process evaluation indicates that the REP program is working effectively. Both REPs and contractors report high satisfaction with the CoolSaver program and feel the tune-up measure in particular is providing a good value to customers. The results indicate it is most likely feasible to offer similar services working with REPs to customers beyond CenterPoint's service territory. However, at the same time, the results also indicate that while participating in an energy efficiency program may be attractive to some REPs, other REPs may not be interested in participating in a program.

4.2 THE LOW INCOME PROGRAM

This section summarizes the key findings and recommendations from the PY2014 evaluation of the Low Income program

4.2.1 Background

The percentage of Texas' population at or below the federal poverty level is higher than the national average. About 17.6 percent of Texas' population is below the poverty level, compared with a national average of 15.4 percent. Some highly urban areas—such as Houston and Dallas—see a high concentration of individuals in poverty (23 percent and 24 percent, respectively)[14].

Households with incomes at or below 200 percent of the Federal Poverty Level are eligible to receive low-income weatherization assistance through the Department of Energy (DOE) Weatherization Assistance Program (WAP), administered through the Texas Department of Housing and Community Affairs (TDHCA). Local Community Action Agencies (also referred to as subrecipients by TDHCA) provide the weatherization services to qualifying households, including the initial audit.

In 2014, DOE administered $4,284,475 in WAP funds to the state of Texas[15]. This value represents the 13th highest allocation in the United States. However, when reviewing the funding provided against the number of households in poverty, Texas receives significantly fewer dollars per impoverished household than the majority of states. This lower allocation is primarily an issue for warmer climate states (e.g., California, Georgia, Florida, and Nevada in addition to Texas) as federal allocations take heating degree days into consideration in the

[14] http://quickfacts.census.gov/qfd/index.html.
[15] http://waptac.org/data/files/Website_docs/Government/Guidance/2014/WPN-14-2.pdf.

formula. Therefore, there is a particular need to continue to help these customers through other funding sources.

In an effort to further help low-income electric customers improve the efficiency of their residences, the Texas legislature ruled that ERCOT utilities include a targeted energy efficiency program in their energy efficiency plans (PURA § 39.905(f)). Specifically, the ERCOT utilities are now required to set aside a minimum of 10 percent (previous legislation set the minimum set aside at 5 percent) of their energy efficiency budget for low-income programs[16] (hereafter generally referred to as Targeted Low Income Energy Efficiency Program, or low income program). The 10 percent set-aside allocation intends to ensure this hard-to-reach segment of the population is receiving appropriate funding.

4.2.2 Overview of the Low Income programs

As outlined in PURA § 39.905(f)), the utility-sponsored low income programs are to coordinate with the federal weatherization program, including complying with the same audit requirements. Therefore, all single family homes served through the low income programs are to be evaluated using the National Energy Audit Tool (NEAT). NEAT is designed to determine the most cost-effective retrofit measures for single-family and small multifamily buildings. NEAT uses each home's historic energy use data to prioritize measures for installation. Program and project cost-effectiveness is measured using the Savings-to-investment Ratio (SIR), which is consistent with DOE requirements. Therefore, the low income programs are required to pass the SIR test rather than the traditional utility cost test that the energy efficiency programs are required to pass.

The programs serve a combination of single family and multifamily units. The utilities generally contract with an implementation organization to help run their programs. Frontier and Associates (Frontier) works with four of the six ERCOT utilities to manage their low income programs. AEP TNC and Oncor contract with the Texas Association for Community Action Agencies (TACAA).

Utilities' implementers reach out to and contract with community organizations (including non-profits and religious affiliations) to provide utility weatherization services. Agencies may also provide services through the DOE WAP and the Low Income Home Energy Assistance Program (LIHEAP), although participation in those federal programs is not a requirement for engaging in the utility low income programs. Leveraging organizations that do not provide weatherization services, as well as those that do, is intended to expand the program's reach to low-income customers.

Utilities pay up to $6,500 per unit through the low income programs. Households that are served by agencies that also participate in DOE WAP can receive an additional $6,500 in benefits. A percentage of LIHEAP funds are also committed to weatherization, which can increase the per home weatherization funding even further.

[16] Increased costs to low-income energy efficiency program attributable to the 10% floor in PURA § 39.905(f).

4.2.3 Process evaluation objectives and approach

The implementation of the low-income programs pose several issues for utilities, which were investigated in this process evaluation. First, they traditionally have difficulty being cost-effective; in fact, some non-ERCOT utilities who are not required to have low income programs have removed low-income programs from their portfolio due in part to the cost-effectiveness issues. These utilities are instead serving the low-income population through their hard-to-reach programs that are delivered as Standard Offer Programs (SOPs). Second, several stakeholders voiced concerns about effectively serving this market while staying under the administrative cost caps, especially with the recent increase in the minimum required expenditure on low income programs from 5 percent to 10 percent. Last, there was concern voiced on whether the utilities can expend the 10 percent allocated to low-income programs, especially cost-effectively.

The EM&V team completed three activities as part of this process assessment:

1. Interviewed program managers responsible for implementing low-income programs. Specifically, the EM&V team interviewed staff from AEP TCC, AEP TNC, CenterPoint, Oncor, Sharyland, and TNMP. Frontier, who is implementing the program for a number of utilities, also participated in the interviews. The purpose of the interviews was to understand the program operations and any issues of concern to the utility related to goals, spending, etc.

2. Interviewed a sample of community action agencies that participate in the utility-run Targeted Low Income Energy Efficiency programs. The purpose of the community action agency interviews was to further understand the processes and procedures for coordinating with the utilities and any issues that may affect meeting goals. The interview also probed on funding levels and ability to reach a geographically and demographically diverse group. Last, the interviews assessed the impact the utility program has on their business.

   In total, the EM&V team spoke with 12 community action agencies. The interviewed agencies spanned across all ERCOT utilities and ranged in level of weatherization activity (from as few as under 50 to as many as over 600 units serviced in 2014). Approximately half of the agencies participate in the utility program only, while another half also receive DOE WAP and LIHEAP funds.

3. Completed an analysis of 2013 actual and 2014 projected spend and savings for each ERCOT utility. This analysis is based on data provided in the utilities' Energy Efficiency Plan and Report (EEPR) from April 1, 2014.

4.2.4 Results summary

In general, the process evaluation found that the Targeted Low Income Energy Efficiency programs are having an impact on Texas' low-income communities, both in terms of number of homes served as well as comprehensiveness of service. Agencies also had high regard for the utilities, their implementers, and the program in general. Last, agencies felt they were sufficiently staffed to handle the allocated funding.

Agencies felt they were doing what they needed to reach a diverse group of low-income customers, both demographically and geographically. CenterPoint's Agencies in Action (AIA)

program was the only one that specifically targeted the multifamily sector; other programs did work with multifamily units, but did not have as concerted an effort as AIA.

The one point of concern raised by some of the utilities as well as community action agencies related to the NEAT tool. As noted above, legislative statute requires that the program comply with the same audit requirements as the federal weatherization program. The NEAT audit, as a modeling tool, is not transparent; therefore, agencies and implementers have difficulty understanding why certain measures do and do not qualify in various homes. Additionally, they reported it is a cumbersome tool to use and is administratively burdensome. Due to the NEAT audit requirement, an implementer (as well as several agencies) reported that training goes into working with agencies who do not work with the DOE program. Last, there was concern that equipment that should be replaced are not prioritized by the tool (e.g., central air conditioning). Several agencies speculated that this was because the tool is set up for colder climate regions and does not recognize the unique issues associated with warmer states such as Texas.

4.2.5 Key findings

The remainder of this memo summarizes the process evaluation key findings. Specifically, we discuss the findings by the following key researchable issues:

- Coordination of low income programs with the Hard-to-reach (HTR) SOP program
- Funding levels
- Program impact on homes served and agency operations
- Administrative processes and NEAT audit tool
- Diversity of population serviced.

A. Coordination of the low income programs with the Hard-to-reach (HTR) SOP

One research question of interest was how the targeted low-income program is coordinating with the HTR SOPs. These programs have very different program designs and delivery; the Targeted Low-income Program is administered through the community action agencies and comprehensively addresses a building's needs at no cost to the recipient. On the other hand, HTR SOP participants are engaged through Energy Efficiency Service Professionals (EESPs) and receive rebates for program qualifying measures. There is some overlap between the measures provided through the Targeted Low Income and HTR SOP programs, although the customer contribution level varies; there is no cost to Targeted Low Income participants, whereas the HTR SOP participants receive an incentive for their purchase (at a higher level than offered through the standard residential SOP).

The HTR SOP and Targeted Low Income Energy Efficiency programs service the same customers; therefore, there is the potential that a household may attempt to participate in both programs, and potentially receive the same measures or funding through both. The utilities and their implementers mitigate against this issue by flagging customers that submit applications under both programs. The system looks as far back as ten years. The utility program manager reviews all households that are flagged as being prior participants and has the opportunity to manually approve the services requested. None of the utilities interviewed

thought offering two programs targeting the same low-income population posed any problems or issues.

Table 4-7 documents, by utility, the average cost per kWh, then average cost per kW, for the low income programs and HTR SOP programs. With the exception of Sharyland, the analysis is based on the actual expenditures and savings reported in utilities' EEPRS from 2013. No data was available for Sharyland; therefore, the 2014 projections were used for this analysis.

Table 4-7. Cost per kWh and kW for Low Income programs and HTR SOPs

Utility	Cost per kWh		Cost per kW	
	Low Income Program	HTR SOP	Low Income Program	HTR SOP
AEP TCC	$1.38	$0.26	$2,641	$629
AEP TNC	$1.30	$0.32	$5,245	$875
CenterPoint	$1.17	$0.39	$1,404	$738
TNMP	$1.04	$0.39	$1,762	$930
Oncor	$2.10	$0.28	$5,899	$1,179
Sharyland	$1.63	$0.40	$2,523	$740

Not surprisingly, the cost for energy (kWh) and demand (kW) savings is less expensive through the HTR SOP than the Targeted Low Income Energy Efficiency programs. Although this analysis is not conclusive in what is driving the cost differential, this may be because the low income program benefits are more comprehensive than what is provided through the HTR SOP. Another part of the explanation may also be the delivery of HTR SOP through the EESPs, similar to the RSOPs.

In addition, there is variability in cost per kWh and kW by utility. The cost per kWh for low income program ranges from $1.04 to $2.10 and the cost per kW ranges from $1,404 to $5,899. The cost per kWh for HTR SOP ranges from $0.26 to $0.40 and the cost per kW ranges from $629 to $1,179.

CenterPoint's AIA program exhibits a marginally lower cost per kWh and kW than most utilities, which may be a result of the program's primary emphasis on multi-family dwellings. Agencies reported that they believe serving multifamily units are more cost-effective than single-family homes. The reasons reported for this are less travel is incurred and there is not a NEAT audit requirement for multifamily.

B. Funding levels

The interviews probed both utilities as well as community action agencies on the level of funding required of and provided for the low income program. Specifically, the interviews asked (1) utilities if they had any concerns about the level of funding legislatively required to be committed to serving the low-income population through programs, (2) agencies if they had any concerns expending the funds allocated to them, and (3) both utilities and agencies if they would have any concerns should the funding levels and goals increase in the future.

Neither the utilities nor the agencies voiced any concerns about being able to spend the 10 percent allocation directed to low-income customers. Nor did either party feel they would have any issues spending funds should energy efficiency budgets increase, also resulting in an overall increase in the amount of funds allocated to low income programs. Both groups expressed the considerable need in their communities and did not feel there would be an issue with expending additional funds.

Several utilities commented on the cost-effectiveness of the program, and the fact that regardless of funding levels the program is not cost-effective under standard cost-effectiveness tests used for Texas' energy efficiency programs (program administrator cost test or PACT). Therefore, the concern raised was whether it would have an impact on portfolio performance, even though the low-income programs are evaluated under a separate cost test (savings-to-investment ratio test). This was also raised as a concern by utilities as part of the PY2012 EM&V cost-effective testing. In response, the EM&V team has calculated the overall cost-effectiveness of each utility's portfolio based on the program administrator cost test both including and excluding low income programs. The EM&V team's PACT PY2012 and PY2013 cost-effectiveness results of the utilities' portfolios both with and without low income program does confirm this report that the low income programs do decrease overall portfolio cost-effectiveness.

C. Program impact on operations

As noted above, about half of community action agencies interviewed provide services through both the utility as well as the federal DOE programs. The utility primarily provides another source of funding to these agencies; therefore, it was interesting to identify, per these agencies, the impact the program has on the community and program operations. Specifically, we probed on three areas—(1) number of homes serviced, (2) number of measures installed per home, and (3) staffing and resources.

Most agencies that leverage multiple funding sources felt that the utility program definitely had a considerable impact on their operations. Although they mostly said they were able to weatherize more homes due to the programs' funds, the most notable impact was the types and number of measures they are able to install in each home. Multiple agencies noted that the utility funding oftentimes is used primarily for efficiency measures, which means they can use other funding (such as DOE WAP and LIHEAP funds) for more health and safety or remediation activities. Doing so allows them to more comprehensively treat a home. Several agencies who only use utility funds to weatherize homes further reinforced this point by stating they felt that just by providing measures that are cost-effective does not ensure the effectiveness of the services; HVAC measures are not as effective in a home that needs remediation or could benefit from air sealing or other infiltration services. Therefore, the agencies saw considerable benefit from the utilities' funds.

In regards to staffing, most agencies interviewed did not necessarily feel that the utility program allowed them to increase their staffing. Many of these agencies initially staffed up as a result of the American Reinvestment and Recovery Act (ARRA), which funneled considerable funds to the agencies for weatherization services. They then needed to ramp down once that funding was depleted. The utility funds, which are considerably lower than what was provided via ARRA, are not seen as an impetus to increased staffing.

D. Administrative processes and NEAT audit tool

Utilities contract with an implementer, who then contracts with the agencies. The agencies provide weatherization services following DOE guidance. This includes completing a NEAT audit, followed by installation of measures prioritized via the NEAT audit. Agencies are reimbursed for the measures installed and receive an administrative fee equaling eight percent of the cost of measures installed. They also receive a set fee for completing the audit itself.

Once the audit is complete, agencies enter the information for the anticipated work into a system housed by the implementation contractor. The contractor then pays the cost of the measures in advance of the work being complete. Doing so is advantageous for the utilities primarily because they can then stay ahead of their contractors' payments instead of waiting the lag time between reporting and payment.

Agencies generally felt the administrative fees they received were sufficient for the work they did, although a number of agencies did note that they NEAT audit requirements are more burdensome than is perhaps recognized via the administrative payment. These agencies saw a number of issues related to the NEAT audit, one of which was the amount of information and level of reporting required of the audit. They felt that the information they are required to obtain is not necessarily critical for informing cost-effective measures (e.g., window sizes) and administratively burdensome.

Individuals from all groups interviewed also mentioned what they perceive to be flaws with the NEAT audit tool. These include:

- Not prioritizing measures that they feel should be prioritized in a home. The reason for these measures not being prioritized, even if they are close to their effective useful life or the condition is not optimal, is not usually clear due to the tool's lack of transparency. A number of interviewees also believe that the tool is developed for northern climates; it does not prioritize warmer climate measures (e.g., central air conditioners) to the extent they believe it should.
- Deeming the project not cost-effective based on data that may not be an accurate reflection of actual energy use. The one example provided by an agency was where the home was disconnected, and because the modeling tool uses the prior year's energy usage it inaccurately characterized the project's cost-effectiveness.
- Increasing administrative burden incurred by using the tool, including the time to capture the information required and uploading the information into the utilities' implementer's system. Several agencies stated the NEAT tool's inability to immediately upload audit results via cellular connections (e.g., using an iPad or other tablet device) increased their administrative burden.
- Requiring increased training time, especially with agencies that are not participating in the federal WAP program. Agencies that do not participate in the federal WAP program require additional training on the NEAT tool, and/or hire additional contractors to complete the NEAT audit rather than providing the audit themselves.
- There is a disconnect between the projected savings determined by the NEAT audit tool and the Texas TRM. The utilities and implementer (Frontier in particular) abide by the Texas TRM savings values. Because the NEAT audit is a model, it determines

savings independently of Texas-specific savings developed by Frontier and the EM&V team. This lends itself to a disconnect in savings values between measures that are installed through both the low income and other Residential SOP programs.

Many agency interviewees who were with the program as few as five years ago recollected the prior system where they would enter measure-level data in Frontier's system and determined prioritized measures through that deemed approach. They talked about the transparency of the process, and even the ease it had on the customer since they were able to determine more quickly what could be installed and communicate that in real-time. Several agencies even discussed using iPads to enter the data while on site and the belief that the system made the process more efficient and eliminated data entry errors.

Of all processes discussed related to this program, the NEAT audit tool was the primary source of concern. And it was voiced by all groups of individuals – utilities, implementers, agencies that provide services through DOE WAP, and agencies that only provide services through the utility program.

E. Diversity of population served

The interviews probed utilities and agencies on whether they felt they were serving a sufficiently diverse group of individuals—and those most in need. Diversity can be defined as diverse demographics, as well as geographic diversity.

All interviewees felt that they were reaching customers most in need. They discussed the prioritization process (prioritizing those that are vulnerable—elderly, households with children, and disabled), as well as the fact that they were serving households that were well within the income requirements.

Most agencies also discussed the fact that they attempt to reach out to a diverse group of individuals across the geographies they served. One agency specifically explained that they allocate funds across counties proportionate to the counties' rate of poverty, so those counties that have higher poverty weatherize more homes.

Funding needs to be sufficient to be able to have a broader reach. Smaller utilities who receive less funding (e.g., Sharyland) can only do so much to reach a geographically diverse group. Because the funding is set at a percentage of portfolio-level budgets, the amount of funding (and number of homes they can serve) tends to be limited for these smaller utilities.

Another area discussed was the proportion of single family versus multifamily homes served. In 2014, CenterPoint's AIA program focused considerably on multifamily homes. Most other programs service more single family than multifamily homes.

Houston, which is the largest city served by CenterPoint, has a high multifamily population; nearly half (48 percent) of the housing units are in a multifamily structure, compared with Texas' state average of 24 percent.[17] Therefore, it is not surprising that CenterPoint's program focused on the multifamily sector in 2014, and several agencies believe will continue to focus on that sector moving into 2015.

[17] http://quickfacts.census.gov/qfd/index.html.

Dallas, which is served by Oncor, also has a high concentration of multifamily units (50 percent). Although agencies that work with Oncor customers noted delivering services to multifamily customers, it was not as concerted an effort as AIA. It also was not noted as a specific need by those interviewed.

4.2.6 Conclusion

In summary, the process evaluation indicates that the ERCOT utilities are effectively utilizing the existing agency infrastructure in Texas to deliver the low income programs. The agencies report high satisfaction with the utility low income programs and feel they are serving a good cross-section of low-income customers that are in need of the program services. Information gathered through the process evaluation may also be helpful to policy makers when considering future program strategies and delivery mechanisms for the low-income population.

4.3 THE SMALL BUSINESS PROGRAM

This section summarizes the key findings and recommendations from the PY2014 evaluation of the Small Business program

4.3.1 Introduction

The Open programs are available to nonresidential electric customers whose maximum peak demand does not exceed 100 kW at any single facility within a service territory. The program offers customers facility assessments that identify energy saving opportunities at no cost, recommendations and estimates of energy savings, project costs, and payback periods. The program also connects customers with pre-qualified contractors capable of installing approved energy saving equipment. Incentives are paid directly to the contractor for installation eligible measures, while customers realize an ongoing reduction in energy costs.

Five utilities were included in the PY2014 evaluation effort: AEP TCC, AEP TNC, Oncor, SWEPCO and TNMP. El Paso Electric's Small Commercial Solutions program was not included in this iteration of study, as it was evaluated as part of the Program Year 2013 (PY2013) evaluation since it had been operational for a number of years.[18] The other utilities' programs were new in PY2013 and therefore the participant research was delayed until PY2014 to allow time for the programs to roll out prior to the evaluation research.

The survey asked participants a series of questions to estimate free-ridership to inform a net-to-gross (NTG) estimate for the program. Respondents were not asked questions related to potential spillover—given the fact these programs are still relatively new in these utilities' territories and we spoke to participants shortly after project implementation. Therefore, spillover is unlikely to have occurred in quantifiable amounts. In addition, the survey asked targeted process questions.

[18] *Interim Net-to-gross (NTG) Results (Final)* to Katie Rich and Therese Harris, PUCT, from the EM&V Team, June 2, 2014.

4.3.2 Key findings

Key findings from the survey are as follows:

- The Small Business Program has high program attribution—in other words, the majority of the program energy and demand savings are resulting due to the program intervention. A majority of the participants said they would not have purchased or installed their energy efficient measures had the program services not been available. Based on the PY2013 and PY2014 NTG results across the six utilities offering a small business program, as well as benchmarking research of NTG ratios of similar programs throughout the country, the EM&V team recommends a NTG ratio for small business programs at 90 percent in Texas. The EM&V team will use the recommended NTG ratio in calculating program cost-effectiveness based on net savings.
- Respondents were motivated to do a lighting project to reduce costs, followed by the desire to save energy. Almost 65 percent of respondents stated the impetus for their project was reducing costs. Other popular reasons included wanting to save energy/be more energy efficient (45 percent), wanting new, more updated equipment (22 percent), and replacing older/poorly functioning equipment (18 percent).
- Respondents were most motivated to participate in the program due to the financial incentive and project payback, followed by the technical assistance and information provided. Respondents were asked to rate the importance of various factors that may have influenced their decision to participate in the program on a 10-point scale (0=not at all important, 10=very important). Financial factors were most important to survey respondents, with the availability of the markdown/financial assistance receiving an average score of 9.0 and payback on investment receiving an average score of 8.8. Information and recommendations provided to customers by their EESP was also rated highly by participants, receiving an average score of 8.4.
- Participants are highly satisfied with the program and are referring others to the program. Almost all participants rate their satisfaction with the program as an 8 or higher on a 10-point scale (0=very dissatisfied, 10=very satisfied). Two-thirds of participants reported recommending the program to others.
- Participants are primarily learning about the program through the program implementer, followed by contractors. Approximately half of the participants learned about the program through the implementer with another 20 percent hearing about the program through contractors. The utility, business contacts or word-of-mouth all accounted for approximately another 10 percent of awareness.

The remainder of this memo details the study methodology and results from the PY2014 research.

4.3.3 Study methodology

The EM&V team conducted telephone interviews with customers that participated in Open during PY2014. Overall, the team completed 74 interviews across five utilities that offer the program in PY2014, as shown in Table 4-8.

Table 4-8. Survey Statistics by Utility

Utility	Completed Surveys	Adjusted Sample[19]	Response Rate
AEP TCC	11	75	14.7%
AEP TNC	17	61	27.9%
Oncor	13	86	15.1%
SWEPCO	17	51	33.3%
TNMP	16	70	22.9%
Total	**74**	**343**	**21.6%**

A. Overarching net-to-gross approach

The EM&V team used a self-report approach (SRA) via customer surveys to calculate free-ridership rates. Spillover is typically realized after several years of program existence. Due to the fact the Open MTPs are still relatively new and surveys were conducted shortly after project implementation, the survey effort did not attempt to estimate spillover. The reader is referred to the PY2012–PY2013 EM&V Plan Appendix B, updated January 23, 2014, which provides more detail on the NTG approach, including an overview of the survey questions and analysis methodology.[20]

When using the SRA approach, the final NTG ratio is calculated using the following formula. The ratio can be applied to the population to determine the final net savings value.

NTG Ratio = 1 – (Free-ridership Rate) + (Spillover)

B. Sampling and survey approach

Open had 403 unique participants[21] through Q3 of PY2014. The EM&V team estimated a response rate of 25 percent and drew a corresponding sample of 283 records to contact. The remaining accounts were retained as contingent sample to support the calling effort if the initial sample was determined inadequate. In an effort to minimize burden on participants, the accounts were divided into replicates supporting response rates of 25, 20, and 15 percent, respectively. Table 4-9 below provides details on the sample and replicates.

[19] Starting sample less ineligible customers.
[20] The updated Appendix B can be found in the *NTG* folder on the Texas PUC EM&V SharePoint site at: https://sites.tetratech.com/projects/158-TexasEMV/Evaluation/Forms/AllItems.aspx.
[21] For the Open MTP survey effort, a unique participant is defined as a unique address.

Table 4-9. Program Participants and Sample Replicates

Utility	PY2014 Participants	Rep 1 (RR=25%)	Rep 2 (RR=20%)	Rep 3 (RR=15%)
AEP TCC	98	60	15	23
AEP TNC	62	48	14	-
Oncor	121	64	16	41
SWEPCO	51	51	-	-
TNMP	71	59	12	-
Total	**403**	**282**	**57**	**64**

Advance letters were mailed to customers in replicate 1 on December 17, 2014, notifying them of their selection for the survey and informing them they may receive a telephone call from Tetra Tech in the near future. Cases in replicate 2 were mailed advance letters December 30, 2014, and were added to the calling effort on January 2, 2015. Cases in replicate 3 were not mailed letters and were not contacted.

The EM&V team used survey results to calculate free-ridership, speaking with small business owners that participated in the program between January and September 2014. Survey results were weighted to account for non-response and disproportionate sampling. These weights are applied when analyzing the participant free-ridership results. Next, expected savings were extrapolated using the weight and savings per survey response, determining net free-ridership rates and ensuring the overall rates were computed taking into consideration the energy savings for each individual premise. In practice, this means large energy savers can have significant impacts on the overall free-ridership rates, particularly when the sample sizes are small.

4.3.4 Net-to-gross results

A. Free-ridership

Table 4-10 and Table 4-11 document the free-ridership results for Open, based on customer data. The results exclude one customer that said he did not receive a final incentive or markdown for the measure *and* was not aware that the services provided by the Energy Efficiency Service Provider were coordinated through a utility program. Free-ridership rates (kWh) ranged from 14 percent among AEP TNC customers to 24 percent among respondents in TNMP's service territory. Corresponding results were found among each utilities kW free-ridership rates.

Table 4-10. Weighted (kWh) Free-ridership Rates by Utility

Utility	Customer Free-ridership Rate
AEP TCC	21% (n=11)
AEP TNC	14% (n=17)
Oncor	16% (n=12)
SWEPCO	20% (n=17)
TNMP	24% (n=16)
Overall	19% (n=73)

Table 4-11. Weighted (kW) Free-ridership Rates by Utility

Utility	Customer Free-ridership Rate
AEP TCC	20% (n=11)
AEP TNC	14% (n=17)
Oncor	16% (n=12)
SWEPCO	20% (n=17)
TNMP	25% (n=16)
Overall	19% (n=73)

Statewide free-ridership rates are shown in Table 4-12, as well as corresponding margins of error. Overall, free-ridership rates are 18.8 percent and 19.0 percent when weighted by kWh and kW, respectively. These findings are in line with free-ridership rates produced during PY2013 for El Paso Electric's Small Commercial Solutions program.

Table 4-12. Statewide Free-ridership Rates and Confidence/Precision

Weight	Customer Free-ridership Rate	90% Margin of Error (±)
kWh	18.8% (n=73)	6.80%
kW	19.0% (n=73)	6.80%

B. Spillover

Typically, spillover takes several years to achieve. Given the fact the Open programs are relatively new in Texas, and the PY2014 survey effort contacted participants during their year of participation, spillover is unlikely to have occurred in large amounts. Therefore, the PY2014 survey effort did not attempt to measure spillover.

C. Comparison to other jurisdictions

Small Commercial Solution and Small Business NTG ratios in other states ranged from 81 to 100 percent. States with reviewed findings included Colorado, Connecticut, Massachusetts, and Oklahoma. NTG research Tetra Tech conducted for a Colorado Small Business program found a 99 percent NTG ratio. A 2011 study in Connecticut found a statewide NTG ratio of 99 percent for the Small Business Energy Advantage, while a 2010 study in Massachusetts calculated the statewide NTG ratio of five utilities' Small Business programs at 96 percent. Lastly, a 2012 study found Oklahoma's Small C&I Solutions program to have a NTG ratio of 81 percent.

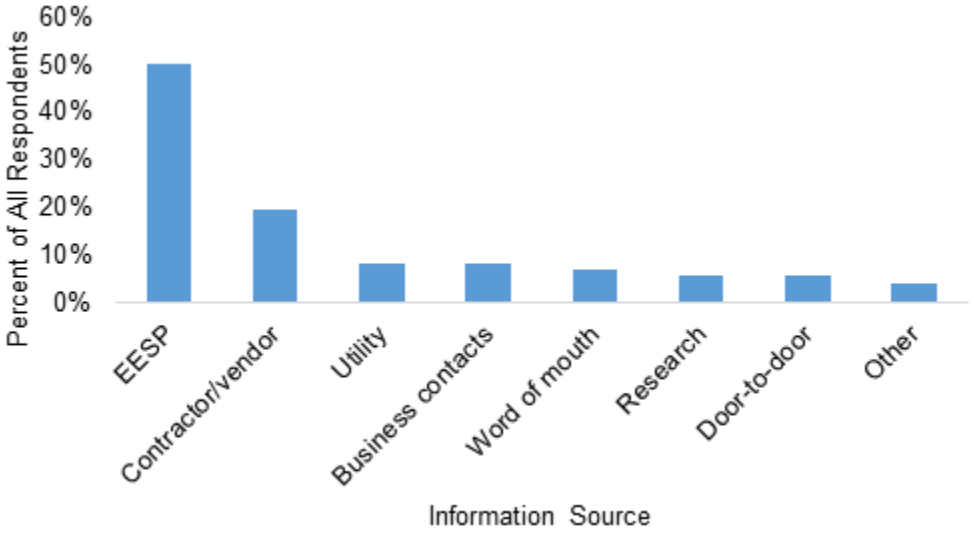
4.3.5 Additional analysis

Next, details of the targeted process questions are summarized.

A. Program awareness

As shown in Figure 4-1, half of all respondents indicated their organization learned of the Open program through their EESP, while 20 percent said a contractor or vendor informed them of the program.

Figure 4-1. How Organizations Learned About Open MTP (n=72) (Multiple Responses Possible)



B. Project and program motivators

When asked why they decided to purchase or install their lighting measure(s), almost 65 percent of respondents stated the impetus for their project was reducing costs. Other popular reasons included wanting to save energy/be more energy efficient, wanting new, more updated equipment, and replacing older/poorly functioning equipment. Table 4-13 provides full details on the distribution of responses.

Table 4-13. Reason for Energy Efficiency Project/Installation (n=73)

(Multiple Responses Possible)

Reason	n	Percent
Reduce costs	47	64%
Save energy/be more energy efficient	33	45%
New, more updated equipment	16	22%
Age/condition of existing equipment	13	18%
Financial incentive from EESP/utility	6	8%
Legal requirements	5	7%
Financing from EESP	4	5%
Environmental concerns	2	3%

A majority of respondents (82 percent) knew of the program prior to purchasing/implementing their energy efficiency measures, and more than half (67 percent) indicated they received technical or planning assistance from their EESP through the Open program.

Respondents were asked to rate the importance of various factors that may have influenced their decision to participate in the program. As Table 4-14 shows, financial factors were most important to survey respondents, with the availability of the markdown/financial assistance provided by the EESP receiving an average score of 9.0 and payback on investment receiving an average score of 8.8. Additionally, the relatively small standard deviations associated with these two factors indicate low variability among survey responses—that is, respondents' responses were very concentrated around 9.0 and 8.8, respectively. Among non-financial factors deemed important, information and recommendations provided to customers by their EESP was rated highly by participants, receiving an average score of 8.4.

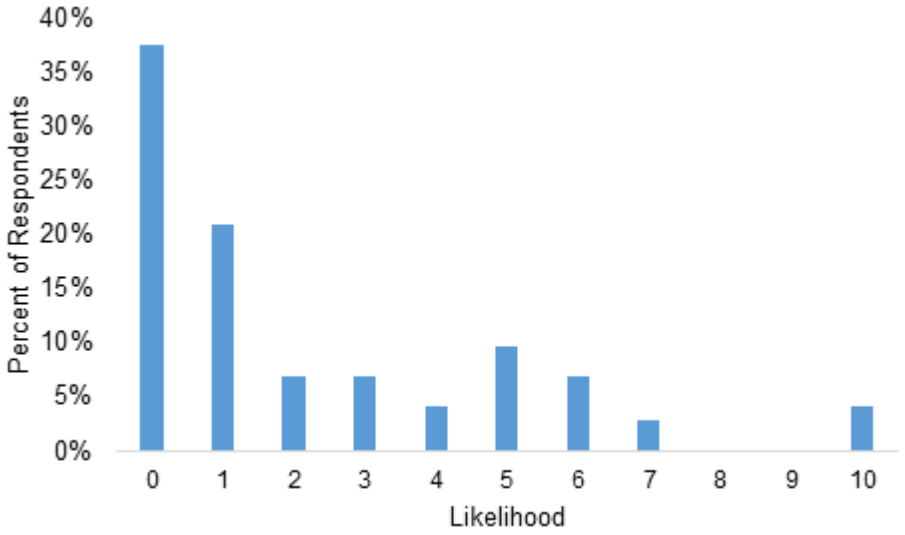
Table 4-14. Importance of Factors Influencing Decision to Purchase/Implement Measures

(0=not at all important, 10=very important)

Factor	Mean	n	Std. Dev.
Availability of the EESP markdown or financial assistance	9.0	51	1.2
Payback on investment	8.8	71	1.4
Information/recommendations provided by EESP or utility program staff	8.4	73	1.9
Financial assistance or rebate from another organization	8.0	56	2.9
Information provided through an EESP-sponsored study, energy assessment, or other technical assistance	7.9	46	2.1
Information from EESP or utility program informational materials	7.4	67	2.7
General concerns about the environment	6.7	73	2.8
Age or condition of the old equipment	6.6	73	2.6
Previous experience with a EESP or utility energy efficiency project	5.6	34	3.7
Standard practice or corporate policy regarding new equipment purchases	5.6	62	3.3
Information from a EESP or utility training course or seminar	4.7	46	3.4

Based on survey results, a majority of the Open program participants would not have purchased or installed their energy efficient measures had the EESP services not been available through the Open program. When asked to rate their likelihood of installing the measures in absence of the Open program, more than half (58 percent) of respondents rated their likelihood as 0 or 1 (0 being extremely unlikely and 10 being extremely likely). Figure 4-2 provides additional details on the distribution of responses.

Figure 4-2. Likelihood of Purchasing/Implementing Measures without Open MTP (0=extremely unlikely, 10=extremely likely)



C. Program satisfaction

Participants indicated high levels of satisfaction with the Open program—70 of 73 respondents rated their satisfaction at 8 or higher (with 0 being very dissatisfied and 10 being very satisfied), and only 2 respondents stated they were very dissatisfied.[22] In addition, 84 percent of respondents stated they would not change any aspect of the program, and 62 percent of surveyed individuals have recommended the program to others.

4.4 THE APPLIANCE RECYCLING PROGRAM

This section summarizes the key findings and recommendations from the PY2014 evaluation of the Appliance Recycling program

4.4.1 Introduction

The Appliance Recycling MTP program provides incentives designed to encourage El Paso Electric's customers to recycle their older, less efficient refrigerators and freezers rather than use them as secondary or backup units. The Appliance Recycling MTP offers eligible customers a $30 incentive to permit El Paso Electric to remove and recycle their old secondary refrigerator or freezer. Incentives are paid to the end user (customer) for refrigerators and freezers that are in working condition and have been removed.

El Paso Electric is—and has been—the only Texas utility implementing the Appliance Recycling MTP. The telephone survey asked participants a series of questions to estimate free-ridership to inform a net-to-gross (NTG) estimate for the program. Respondents were

[22] One respondent experienced an increase in energy consumption and never received a rebate check to offset the installation; one respondent experienced difficulties with his EESP's timeliness and quality of work.

also asked questions related to potential spillover—given the fact this program has been implemented for a few years now. In addition, the survey asked targeted process questions.

4.4.2 Key findings

Key findings from the survey are as follows:

- *The Appliance Recycling MTP has typical attribution for programs of this type.* The program is effectively removing appliances from the grid that would have remained on the grid using electricity less efficiently in the absence of the program. Many of the respondents planned to dispose of their appliances in a way where it would have remained on the grid (43 percent), and others would have continued to use the old appliance for at least a year (30 percent). The Appliance Recycling MTP resulted in customers disposing of their old appliances sooner and in a way where they are no longer using energy. The EM&V recommends an 80 percent NTG ratio for the program, which will be used in calculating the program's cost-effectiveness based on net savings.
- *Participants are primarily learning about the program through bill inserts, followed by a friend or family member.* Almost half of all respondents indicated they became aware of the Appliance Recycling MTP through a bill insert, while nearly a quarter said they heard of the program through a friend or family member.
- *Most appliances being recycled were being used as the primary appliance.* Just over half of all respondents said before they removed the recycled appliance, it was being used as their primary appliance.
- *Most refrigerators and freezers were removed due to a new appliance purchase or because the current appliance did not work well. O*ver a third of respondents said they decided to remove the recycled appliance because they had purchased a replacement or that it did not work well. Other popular reasons included they did not need it anymore and it cost too much to run.
- *Participants are highly satisfied with the program and are referring others to the program.* Almost all participants rate their satisfaction with the program as an 8 or higher on a 10-point scale (0=very dissatisfied, 10=very satisfied). The mean satisfaction rating across all respondents was 9.3. Nearly two-thirds of surveyed individuals have recommended the program to others.

The remainder of this memo details the study methodology and results from the PY2014 research.

4.4.3 Study methodology

The EM&V team conducted telephone interviews with customers that participated in El Paso Electric's Appliance Recycling MTP during PY2014. Overall, the EM&V team completed 71 interviews, as shown in Table 4-15.

Table 4-15. Survey Statistics

Utility	Completed Surveys	Adjusted Sample[23]	Response Rate
El Paso Electric	71	250	28.4%
Total	**71**	**250**	**28.4%**

A. Overarching net-to-gross approach

The EM&V team used a self-report approach (SRA) via customer surveys to calculate free-ridership and spillover rates.

When using the SRA approach, the final NTG ratio is calculated using the following formula. The ratio can be applied to the population to determine the final net savings value.

NTG Ratio = 1 – (Free-ridership Rate) + (Spillover)

B. Sampling and survey approach

Appliance Recycling MTP had 619 unique participants[24] through Q3 of PY2014. The EM&V team estimated a response rate of 40 percent and drew a corresponding sample of 175 records to contact. Additionally, we drew contingency samples to support the calling effort if the initial sample was determined inadequate. In an effort to minimize burden on participants, the accounts were divided into replicates supporting response rates of 40, 35, and 30 percent, respectively. Table 4-16 below provides details on the sample and replicates.

Table 4-16. Sample Replicates

Utility	Total Potential Sample	Rep 1 (RR=40%)	Rep 2 (RR=35%)	Rep 3 (RR=30%)
El Paso Electric	250	175	25	50
Total	**250**	**175**	**25**	**50**

Advance letters were mailed to customers in replicate 1 on December 10, 2014, notifying them of their selection for the survey and informing them they may receive a telephone call from Tetra Tech in the near future. Cases in replicates 2 and 3 were mailed advance letters December 19, 2014, and were added to the calling effort on December 22, 2014. To help with respondent burden, for households where more than one piece of equipment was recycled, survey questions were only asked about one piece of recycled equipment.

The EM&V team used survey results to calculate free-ridership and to gauge spillover, speaking with homeowners that participated in the program between January and September

[23] Starting sample less ineligible customers.

[24] For the Appliance Recycling MTP survey effort, a unique participant is defined as a unique address. Additionally, there were 404 participants that included “Housing Authority” in the customer name; these were not included in the valid list of participants from which to draw the sample from.

2014. Due to the random sampling technique and the deemed savings methodology for the equipment recycled through this program, survey results were not weighted.

4.4.4 Net-to-gross results

A. Free-ridership

Table 4-17 documents the NTG results for the Appliance Recycling MTP based on customer data. The results exclude one customer who was unable to say what they planned to do with the appliance without the program's influence. Free-ridership rates ranged from 10 percent for customers who recycled freezers to 26 percent for customers who recycled refrigerators.

Table 4-17. Free-ridership Rates by Measure

Measure	Free-ridership	Spillover	Net-to-Gross
Freezer	10%	0%	90%
Refrigerator	26%	3%	77%
Total	**24%**	**3%**	**79%**

The margin of error at 90% confidence is ± 8.0% for the overall program results.

B. Comparison to other jurisdictions

Appliance Recycling NTG ratios in other states ranged from 54 to 85 percent. States with reviewed findings included Illinois, Colorado, California, Ohio, and Kentucky. NTG research reported in 2014 for an Illinois program found a 79 percent NTG ratio. A 2011 study in Colorado found a NTG ratio of 72 percent, and a 2012 study in California calculated the statewide NTG ratio of three utilities' programs between 67 and 75 percent. Lastly, a 2014 study found programs in Ohio and Kentucky to have NTG ratios from 54 percent for freezers to 85 percent for refrigerators.

C. Recommended NTG ratio

Based on the customer survey and benchmarking results, we recommend a NTG of 80 percent is used in Texas for Appliance Recycling programs. The EM&V team will use this NTG ratio to estimate the cost effectiveness of the program based on net savings. This is slightly higher than the 79 percent NTG based solely on free-ridership as Appliance Recycling programs can encourage spillover, and there was some evidence of that from the survey, though it was not extensive.

4.4.5 Additional analysis

Next, details of the targeted process questions are summarized.

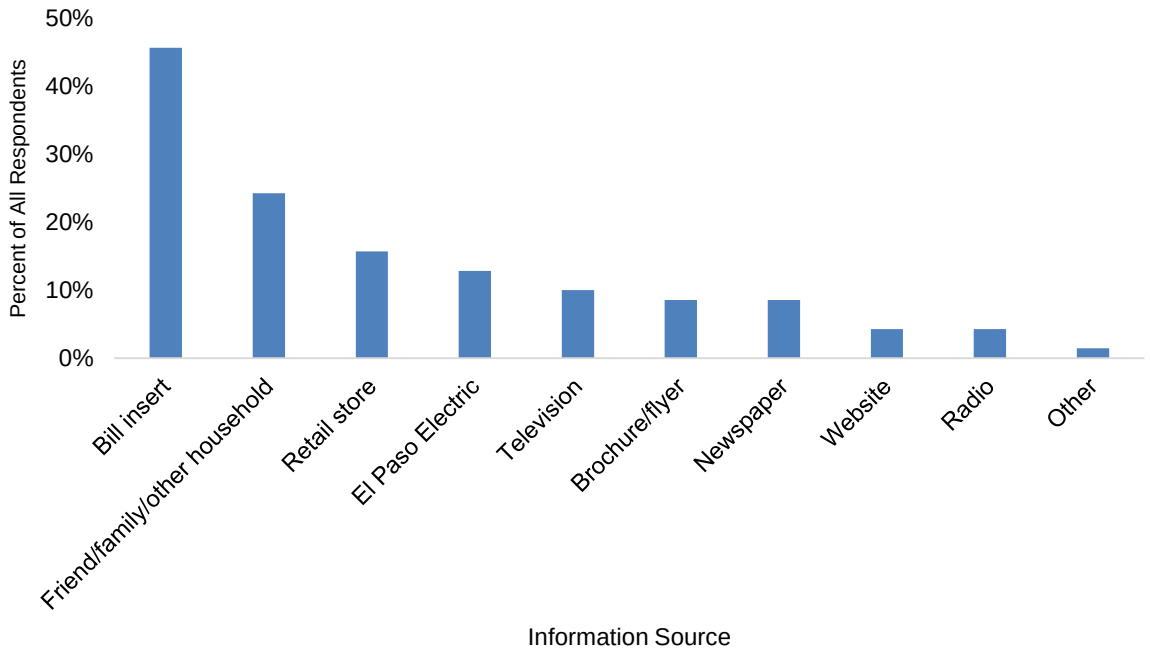
A. Program awareness and appliance use

As shown in Figure 4-3, almost half (46 percent) of all respondents indicated they became aware of the Appliance Recycling MTP through a bill insert, while nearly a quarter (24 percent) said they heard of the program through a friend or family member. In comparing those participants who recycled a refrigerator (n=62) to those that recycled a freezer (n=8), 49

percent of those that recycled a refrigerator became aware of the program through a bill insert compared to 25 percent of those that recycled a freezer. Additionally, half (50 percent) of the participants that recycled a freezer said they heard of the program through a friend or family member compared to 21 percent that recycled a refrigerator.

Figure 4-3. How Households Learned About Appliance Recycling MTP (n=70)

(Multiple Responses Possible)



As shown in Table 4-18, just over half (55 percent) of all respondents said before they removed the recycled appliance, it was being used as their primary appliance. However, as might be predicated, there is some variation within in this number when comparing freezers to refrigerators—59 percent of refrigerators were being used as the primary appliance, whereas 32 percent of the freezers were being used as the primary appliance.

Table 4-18. Primary or Secondary Use

Category	Freezer (n=8)	Refrigerator (n=63)	Total (n=71)
Primary	25%	59%	55%
Secondary	63%	32%	35%
Not being used at all	13%	10%	10%

B. Program motivators

When asked why they decided to remove the appliance, over a third said they had purchased a replacement (38 percent) or that it didn't work well (35 percent). Other popular reasons included they did not need it anymore (23 percent) and it cost too much to run (20 percent). Table 4-19 provides full details on the distribution of responses, including a comparison between those that recycled freezers to those that recycled a refrigerator.

Table 4-19. Reason for Removing Appliance
(Multiple Responses Possible)

Reason	Freezer (n=8)	Refrigerator (n=63)	Total (n=71)
Bought a replacement	13%	41%	38%
It didn't work well	25%	37%	35%
Didn't need it anymore	75%	16%	23%
It cost too much to run	13%	21%	20%
It didn't work at all	0.0%	6%	6%

A majority of respondents (83 percent) did replace the appliance they recycled—91 percent of those that recycled a refrigerator and 25 percent of those that recycled a freezer purchased replacements. The majority of these replacements were new ENERGY STAR-rated appliances.

Respondents were asked for the main reason they decided to recycle their appliance through El Paso Electric's Appliance Recycling MTP, rather than disposing of it in some other way. As Table 4-20 shows, the rebate and recycling in an environmentally safe way were the top two main reasons (each at 32 percent) survey respondents decided to recycle their appliance through the program.

Table 4-20. Main Reason for Appliance Recycling Decision

Main Reason	Freezer (n=8)	Refrigerator (n=63)	Total (n=71)
The rebate	25%	33%	32%
It was a way to recycle it in an environmentally safe way	38%	32%	32%
It was convenient	13%	14%	14%
The free pick-up service provided by the program	0%	11%	10%
The sponsorship from the utility	0%	3%	3%
A friend/family member's recommendation	13%	0%	1%

C. Program satisfaction

Participants indicated high levels of satisfaction with the Appliance Recycling MTP—62 of 70 respondents rated their satisfaction at 8 or higher (with 0 being "very dissatisfied" and 10 being "very satisfied"), and no respondents stated they were very dissatisfied, as depicted in Figure 4-4. The mean satisfaction rating across all respondents was 9.3. In addition, almost three-quarters (73 percent) of respondents stated they would not change any aspect of the program, and 63 percent of surveyed individuals have recommended the program to others.

Figure 4-4. Program Satisfaction (n=71)

(0=very dissatisfied, 10=very satisfied)

4.5 THE COOLSAVER PROGRAM

This section summarizes the key findings and recommendations from the PY2014 evaluation of air conditioner tune-ups, or "CoolSaver" program.

4.5.1 Introduction

The tune-up measures are currently provided to residential and commercial customers through six Texas utilities across eleven different program offerings (Table 4-21). Furthermore, PY2014 showed a marked increase in the number of tune-ups and therefore percent of savings from these measures with approximately a 150 percent increase in tune-ups since PY2012.

Table 4-21. PY2014 Tune-Up Summary by Program

Utility	Market Transformation Program	Energy Savings		Tune-Up Count
		Reported kW	Reported kWh	
AEP TCC	CoolSaver	2,214	7,508,243	3,726
CenterPoint	Retail Electric Provider	4,625	13,624,189	6,693
El Paso Electric	Large Commercial Solutions	156	342,704	124
	SCORE	53	71,198	29
	Small Commercial Solutions	27	54,538	24
SWEPCO	CoolSaver	206	443,202	444
Entergy	Commercial Solutions	250	708,482	203
	SCORE/CitySmart	26	51,775	40

Utility	Market Transformation Program	Energy Savings		Tune-Up Count
		Reported kW	Reported kWh	
TNMP	Commercial Solutions	96	337,199	99
	SCORE/CitySmart	44	68,617	50
	SCORE/CitySmart Lite	56	127,462	49
Total		**7,753**	**23,334,609**	**11,481**

Recommendation #2a[25] from the PY2013 Statewide Report was that deemed values be developed for tune-ups. Feedback from utilities and their implementation contractor was that a M&V approach was preferred. Therefore, the EM&V team worked with the implementation contractor to include a M&V protocol for tune-ups in the Texas Technical Reference Manual (TRM) version 3.0. In addition, the EM&V team identified the need for a comprehensive review of the tune-up measures in PY2014 focused on comparing the implementation contractor's *stipulated* (previously named "*modeled")* approach versus the M&V protocol to better understand the methodologies and their influences on program energy savings.

4.5.2 Evaluation overview

As a first step, the EM&V team conducted a complete tracking system review. This was then followed by in-depth desk reviews for 92 tune-up projects completed in January to December 2014 across seven different utility programs as summarized in Table 4-22 below.

Table 4-22. PY2014 Tune-Up Measures Comparison—Desk Review Sample vs. Population

	Energy Savings		Tune-Up Counts and Percentage by Savings Methodology		
Tune-Up Group	**Reported kW**	**Reported kWh**	**M&V**	**Stipulated**	**Total**
EM&V Sample	105	268,714	33	59	92
Population	7,753	23,334,609	2,260	9,221	11,481
			20%	80%	100%

These tune-ups covered both M&V and stipulated savings methodologies. Their comparison to the entire tune-up population is provided in Table 4-22. This table also provides a breakdown overall at the statewide level for how many tune-ups occurred by savings methodology.

Based on initial understanding for how tune-ups were being conducted in the field, a random sample of tune-up projects was drawn. If more about the savings approaches had been known first, a stratified sample by tune-up methodology type (stipulated/modeled protocols versus M&V procedure) would have been preferred.

In addition, a census savings review was completed for all tune-ups reported in PY2014.

[25] Recommendation #2a stated: "From PY2012 to PY2013, the mix of deemed and custom measures funded through the commercial sector programs remained fairly consistent. However, the EM&V team recommends considering establishing deemed values for air conditioning tune-ups for both sectors that were part of both program years. Most TRMs do include air conditioning tune-up as a deemed measure."

4.5.3 Key findings and recommendations

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

A. Key Finding #1: The Tracking System is comprehensive; however, corrected field labeling is needed.

The data collected and tracked for tune-up measures is quite comprehensive and thorough. While no major issues were identified within the tracking system, minor labeling issues created uncertainty about particular data presented, such as:

- For Stipulated/Modeled tune-up projects the actual Test-Out measurement values that establish the post tune-up Energy Efficiency Ratio (EERpost) are incorrectly labelled as Test-In (EERpre) values—when in fact only Test-Out values are recorded following completion of all tune-up procedures.
- The tracking data includes condition_1 and condition_2 entries to indicate adjustments (addition/subtraction) of refrigerant to proper levels; in several instances condition_2 indicates adjustments have been made but no amounts are noted in the adjacent data fields to track refrigerant adjustment quantities.

No units are indicated in column headings for certain measured data, including:

- Ductwork dimensions
- Air speeds (not clear: it is feet or inches, per second or per minute).

Recommendation: Tracking system labeling issues should be corrected for transparency of the data collected through the programs. Utilities report that labelling issues have already been corrected by the implementer.

B. Key Finding #2: While overall savings calculations were determined to be reasonable, opportunities for improvements were identified for both the M&V and stipulated approach.

The reviews and subsequent discussions with the implementation contractor found that the M&V procedure relies on stipulated energy loss factors to calculate energy savings. The pre and post tune-up measurements collected as part of the M&V tune-up protocol are not used to calculate energy impacts, but instead are added by the implementation contractor to their dataset to recalibrate the “deemed” (stipulated) energy loss factor for use in future program years.

The desk review process included attempts to replicate the tune-up calculation methodologies provided by the implementer. A key component of the tune-up methodology is the efficiency loss, which is applied to the EERpost to calculate the EERpre condition, and then EERpre and EERpost results are used to calculate kWh and kW impacts. The EM&V team investigated to determine actual efficiency loss/improvements for M&V (non-modeled/stipulated) projects to compare against stipulated values. While the EM&V team was not able to fully replicate the process by which the implementer determined the efficiency loss

(e.g., conduct a complete regression analysis), the cursory review of the efficiency loss numbers recorded by the implementer generally align with the EM&V team assessment. Table 4-23, below, reflects the current tune-up protocol's stipulated efficiency loss and the EM&V team's calculated efficiency loss for all PY2014 M&V tune-ups completed. While the EM&V team could not fully replicate the tune-up calculation process, we did determine that the efficiency loss is within a reasonable range.

Table 4-23. Efficiency Loss Comparison

Efficiency Loss Basis	Program Stipulated	Evaluated*
Units with refrigerant charge adjustment	14.5%	17.8%
Units with no refrigerant charge adjustment	10.8%	10.0%

*The evaluated results were completed for the 2,260 tune-ups that received both pre and post field measurements as part of the M&V protocol.

According to the M&V Plan, the equivalent full load hours (EFLH) values are determined for regions where there is no approved Technical Reference Manual (TRM) with stated EFLHs. EFLHs are developed using a proprietary model developed using data from the Energy Start Calculator[26], cooling degree days (CDD), heating degree days (HDD), and building type information. EFLH for each county and building type in the participating region were calculated using the proprietary model input with CDD and HDD for the location. Texas does have a TRM with Commission approved energy and demand savings for AC equipment established by building type and weather zone. These deemed EFLHs were approved by the PUCT in prior Dockets as documented in the TRM prior to being included in the statewide TRM when it was first created in 2013. The EM&V team compared the EFLHs the implementer created with their proprietary model to those within the statewide TRM and found the values were comparable to one another by building type. Two slight differences found between the two were the number of building types and the region breakdown. The TRM covers up to 25 building types, whereas the implementers covers 19. The TRM EFLH values are separated by the five weather zones in Texas, whereas the implementers are provided by county, which covers 254 counties.

Recommendation: The applicable program year TRM values (i.e., building type, EFLH, CF) should be used in savings calculations.

The M&V Plan does not include the methodology to adjust measured capacities and measured EERs (e.g., EERs calculated from measurement data) to Air-Conditioning and Refrigeration Institute (ARI) conditions—a key step needed to verify energy savings estimates. As noted, the M&V Plan does not clearly state that M&V tune-ups also rely on stipulated energy loss factors, but the M&V Plan does present 23 equations with discussion that gives the impression that use of those 23 equations in concert with the data will allow one to calculate and match ex ante savings estimates. They do not, but because twenty some equations are involved, the EM&V team invested considerable effort before it was determined the M&V Plan was incomplete. Missing from the M&V Plan are the ARI Adjustment methodologies, constants, and subroutines needed to calculate ARI correction (adjustment) factors.

[26] Cadmus Group Inc. "ENERGY STAR Calculator." 4/2009. www.energystar.gov.

Recommendation: The M&V Plan should be updated to include the ARI adjustment/correction methodologies employed to derive post tune-up EERs.

Project documentation and raw data files included enough information that critical inputs to calculating savings could be determined and compared to the CoolSaver AC Tune-Up M&V Plan. The challenges the EM&V team encountered were that the M&V tune-up savings calculation methodology was essentially the same as the stipulated methodology, and this is not stated in the M&V Plan leaving the impression that savings accrued from M&V projects were derived directly from pre tune-up (i.e., test-in) and post tune-up (i.e., test-out) field measurements. That was not the case. We learned that the additional data points collected as part of the tune-up visit during PY2014—as part of the M&V process—were not directly being used to calculate energy savings or to calibrate the model and hence not directly affecting current PY2014 projects.

Recommendation: Calibration of the model used to develop the critical stipulated savings factors should be completed annually with the M&V data collected in the prior program year.

C. *Key Finding #3: Completion of all six measures is presented as what distinguishes a "CoolSaver Tune-Up" from an ordinary service/maintenance tune-up. Therefore noting their completion is worthwhile; especially in situations with exceptionally fouled or degraded heat exchanger surfaces.*

In order to complete a comprehensive desk review for this program, the EM&V team requested all project documentation associated with each sampled project, including the customer application and invoice, any calculators used, and reports of QA/QC or M&V activity if conducted. What the EM&V team received for most projects was an invoice from the contractor, the Incentive Check Request, and the Tune-up Data Collection Sheet (contractor field reports). The implementer also provided program documentation including the Contractor Manual, Contractor FAQs, an Equivalent Full Load Hours (EFLH) spreadsheet and the 2014 CoolSaver Air-Conditioning Tune-Up M&V Plan (M&V Plan).

The project documentation does not include any indication that all of the required six measures have been performed as part of the tune-up. For example, contractor invoices and field reports did not indicate whether condenser coils were cleaned, or airflows adjusted to proper volumes (CFM per ton) in keeping with the CoolSaver AC Tune-Up M&V Plan protocols.

Recommendation: Project documentation should include indication that all of the required six measures have been performed as part of the tune-up.

4.5.4 Conclusion

Results of the PY2014 tune-up evaluation continue to support Recommendation #2a from PY2013, that tune-up measure savings methodologies should be based upon a deemed value, or rather a deemed efficiency loss factor and deemed calculation methodologies. With the increased number of AC tune-ups that can now be integrated into the dataset, the modeled values should be sufficiently stable and robust over the next two to three years that the field M&V measurements that are currently occurring could be suspended. Not having to take M&V measurements for a number of years would streamline program implementation. However, field M&V measurements must continue if the program does not have Commission

approved deemed values. This recommendation is further supported by the fact that other similar programs in the same region (in particular, Arkansas) have deemed savings for tune-ups that include refrigerant charge adjustments

5. IMPACT EVALUATION KEY FINDINGS AND RECOMMENDATIONS

This section documents overarching key findings and recommendations from the PY2014 impact evaluations conducted across the ten utility portfolios. Key findings and recommendations are presented by those that apply to both sectors and then specifically for residential and commercial programs.

5.1 CROSS SECTOR

5.1.1 Recommendation: Deemed savings calculations in tracking systems and savings tools should be updated to the applicable TRM version with the exception of carryover projects.

For a couple of measures across some utilities, the EM&V team's residential tracking system review found that residential savings were calculated based on prior approved deemed savings as opposed to the applicable TRM, which was TRM 1.0 for PY2014. Likewise for commercial programs, there were some instances where outdated savings calculators were used. For commercial projects outdated savings were typically found when the project was a "carryover" from the prior year. However, projects should calculate savings based on the program year in which the savings are claimed as opposed to when the program starts.

5.1.2 Recommendation: Utilities may want to consider increased QA/QC of program documentation with tracking system inputs into deemed savings calculations.

Both the residential and nonresidential desk reviews found some discrepancies between program documentation and tracking system or savings calculator inputs across different measures. While these had a minor impact on realization rates, there may be opportunity to improve QA/QC review of inputs. Examples of discrepancies found between program documentation and savings inputs included pre- or post-treatment air infiltration values (i.e., CFM), HVAC unit tonnage or efficiency level, heating type, square footage and pre-treatment R-values.

5.1.3 Recommendation: Measures with claimed savings need to have Commission approved deemed savings values or supported by M&V consistent with the IPMVP.

In a few instances, the EM&V team encountered measures with claimed savings that neither had a Commission approved deemed savings value or utilized M&V to calculate savings. Under the current regulatory framework, the basis of savings in M&V protocols in accordance with the IPMVP or Commission approved values: Commission-approved deemed energy and peak demand savings may be used in lieu of the energy efficiency service provider's measurement and verification (16 TAC § 25.181 (p) (2)). The Commission has included in the EM&V contractor's scope technical assistance if a utility desires to pursue Commission-approved deemed savings as well as review of M&V plans.

5.1.4 Recommendation: LEDs should meet TRM certification requirements or have a M&V Plan in place.

In the PY2013 Statewide Portfolio Report it was noted that the EM&V team found that several LED lighting fixtures and lamps were not meeting the qualification requirements specified in the TRM. The new LED fixtures and lamps installed as part of the commercial energy efficiency programs should verify certification to confirm the eligibility of the LED fixtures and lamps. The qualification requirements are in keeping with national industry practice that protect customers from inferior products and help ensure the energy savings. The action plan to respond to this recommendation (#1a) was that utilities will require certification for all LEDs with a certification category with the Design Light Consortium (DLC) or ENERGY STAR as specified in the TRM. At the utilities' request, LED Lighting Facts®, a program of the U.S. Department of Energy, is also being considered for inclusion in TRM 3.1.The action plan further notes that in cases where a certification category does not address a certain LED usage (i.e., outdoor signage), utilities should inform the EM&V team and discuss a M&V plan and supporting savings information for these LED applications. Utilities are expected to be in full compliance in PY2015 with the certification requirement or M&V Plan as agreed upon in the PY2013 action plan.

5.2 RESIDENTIAL

5.2.1 Recommendation: Infiltration reduction measure savings should not be claimed where infiltration levels remain within 10 percent of the initial cap post-retrofit or beyond final ventilation levels specified for health and safety reasons.

The TRM contains several eligibility requirements for the infiltration reduction measure and the EM&V team did find some instances where there is room to improve the claiming of infiltration measure savings in accordance with the TRM. The TRM applies a cap to the pre-treatment infiltration against which contractors can claim savings.[27] For homes where the initial leakage exceeds 4.0 CFM_{50} per square foot, this cap is to be treated as the starting leakage. The TRM also requires that contractors reduce air leakage by at least 10% through implementation of this measure, with this requirement measured relative to the initial leakage cap where applied. In addition, for health and safety reasons, final ventilation levels are specified within the TRM, with savings not awarded for reducing leakage below these levels. In a few cases, post-treatment infiltration levels fell below the minimum final ventilation. Ex-post savings calculated for these homes were based on reduction to the minimum ventilation level; however, ex-ante savings for one of these homes were reported as 0, and for the remaining two were calculated for the full reduction (i.e., the minimum ventilation limit was not applied).

[27] The deemed savings awarded for this measure are not considered to vary linearly with leakage above the level of the cap, and since few homes have such high initial leakage the cap also serves to prevent data entry errors.

5.2.2 Recommendation: Insulation savings should not be claimed when it is installed in an unconditioned space such as a garage.

There were a few instances where the EM&V team on-site inspections found insulation savings were claimed for unconditioned spaces.

5.2.3 Recommendation: The installed heating system type should be used to calculate shell measure savings.

The on-site M&V found several cases where the incorrect heating system was recorded across utility programs for claimed savings. The most common error was that electric resistance heat was chosen to calculate savings instead of the heat pump found on-site. In some cases, it appears that the EESP may have recorded the wrong heating system type. In other cases, this was because the program replaced electric resistance heat with a heat pump. However, even if the program replaced electric resistance heat with a heat pump, savings for shell measures should use the newly installed heating system to calculate savings.

5.2.4 Recommendation: Low flow showerhead savings may be claimed at the measure level.

In several cases, the EM&V team found multiple low-flow showerheads were installed in a household when only one showerhead was claimed per household. This is a conservative approach; however, the TRM does not restrict low flow showerhead savings per household. Savings may be claimed at the measure level for each installed unit.

5.2.5 Recommendation: Utilities may want to consider education about the importance that no major renovations or equipment changes that would negatively affect measure savings are planned in the next year by the household.

In a couple of instances on-site M&V findings regarding major household changes (a remodel or new heating system installed after program participation) decreased program realization rates. Given that the EM&V on-sites occur closely after projects are completed, near-term changes such as these can affect first year savings.

5.2.6 Recommendation: Assess TRM values for duct sealing, air infiltration and ceiling insulation measures to see if they are reasonable or if any updates are needed.

Duct sealing, air infiltration, and ceiling insulation measures account for a preponderance of savings for residential, hard-to-reach, and low-income programs in Texas. In PY2014, these three measures alone accounted for 94% of energy savings and 90% demand savings in the residential sector, as shown in Table 5-1.[28]

[28] The residential sector here denotes the Residential SOP, Hard-to-Reach SOP, Hard-to-Reach MTP, and Low-Income Weatherization programs.

Table 5-1. Distribution of Residential Evaluated Savings across Measures

Measure	Percentage of Energy Savings	Percentage of Demand Savings
Duct Sealing	49.1%	26.5%
Ceiling Insulation	23.4%	28.7%
Infiltration	21.2%	34.8%
HVAC Equipment	4.6%	8.8%
Lighting	0.6%	0.2%
Other Envelope Measures	0.5%	0.6%
Water Heater Measures	0.4%	0.3%
Other Measures	0.2%	0.1%

During its site inspection activities in PY2013 and PY2014, the EM&V team observed notable variation in air and duct leakage rates relative to the reported values, with these site visit findings significantly influencing realization rates. Given the large proportion of program savings derived from these measures, the PY2015 EM&V scope will include a robust approach to assess the impacts of these and other program measures through a billing analysis. Billing analysis is considered industry best practice for multi-measure whole house programs similar to the Texas residential programs, as discussed in the Uniform Methods Protocol (UMP)[29] and the International Performance Measurement and Verification Protocol (IPMVP).[30]

5.3 COMMERCIAL

5.3.1 Recommendation: Sufficient justification for custom values is needed when used in lieu of Commission approved values.

In the course of the PY2014 evaluation, the EM&V team encountered some projects where savings were calculated with custom analysis instead of the Commission approved deemed savings calculations. Because of insufficient documentation provided to the EM&V team to support the use of the custom analysis, evaluated savings were calculated based on the deemed savings calculations, which decreased realization rates for these projects.

[29] Agnew, K., and Goldberg, M. Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Prepared by DNV Kema. NREL/SR-7A30-53827. April 2013.

[30] International Performance Measurement & Verification Protocol. Concepts and Options for Determining Energy and Water Savings. DOE/GO-102002-1554. March 2002.

5.3.2 Recommendation: Review correct selection of building type and capture decision-making process of why a building type was selected when a judgment call is needed.

The EM&V team made several adjustments across projects based on the building type selected for the calculation. In many of these instances the more accurate building type was apparent through a desk review and did not require the on-site M&V while in other cases on-site M&V was critical in determining the correct building type. While in some cases these changes in building types by the EM&V team had a positive effect on savings and sometimes a negative, for the accuracy of the savings, building type should be assigned as close as possible. Because judgment calls may be needed in determining building types, the EM&V is further recommending a field to track why the building type was selected. Furthermore, it is important that building type is assigned at the facility-level instead of by business type. For example, an energy efficiency project completed for a university of a warehouse should select 'warehouse' as the building type as opposed to "education."

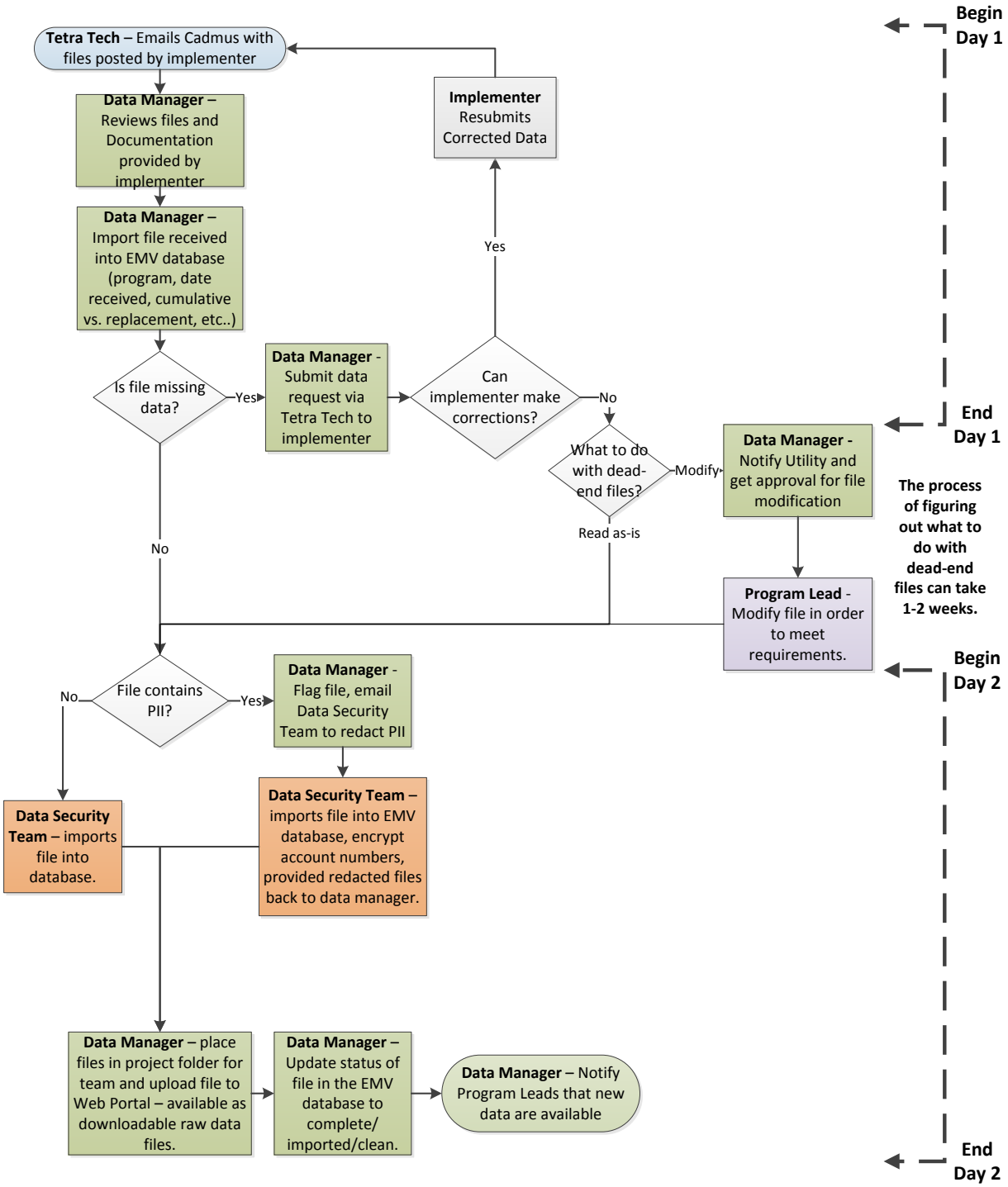
5.3.3 Recommendation: Utilities may want to consider a process to support the importance that small business participants plan to remain in the participating facility for the next 12 months.

In a couple of instances on-site M&V findings for the Small Business Program found that the participating business had already moved and business changes affected first year savings. While unplanned changes are unavoidable, especially in the small business sector, there may be opportunity to increase persistence of at least first year savings by screening participants for at least one year of planned occupancy at the participating facility.

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 Public Utility Commission of Texas (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 Program Administrator Cost Test (PACT). Based on this definition, we collected the costs reported in the utilities' 2014 Energy Efficiency Plan and Reports (EEPRs), filed on April 1, 2014.[31] The program benefits must be calculated at a measure level in order to apply individual effective useful lives (EULs). 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 evaluation team has provided results for benefit-cost calculation using an escalation rate of 2 percent and without an escalation rate.

[31] PUCT filing number 42264.

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. Evaluation, Measurement and Verification (EM&V) costs were previously distributed among utility programs by the evaluation 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 Savings-to-Investment Ratio (SIR) rather than the PACT described above.

The SIR is significantly different in both the benefits and costs included. The benefits are composed 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 weighted average cost of capital, 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	$0.1240
AEP TNC	$0.1240
CenterPoint	$0.1328
Oncor	$0.1298
Sharyland	$0.1390
TNMP	$0.1292
Xcel Energy	$0.1050

B.1.1 Net-to-gross ratios

The following net-to-gross ratios (NTG) 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 Sector		
Commercial SOP	78%	88%
Texas SCORE MTP (Commercial MTP)	93%	93%
Retro-commissioning MTP	90%	90%
Advanced Lighting MTP (Nonresidential)	90%	90%
Residential Sector		
ENERGY STAR Homes MTP	70%	70%
Residential & Small Commercial SOP	78%	78%
Advanced Lighting MTP (Residential)	90%	90%
A/C Distributor MTP	84%	84%
Home Performance with ENERGY STAR MTP	80%	80%
Energy Wise Resource Action MTP	80%	80%
Multi-family MTP (Residential)	80%	80%
Hard-to-Reach SOP	100%	100%
Multi-family MTP (Hard-to-Reach)	100%	100%
Low-Income		
Agencies in Action MTP	100%	100%
Load Management		
Load Management SOP	100%	100%
Pilots		
Sustainable Schools Pilot	93%	93%
Pool Pump Pilot	80%	80%
Retail Electric Provider Pilot MTP (Nonresidential)	80%	80%
Retail Electric Provider Pilot MTP (Residential)	90%	90%
Residential Ecofactor Pilot Load Management Program	100%	100%
Residential EarthNetworks Pilot Load Management Program	100%	100%

APPENDIX C: QA/QC PROTOCOLS

This appendix documents the quality assurance (QA) 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 processes within the reporting stage. A Quality Assurance team (QA team), which will be led by the Tetra Tech reporting lead, will be developed and accountable for ensuring all QA protocols are being followed.

Below we summarize the specific activities that will be subject to quality assurance and processes. Note that these QA 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 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-staged impact reporting process, the EM&V team builds into the process a point of verification of the data. 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 Quality Assurance team will be able to go refer to the original source to verify the results.

- Responsibility: Program leads
- Accountability: QA 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 within over 100 tables. It will be critical to spend considerable time providing QA 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 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 function, the team's development of these reporting functions with the overarching goal of ensuring transparency will inherently allow for ad hoc QA 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 team (for final review and cross-checks of impact tables)
- Consulted: Impact leads, EM&V Data lead, utilities, and EM&V Project Manager.

APPENDIX D: WATER HEATER SET POINT STUDY

Through its program year 2015 (PY2015) evaluation of the Texas utilities' energy efficiency program, Cadmus undertook a study of residential water heater set point temperatures to inform an update to the Texas Technical Reference Manual (TRM).

D.1 BACKGROUND

The savings values provided in the Texas TRM version 3.0[32] rely on an assumption of a 120°F set point in deriving energy savings for water heating measures such as water heater replacements, pipe and tank insulation, faucet aerators, and low-flow showerheads. This value represents the water heater set point recommended by both the U.S. Department of Energy[33] (DOE) and the New York State Department of Public Service.[34]

However, compared to other jurisdictions, TRM documentation, and publically-available studies, this set point could be considered conservative. To protect against Legionnaires' disease, the Occupational Safety and Health Administration (OSHA) recommends a water heater set point of 140°F or above. In other jurisdictions, Cadmus has observed average water heater set point temperatures for both gas and electric water heaters to be near 130°F.[35] Additionally, a 2010 Cadmus study for the California Public Utilities Commission found households' mean water heater set point temperature to be 128°F for Pacific Gas & Electric and 125°F for San Diego Gas & Electric.[36]

Therefore, given the variability in recommended and observed water heating temperatures, as well as the dependence of the savings calculation for several energy efficiency measures on this parameter, the evaluation, measurement and verification (EM&V) team collected primary data on hot water temperatures in homes across Texas to determine whether there were differences between the observed and assumed set points, necessitating revisions to the Texas TRM are necessary.

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[32] Texas Technical Reference Manual, Version 3.0, Volume 2: Residential Measures Guide for PY2016 Implementation. Prepared for the Public Utility Commission of Texas. Available online at: http://www.texasefficiency.com/images/documents/RegulatoryFilings/DeemedSavings/trm3v2.pdf. Accessed June 8, 2015.

[33] Office of Energy Efficiency and Renewable Energy. Covered Product Category: Residential Electric Resistance Water Heaters. Available online at: http://energy.gov/eere/femp/covered-product-category-residential-electric-resistance-water-heaters. Accessed June 8, 2015.

[34] TecMarket Works. *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs*. October 2010; page 99.

[35] Cadmus. *Focus on Energy. Calendar Year 2013 Baseline Market Study*. May 14, 2014. Available online at: https://focusonenergy.com/sites/default/files/FOC_XC_Baseline%20Evaluation%20Report%20CY%202013.pdf Accessed June 23, 2015.

[36] Cadmus. *Residential Retrofit High Impact Measure Evaluation Report*. February 2010; page 73. Available online at: http://www2.epa.gov/sites/production/files/documents/CA_PUC_Assessment.pdf. Accessed July 3, 2015.

D.2 DATA COLLECTION

The EM&V team collected hot water temperature data for 159 single- and multi-family homes distributed across all 10 Texas investor-owned utilities' territories. These sites were randomly selected from participants in these utilities' residential and hard-to-reach standard offer programs, as well as their low-income programs. Six sites' measurements were excluded from the final dataset, either as a result of duplicative measurements for multi-family residences, or due to outlying values that may have resulted from measurement error. The sample is outlined in Table D-1

Table D-1. Sample Statistics

Statistics	Electric Water Heater	Gas Water Heater	Total
Number of individual set points recorded	85	74	159
Number of set points excluded	2	4	6
Final set point sample size	83	70	153

Table D-2 presents the distribution of the sites sampled by water heater fuel type and by geographic region across the state of Texas. The team recorded set point temperatures for both electric and gas water heaters, with electric water heaters comprising 54% of the sample and gas units making up 46%. Climate zones 2 and 3 together accounted for a preponderance of the final sample, with just over two-fifths of the sites from Climate Zone 2 and approximately one-fourth from Climate Zone 3.

Table D-2. Regional Distribution of Sample

Texas Climate Zone		Electric Water Heater	Gas Water Heater	Total
1	Panhandle - Amarillo	11	6	17
2	North - Dallas/Ft. Worth	44	21	65
3	South- Houston	21	21	42
4	Valley- Corpus Christi	4	8	12
5	West- El Paso	3	14	17

Field technicians were instructed to record the water heater fuel type and the hot water temperature for all houses after gaining participant consent. Hot water temperatures were recorded at the faucet located closest to the water heater after running hot water from the faucet for at least three minutes or until the temperature at the faucet reached a steady state. Water temperatures were recorded using digital thermometers which, in the 120°F range, are accurate to better than 1°F.

D.2.1 Exclusions

During analysis of the measured temperature data, the EM&V team excluded six temperature measurements from consideration. Four gas water heater measurements were excluded so that measurements taken from the same multi-family gas units would not be included in the

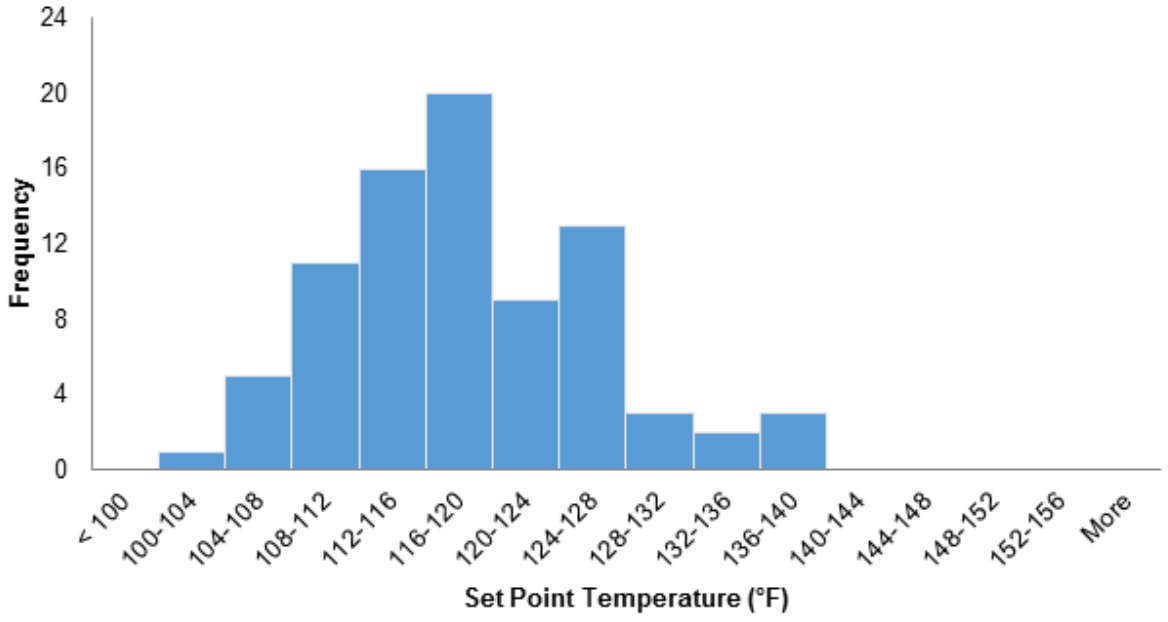
sample more than once. Since these measurements were not independent, they could otherwise have led to skewed results and were therefore excluded. A further two electric water heater measurements were removed from the analysis due to reported temperatures falling below 100°F. At temperatures below this level, customer comfort, as well as health and safety, would be noticeably compromised. It is expected that these values may have been a result of measurement error.

D.3 RESULTS

Through a review of the collected water heater temperatures, the EM&V team found a mean hot water temperature of 118.7°F for homes with electric water heaters and 123.1°F for homes with gas water heaters. The temperature drop between the water heater tank and the nearest tap is dependent on numerous factors, including location, insulation, and length of pipes, and could not be verified based on available data; however, temperature drops between the water heater tank and nearest tap are not typically substantial.

The majority of Texas' water heating measures award savings only to homes with electric water heaters. The data collected in these homes reflect a range of set points between 103.2°F and 139.1°F. The 90% confidence interval around the mean is ± 1.4°F, or from 117.3°F to 120.1°F. Therefore, given a previously assumed value of 120°F, the team considers the collected data to validate this assumption. Figure D-1 presents the distribution of hot water temperatures measured by the EM&V field team at homes with electric water heaters.

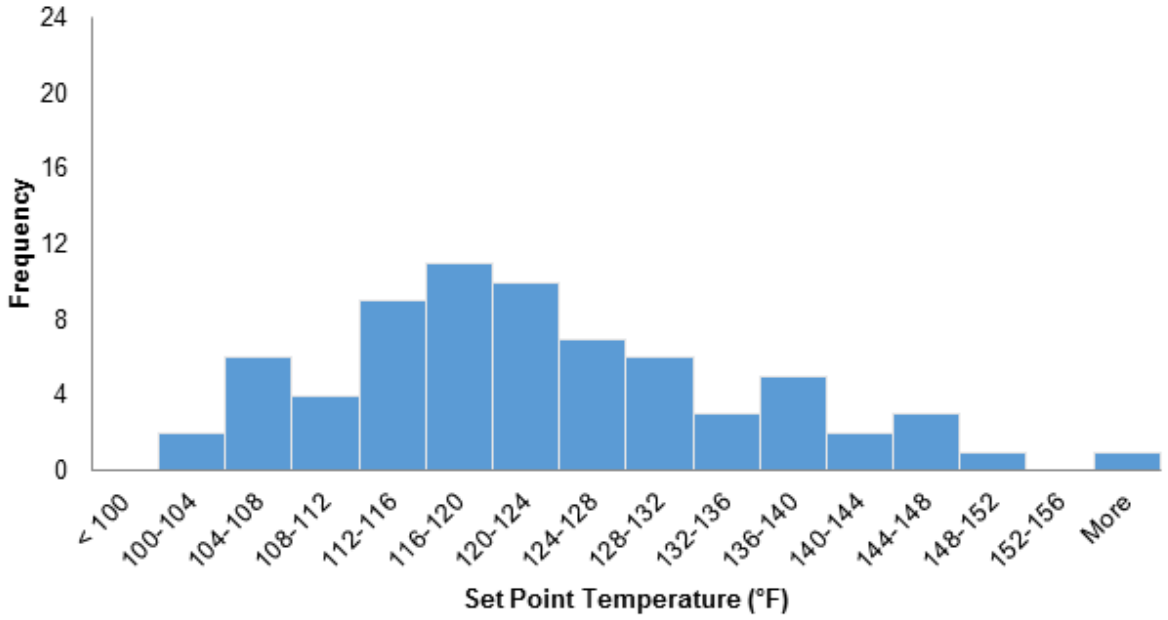
Figure D-1. Distribution of Hot Water Temperatures at Homes with Electric Water Heaters



While similar values were observed at homes with gas water heaters, the team noted that gas water heaters tended to result in a wider range of temperature values, resulting in an average hot water temperature that was significantly higher than that measured at homes with electric water heaters. Temperatures as high as 157.0°F were measured at homes with gas water

heaters, and the 90% confidence interval spans 120.7°F to 125.6°F. The team has not observed similar differences between water heater fuel types in other jurisdictions. Figure D-2 depicts the team's measured hot water temperatures at homes with gas water heaters.

Figure D-2. Distribution of Hot Water Temperatures at Homes with Gas Water Heaters



In addition to calculating the mean values for the entire sample, the EM&V team also evaluated the set point temperatures by cross sections of utilities, programs, and climate zones. Although there was variation around the mean by these subgroups, the sample sizes were too small to detect any statistically significant trends. The most robust estimate is therefore at the aggregate water heater type level, with confidence intervals around the mean.

D.3.1 Sensitivity of savings to variation in set point temperature

The EM&V team sought to understand how adjusting the assumed set point temperature downward by 1.1%, to the sampled mean of 118.7°F, would impact the savings calculations for energy efficiency measures. Five measures within the Residential Water Heating section of the Texas TRM version 3.0 (section 2.4) use an assumed value for water heater set point temperature: faucet aerators, low-flow showerheads, water heater pipe insulation, water heater tank insulation, and electric water heaters replaced by electric tankless water heaters. To test the sensitivity of energy savings to set point temperature for each of these measures, the team performed example calculations and compared savings derived using the current 120°F set point to the sample mean set point of 118.7°F, as well as the upper and lower bounds of the 90% confidence interval. Table D-3 outlines the assumptions used for the team's sample calculations, which were chosen to be representative of mean values found in past Texas tracking data.

Table D-3. Example Calculation Assumptions

Parameter	Assumption
Climate Zone	Climate Zone 2: North
Number of Bedrooms	2
Average Ambient Temperature	73.1°F
Recovery Efficiency (RE)	0.98
Faucet Flow Rate	1.5 gallons per minute
Shower Flow Rate	1.75 gallons per minute
Pipe Diameter	0.75 inches
Pipe Length	3 feet
Pipe Insulation R-Value	R-4
Water Heater Tank Volume	50 gallons
Water Heater Tank Insulation R-Value	R-11

As the assumed set point temperature increases, so does the assumed amount of energy required to operate the water heater to reach that set point, allowing for greater potential energy savings from related measures. Therefore, the team expected to find the inverse to be true, that a decrease in the assumed set point would result in lower expected energy savings from these measures.

The team found that a 1.1% drop in set point temperature has a relatively minor impact on final energy savings for each of these measures, ranging from a 2.6% to 2.7% reduction. Note that since the upper 90% confidence interval around the set point temperature mean lies *above* the current 120°F, the upper limit of the savings estimations is also greater than the initial savings estimates for these measures. Table D-4 presents the results.

Table D-4. Impacts of Set Point Temperature Change on Energy Savings of Water Heater Measures

Measure Name	Impact on kWh Savings		
	Mean Observed Set Point Temperature (T = 118.7°F)	Lower 90% Confidence Interval (T = 117.3°F)	Upper 90% Confidence Interval (T = 120.1°F)
Faucet Aerators Measure (2.4.1)	-2.63%	-5.52%	0.25%
Low-Flow Showerheads Measure (2.4.2)	-2.63%	-5.52%	0.25%
Water Heater Pipe Insulation Measure (2.4.3)	-2.71%	-5.68%	0.26%
Water Heater Tank Insulation Measure (2.4.4)	-2.71%	-5.68%	0.26%
Electric Water Heater Replaced with Electric Tankless (2.4.5)	-2.71%	-5.68%	0.26%

D.4 RECOMMENDATIONS

Due to the proximity of the EM&V team's findings to the assumptions in the TRM, 120°F being within the 90% confidence interval, as well as the uncertainty surrounding the temperature drop between the water heater tank and the measurement site, the team recommends that the TRM retain 120°F as the average water heater set point temperature. This value is supported by the DOE and provides a conservative estimate of savings for the measures in question.

APPENDIX E: GARAGE TEMPERATURE ANALYSIS

E.1 PURPOSE

Cadmus investigated ambient garage air temperatures in an effort to improve the energy savings estimates for heat pump water heaters in the Texas technical reference manual (TRM). The ambient garage air temperature is a key input used to evaluate energy savings for units installed in unconditioned spaces, and is currently estimated based on a combination of typical meteorological year (TMY3) data and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) guidelines. Cadmus proposed a metering study with the intention of either validating the temperatures currently being used or providing primary data to use in lieu of the current temperature estimates.

E.2 SCOPE

Cadmus installed 38 temperature and relative humidity meters throughout three of the five Texas weather zones, representing the areas around Amarillo, Dallas, and Houston. We installed meters from mid-August 2014 through mid-October 2014 in coordination with the Q1-Q2 on-site verification visits, and left these meters in place through the end of the calendar year. Energy Efficiency Rule 21.181 defines peak periods for the Texas energy efficiency programs (25.181, (c) (44) (45) (46)), with associated shoulder periods occurring outside of the peak definitions (e.g., September through December).[37] Using this definition as guidance, this study aimed to capture meter data from August through December in an attempt to assess this fall "shoulder" season when the average daily temperature changes most rapidly.

E.3 DATA PROCESSING

Cadmus was only able to retrieve 32 of the 38 meters due to unresponsive participants. These 32 meters had been installed in the Amarillo, Dallas, and Houston weather zones, as shown in Table E-1.

[37] The EE Rule defines the full peak period as the hours from 1 p.m. to 7 p.m. during the months of June, July, August and September, and the hours from 6 a.m. to 10 a.m. and 6 p.m. to 10 p.m. during the months of December, January and February (excluding weekends and Federal holidays).

Table E-1. Retrieved Meter Distribution

Weather Zone	Corresponding City	Number of Meters
1	Amarillo	8
2	Dallas	9
3	Houston	15
4	Corpus Christi	0
5	El Paso	0

Cadmus calculated the average daily temperature for each meter during the installation period, then combined these daily averages based on the weather zone. We tied both TMY3 and actual weather data to the daily weather-zone metered temperatures, then determined the average of all three temperatures over each calendar month. Cadmus compared these calendar month estimates against the TRM garage temperature values, as shown by weather zone in Table E-2 through Table E-4.

Table E-2. Temperature Comparison by Month, Weather Zone 1

Month	Number of Meters				Meter Temp	Actual Temp	TMY3 Temp	TRM Garage Temp
	Min.	Max.	Avg.	Std. Dev.				
1	0	1	0.6	0.5	53.6	33.3	35.6	47.5
2	0	0	0.0	0.0	--	--	--	50.7
3	0	0	0.0	0.0	--	--	--	57.8
4	0	0	0.0	0.0	--	--	--	70.0
5	0	0	0.0	0.0	--	--	--	72.2
6	0	0	0.0	0.0	--	--	--	81.8
7	0	0	0.0	0.0	--	--	--	85.3
8	0	0	0.0	0.0	--	79.0	74.6	82.5
9	0	0	0.0	0.0	--	68.7	69.8	76.8
10	0	8	2.2	3.4	68.5	60.8	57.0	68.0
11	7	8	7.2	0.4	57.3	43.3	43.5	54.5
12	1	7	4.0	3.0	54.8	38.6	37.1	48.1

Note: Empty cells indicate that no meter data was recorded for that month in that weather zone.

Table E-3. Temperature Comparison by Month, Weather Zone 2

Month	Number of Meters				Meter Temp	Actual Temp	TMY3 Temp	TRM Garage Temp
	Min.	Max.	Avg.	Std. Dev.				
1	0	0	0.0	0.0	--	40.9	42.4	55.2
2	0	0	0.0	0.0	--	--	--	59.8
3	0	0	0.0	0.0	--	--	--	70.0
4	0	0	0.0	0.0	--	--	--	74.1
5	0	0	0.0	0.0	--	--	--	80.2
6	0	0	0.0	0.0	--	--	--	87.2
7	0	0	0.0	0.0	--	--	--	92.5
8	4	4	4.0	0.0	80.2	85.7	83.2	91.1
9	4	8	6.2	1.1	83.1	80.0	79.1	86.1
10	8	8	8.0	0.0	79.0	71.5	65.1	74.1
11	8	8	8.0	0.0	63.5	50.9	55.8	66.8
12	0	8	3.9	4.1	65.1	49.6	45.6	56.6

Note: Empty cells indicate that no meter data was recorded for that month, in that weather zone.

Table E-4. Temperature Comparison by Month, Weather Zone 3

Month	Number of Meters				Meter Temp	Actual Temp	TMY3 Temp	TRM Garage Temp
	Min.	Max.	Avg.	Std. Dev.				
1	1	2	1.7	0.5	57.4	44.8	48.7	61.9
2	0	0	0.0	0.0	--	--	--	66.0
3	0	0	0.0	0.0	--	--	--	72.2
4	0	0	0.0	0.0	--	--	--	75.9
5	0	0	0.0	0.0	--	--	--	82.3
6	0	0	0.0	0.0	--	--	--	87.6
7	0	0	0.0	0.0	--	--	--	89.9
8	0	0	0.0	0.0	--	83.1	81.4	89.8
9	0	4	2.8	1.2	83.3	78.0	79.6	86.6
10	4	14	11.7	2.2	78.5	70.8	68.6	75.6
11	14	14	14.0	0.0	65.0	55.3	62.8	73.8
12	2	14	8.7	5.4	65.6	55.0	54.6	65.6

Note: Empty cells indicate that no meter data was recorded for that month, in that weather zone.

Due to differences between the actual weather data and the TMY3 weather data, and because the TRM values rely on TMY3 weather data, Cadmus adjusted the metered temperature values to align with the TMY3 weather data.

Table E-5 shows the percentage difference between the actual outdoor air temperature and the TMY3 outdoor air temperature. Negative values indicate that the actual outdoor temperature was less than the TMY3 outdoor temperature.

Table E-5. Percentage Difference Between Actual and TMY3 Outdoor Air Temperatures, by Month and Weather Zone

Zone	City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Amarillo	-9%	--	--	--	--	--	--	--	--	7%	0%	4%
2	Dallas	--	--	--	--	--	--	--	2%	1%	10%	-9%	9%
3	Houston	-12%	--	--	--	--	--	--	--	-2%	3%	-12%	1%
4	Corpus Christi	--	--	--	--	--	--	--	--	--	--	--	--
5	El Paso	--	--	--	--	--	--	--	--	--	--	--	--

Note: Empty cells indicate that no meter data was recorded for that month, in that weather zone.

Cadmus used values from Table E-5 to normalize the meter data for comparison to TMY3 outdoor air temperatures, using the following equation:

$$Temp_{Normalized} = \frac{Temp_{Metered}}{(1 + \%Diff)}$$

Where:

$Temp_{Normalized}$ = Metered garage temperature, normalized to TMY3 outdoor air temperature.

$Temp_{Metered}$ = Metered garage temperature corresponding to actual outdoor air temperature.

%Diff = Percentage difference between the actual outdoor air temperature and TMY3 outdoor air temperature.

The normalized meter data is shown in Table E-6.

Table E-6. Normalized Metered Garage Temperatures, by Month and Weather Zone

Zone	City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Amarillo	58.8	--	--	--	--	--	--	--	--	64.3	57.6	52.8
2	Dallas	--	--	--	--	--	--	--	78.7	82.2	71.9	69.7	59.9
3	Houston	65.2	--	--	--	--	--	--	--	84.9	76.1	73.8	65.1
4	Corpus Christi	--	--	--	--	--	--	--	--	--	--	--	--
5	El Paso	--	--	--	--	--	--	--	--	--	--	--	--

Note: Empty cells indicate that no meter data was recorded for that month, in that weather zone.

E.4 METHODOLOGY

Cadmus reviewed the TMY3 data and the ASHRAE guidelines used in the TRM, which both use garage temperatures that vary throughout the year, with a peak around July and August and a valley around December and January. Figure E-1 shows the monthly TMY3 outdoor air temperature for each weather zone, as well as a generic sine wave for comparison. Figure E-2 shows the average monthly TRM garage temperature for each weather zone.

Figure E-1. Average Monthly TMY3 Outdoor Air Temperature by Weather Zone

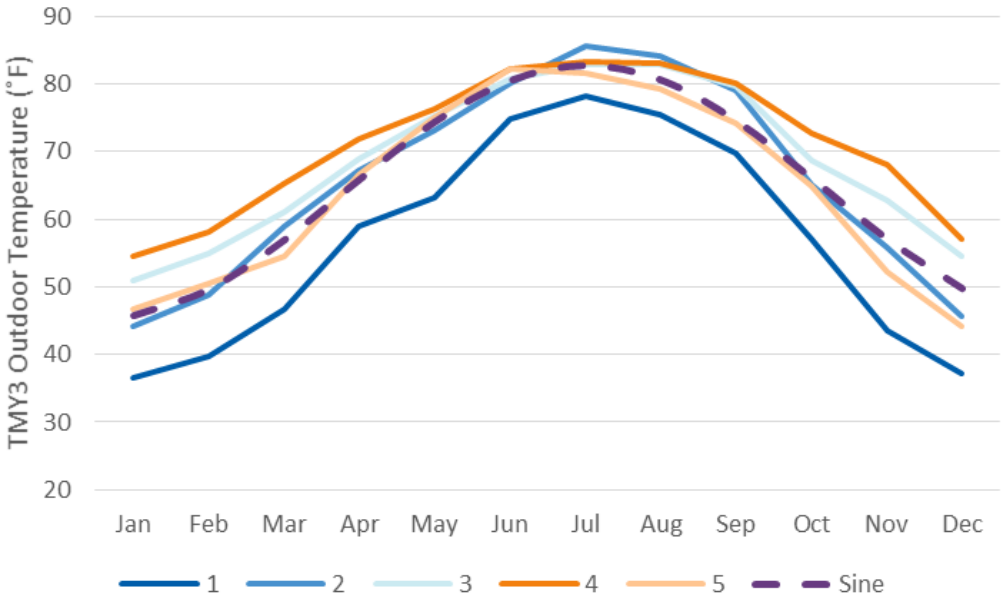
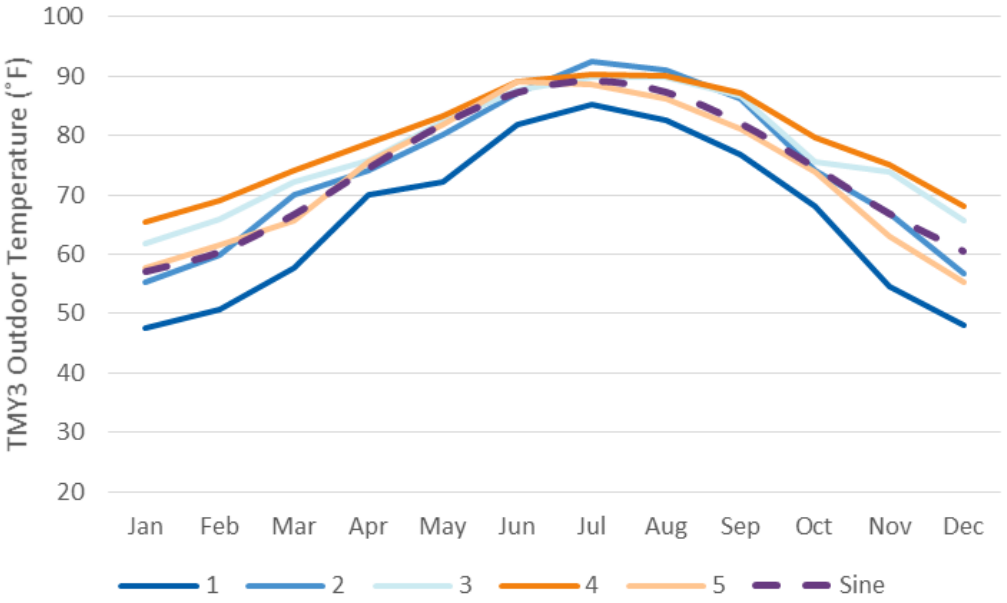


Figure E-2. Average Monthly TRM Garage Temperature by Weather Zone



Based on the sinusoidal relationship between calendar month, TMY3 temperature, and TRM garage temperatures, Cadmus used the normalized meter data to develop regression coefficients for each weather zone. We estimated all of the regression coefficients using a least-squares approach. We also developed TMY3 regression coefficients for each weather zone based on the assumption that the sine wave's peak and trough should occur in the same month for both the TMY3 regression and the garage temperature regression.

Cadmus then used these regression coefficients to estimate the garage temperature for each month based on the relationship between the TMY3 outside air temperature and the normalized meter data we collected. The general form of the regression equation is:

$$Temp_{Regression} = A * \sin(m * x + b) + C$$

Where:

$Temp_{Regression}$ = Regression evaluated garage temperature.

A = Amplitude of the sine wave, representing one-half of the difference between the yearly maximum and minimum temperatures.

m = Angular frequency of the sine wave, representing the rate of change of the function. Cadmus assumed this value was the same for both the TMY3 function and the garage function.

x = Independent variable of the sine wave. Integer representation of the calendar month from 1 (January) through 12 (December).

b = Phase angle of the sine wave, representing the horizontal shift of the function. Cadmus assumed this value was the same for both the TMY3 function and the garage function.

C = Y-intercept of the sine wave, representing the mean yearly temperature.

The regression coefficients for the garage temperature function are shown in Table E-7.

Table E-7. Garage Temperature Regression Coefficients, by Weather Zone

Zone	City	A	m*	b*	C
1	Amarillo	17.1	0.5	-2.2	67.8
2	Dallas	15.5	0.5	-1.8	72.6
3	Houston	12.5	0.5	-1.8	75.8
4	Corpus Christi	10.9**	0.4	-1.5	75.8**
5	El Paso	12.3**	0.5	-2.0	71.8**

* Cadmus assumed this value was constant between the TMY3 and garage temperature regression.

** Cadmus estimated these coefficients based on the other weather zones due to a lack of meter data.

Cadmus estimated the coefficients for weather zones 4 and 5 by extrapolating from the results of weather zones 1 through 3. Due to the large variability in weather across the five weather zones, we elected not to use a simple average of the three metered weather zones. Instead, we compared the weather zones using a number of criteria, and used the most similar weather zone as a basis for estimating regression coefficients. The criteria we used to determine weather-zone similarity were average yearly temperature, average yearly temperature-heat index (a metric that accounts for temperature and relative humidity), heating

degree days, and cooling degree days. These weather similarity metrics are shown in Table E-8.

Table E-8. Weather Zone Similarity Metrics

Zone	City	Avg. Temp	Avg. Temp. Heat Index	HDD_{65}	CDD_{65}
1	Amarillo	56.8	56.1	4,565	1,595
2	Dallas	65.6	63.8	2,567	2,830
3	Houston	68.6	66.7	1,686	3,017
4	Corpus Christi	71.0	69.2	1,129	3,349
5	El Paso	64.3	61.5	2,677	2,446

Based on the similarity metrics shown above, Cadmus determined that weather zone 4 is most similar to weather zone 3, and that weather zone 5 is most similar to weather zone 2. As a result, we based the regression coefficients for weather zone 4 on the regression coefficients from weather zone 3, and based the regression coefficients for weather zone 5 on the regression coefficients from weather zone 2.

E.5 RESULTS

Cadmus applied the regression equation and zone-specific regression coefficients to determine the average temperature for each month and each weather zone. Table E-9 shows the Cadmus-evaluated garage temperatures, while Table E-10 shows the garage temperatures currently used in the TRM. Then, Table E-11 shows the difference between the Cadmus-evaluated and TRM values, and Table E-12 shows these differences expressed as percentages.

Table E-9. Cadmus-Evaluated Garage Temperatures

Zone	City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Amarillo*	50.7	52.6	58.7	67.3	76.0	82.4	84.8	82.5	76.0	67.3	58.7	52.6
2	Dallas**	57.5	61.0	67.1	74.5	81.5	86.4	88.2	86.3	81.4	74.4	67.0	60.9
3	Houston*	63.7	66.3	71.1	77.0	82.6	86.7	88.4	87.3	83.6	78.2	72.3	67.2
4	Corpus Christi***	66.9	70.0	74.4	79.2	83.6	86.7	88.0	87.2	84.5	80.4	75.6	71.0
5	El Paso***	59.3	61.7	67.0	73.8	80.2	84.6	85.8	83.5	78.4	71.6	65.2	60.6

* This regression is based on all available meter data points.

** This regression excludes August meter data points.

*** No meter data points were available for these weather zones, so Cadmus estimated the regression coefficients based on the values for weather zones 1, 2, and three.

Table E-10. TRM-Listed Garage Temperatures

Zone	City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Amarillo	47.5	50.7	57.8	70.0	72.2	81.8	85.3	82.5	76.8	68.0	54.5	48.1
2	Dallas	55.2	59.8	70.0	74.1	80.2	87.2	92.5	91.1	86.1	74.1	66.8	56.6
3	Houston	61.9	66.0	72.2	75.9	82.3	87.6	89.9	89.8	86.6	75.6	73.8	65.6
4	Corpus Christi	65.5	69.1	74.2	78.8	83.2	89.1	90.3	90.2	87.1	79.7	75.0	68.1
5	El Paso	57.6	61.5	65.6	75.6	81.9	89.1	88.6	86.3	81.1	73.9	63.1	55.2

Table E-11. Difference Between Cadmus and TRM Regression Values

Zone	City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Amarillo	3.2	1.9	0.9	-2.8	3.8	0.6	-0.5	-0.1	-0.8	-0.7	4.2	4.5
2	Dallas	2.3	1.2	-2.9	0.4	1.3	-0.8	-4.3	-4.8	-4.7	0.3	0.2	4.3
3	Houston	1.7	0.4	-1.0	1.1	0.3	-1.0	-1.5	-2.5	-3.0	2.7	-1.4	1.6
4	Corpus Christi	1.4	1.0	0.2	0.4	0.3	-2.5	-2.3	-3.0	-2.6	0.7	0.6	3.0
5	El Paso	1.6	0.2	1.4	-1.9	-1.7	-4.5	-2.7	-2.7	-2.7	-2.3	2.0	5.4

* Negative values indicate that the Cadmus-evaluated temperatures are lower than TRM temperatures.

Table E-12. Percentage Difference Between Cadmus and TRM Regression Values

Zone	City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Amarillo	7%	4%	2%	-4%	5%	1%	-1%	0%	-1%	-1%	8%	9%
2	Dallas	4%	2%	-4%	1%	2%	-1%	-5%	-5%	-6%	0%	0%	8%
3	Houston	3%	1%	-1%	1%	0%	-1%	-2%	-3%	-3%	4%	-2%	3%
4	Corpus Christi	2%	1%	0%	1%	0%	-3%	-3%	-3%	-3%	1%	1%	4%
5	El Paso	3%	0%	2%	-2%	-2%	-5%	-3%	-3%	-3%	-3%	3%	10%

* Negative values indicate that the Cadmus-evaluated temperatures are lower than the TRM temperatures.

Table E-11 and Table E-12 show that the difference between the TRM temperature estimates and Cadmus' evaluated temperature estimates is typically quite small. Generally, the Cadmus-evaluated temperature values are higher in the winter months and lower in the summer months. This result is most prominent in weather zone 2. Figure E-3 through Figure E-7 show how the TRM estimates, Cadmus' estimates, and the TMY3 data compare against one another by weather zone.

Figure E-3. Comparison of Temperature Curves, Weather Zone 1

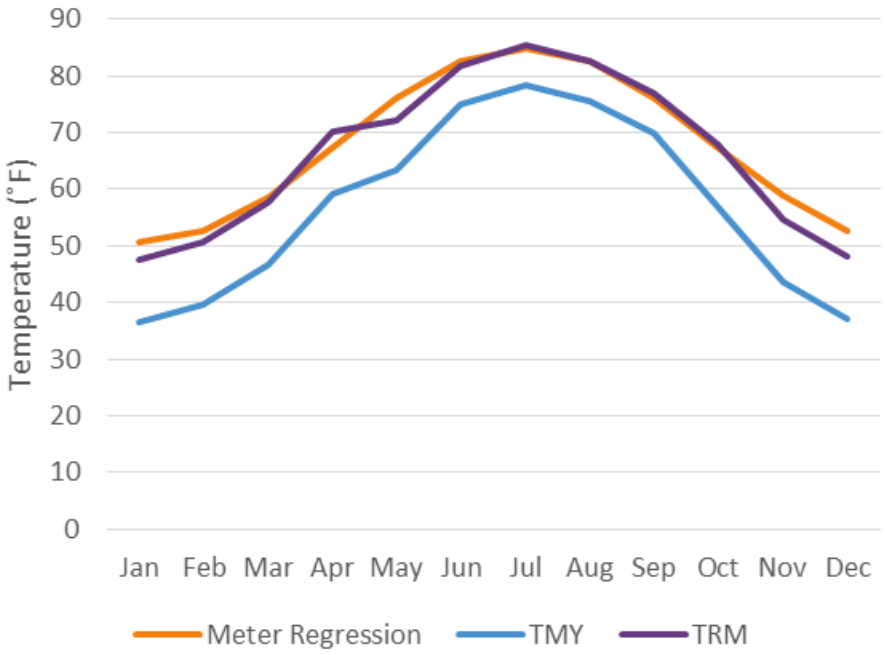


Figure E-4. Comparison of Temperature Curves, Weather Zone 2

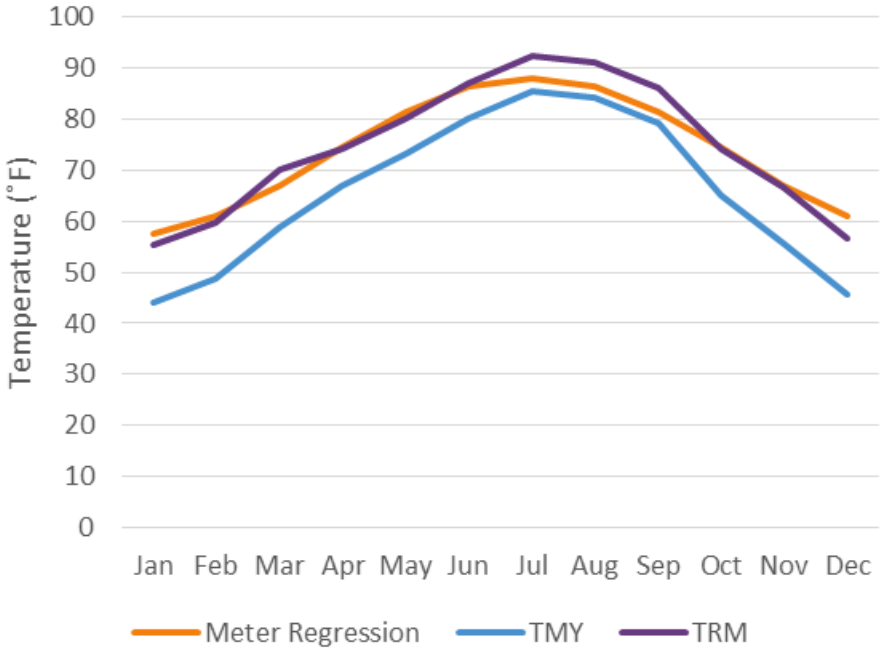


Figure E-5. Comparison of Temperature Curves, Weather Zone 3

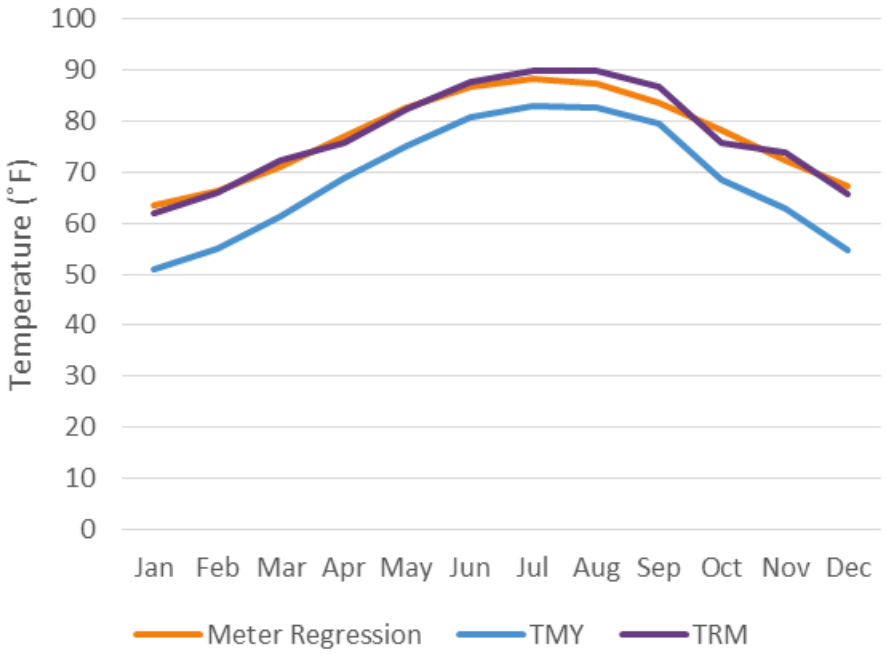


Figure E-6. Comparison of Temperature Curves, Weather Zone 4

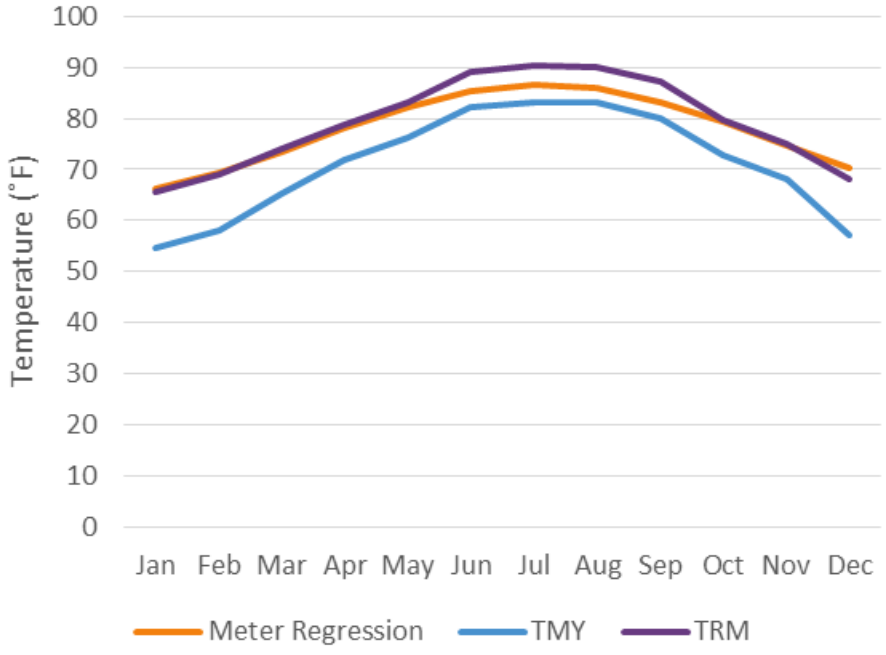
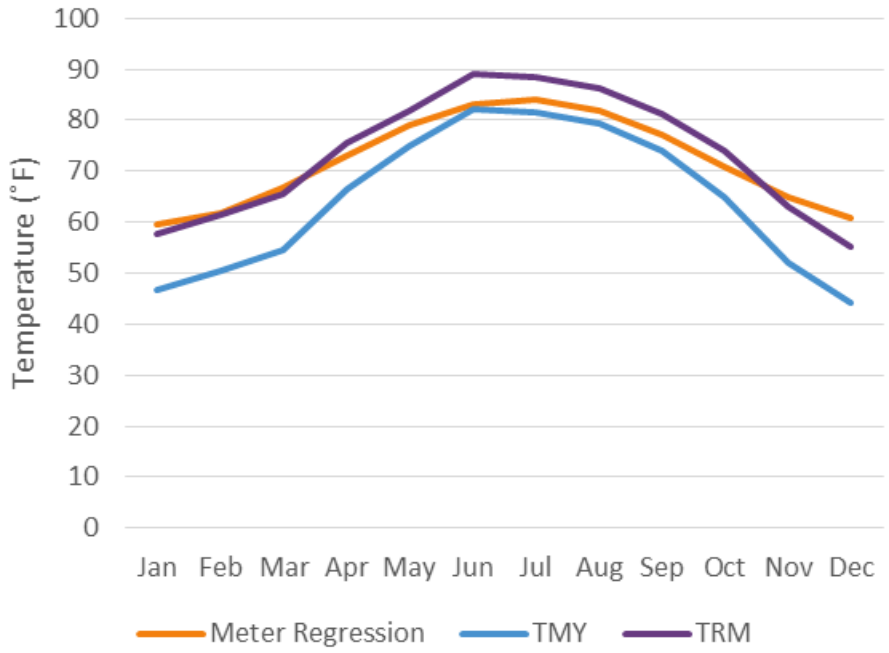


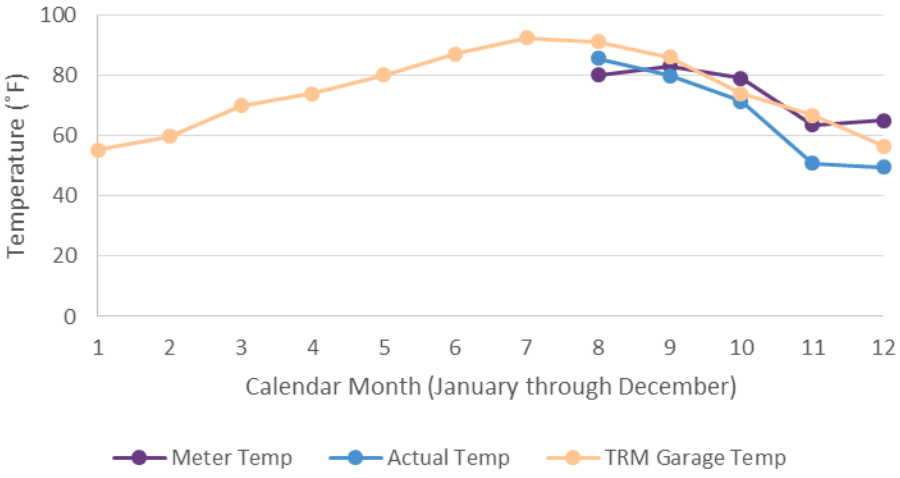
Figure E-7. Comparison of Temperature Curves, Weather Zone 5



In general, the meter regression aligns well with the TRM temperature estimates. The largest difference is in weather zone 2 during July, August, and September. This difference is a result of the regression for weather zone 2 being based entirely on data points from September through December, instead of being based on September or October through January (similar to zones 1 and 3). Additionally, the meter data for weather zone 2 showed disagreement between the metered garage temperature and the expected temperature during the month of August, as shown in Figure E-8.

There is also a difference in weather zone 5 during June through September: this finding is a result of Cadmus estimating the regression coefficients for this weather zone based on the coefficients from weather zone 2 (which has similar weather characteristics).

Figure E-8. Weather Zone 2 Garage Temperature Discrepancy



During the month of August, the meter temperature is significantly lower than the actual outdoor air temperature. This finding is in stark contrast to the rest of the metered period, when the metered garage temperature is higher than the actual outdoor air temperature. Due to this strange meter data profile in August, Cadmus elected not to include the August meter data in regression coefficient calculations for weather zone 2.

E.6 CONCLUSIONS AND RECOMMENDATIONS

The Cadmus-metered temperature regressions produced garage temperatures very similar to those currently used in the TRM. To fully understand the effect of this small difference in temperatures, we calculated heat pump water heater savings using the regression results. Then, Cadmus compared these results against the TRM savings values, as shown in Table E-13.

Table E-13. Comparison of Energy Savings in Unconditioned Spaces Using TRM Garage Temperatures vs. Cadmus-Metered Regression Garage Temperatures

Zone	City	Tank Size (Gallons)	TRM Savings	Regression Savings	Difference*	Percent Difference
1	Amarillo	40	1,645	1,651	-6	-0.4%
		50	1,916	1,923	-7	-0.4%
		60	302	300	2	0.7%
		80	386	384	2	0.5%
		Average	**1,062**	**1,065**	**-2**	**-0.2%**

Zone	City	Tank Size (Gallons)	TRM Savings	Regression Savings	Difference*	Percent Difference
2	Dallas	40	1,362	1,357	5	0.4%
		50	1,585	1,579	6	0.4%
		60	230	231	-1	-0.4%
		80	294	296	-2	-0.7%
		Average	**868**	**866**	**2**	**0.2%**
3	Houston	40	1,273	1,272	1	0.1%
		50	1,481	1,480	1	0.1%
		60	206	206	0	0.0%
		80	263	263	0	0.0%
		Average	**806**	**805**	**1**	**0.1%**
4	Corpus Christi **	40	1,193	1,185	8	0.7%
		50	1,387	1,378	9	0.6%
		60	187	189	-2	-1.1%
		80	239	241	-2	-0.8%
		Average	**752**	**748**	**3**	**0.4%**
5	El Paso ***	40	1,409	1,396	13	0.9%
		50	1,639	1,626	13	0.8%
		60	240	243	-3	-1.3%
		80	307	311	-4	-1.3%
		Average	**899**	**894**	**5**	**0.5%**

* Values in the table above may not add up exactly due to rounding.

** The regression coefficients for weather zone four are extrapolated from the coefficients in weather zone three. Weather zone three was selected as it is the most similar to weather zone four based on: Heating Degree Days, Cooling Degree Days, average monthly temperature, and average monthly temperature-humidity index.

*** The regression coefficients for weather zone five are extrapolated from the coefficients in weather zone two. Weather zone two was selected as it is the most similar to weather zone five based on: Heating Degree Days, Cooling Degree Days, average monthly temperature, and average monthly temperature-humidity index.

The magnitude of the savings differences shown in Table E-13 are quite small. In each of the metered weather zones, the relative percentage of difference is never greater than ±1% savings. The percentage difference is slightly larger in weather zones 4 and 5, for which the regression coefficients were estimated, but is still within ±1.5% savings.

Because heat pump water heaters do not constitute a significant portion of the program energy savings—and because the impact of new temperature findings on the measure energy savings are minimal—therefore Cadmus does recommend that any changes to the garage temperature estimation methodology be made in the TRM.